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GREEN LOGISTICS

Theoretical & Practical Approaches to Green Logistics

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AUTHORS

ALTAN DİZDAR
HELMUT PRENNER
GAMZE YÜCEL IŞILDAR
STANISLAV AVSEC
ARACELI QUEIRUGA DIOS
S.ALEV SÖYLEMEZ
ERTUGRUL DİZDAR
DENİZ IŞILDAR
DAVID RIHTARSIC
DONALD ROMARIC YEHOUENOUI TESSI
CEMRE EDA ERKILIÇ
ÇAĞAN DİZDAR

EDITORS

YUSUF MURATOĞLU
SERDAR VARLIK
ŞAFAK BULUT
ALTAN DİZDAR

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Table of Contents

Figures

Tables

Author:

Araceli Queiruga DIOS

1. Basic Knowledge of Logistics

The concept of logistics is not a new term. It has been described as the art and science of moving things from here to there and storing them along the way (Swamidass, 2000). The underlying principles related to the effective flow of materials and information has been altered from the building of the pyramids to XXI Century. The concept of logistics was first used by the military. They used this term to describe the activities related to the maintenance of a fighting force in fields and. It describes the housing of troops. Over the years the meaning of the logistics has gradually generalized to cover business and service activities (Ghiani et al., 2004). Logistics can be defined as:

> *The process of strategically managing the procurement, movement and storage of materials, parts and finished inventory (and the related information flows) through the organization and its marketing channels in such a way that current and future profitability are maximized through the cost-effective fulfilment of orders* (Christopher, 2016).

Logistics is essentially a set of means, methodologies and a framework that seeks to create a single plan for the flow of product and information through a business. In this sense, the definition that we will use throughout this book is given in the *Encyclopaedia of production and manufacturing management* (Swamidass, 2000):

> *Logistics refers to the process of planning, implementing, and controlling the efficient, effective flow and storage of goods, services, and related information from point of origin to point of consumption while meeting customer requirements*.

Logistics employs planning and resource management tasks. Its main function is to effectively control the materials and products, with the intention of satisfying the needs of customers, taking into account the least possible costs.

In 1963, a group of practitioners and academicians created the first professional association of logisticians with the name of the National Council of Physical Distribution Management. Later on, in 1985 it changed to the Council of Logistics Management, and then in 2004 to the Council of Supply Chain Management Professionals ("The Council"). There are currently several professional associations all over the world with similar objectives: to conduct research, provide education, and disseminate knowledge for the advancement of the logistics discipline worldwide. (Taylor, 2007).

Logistics has evolved considerably since the seventies. Until fourties, logistics did not play an important role. It has been dormant. 1930s was characterized by higher demand capacity (stabilized) and the emphasis on marketing to generate demand. At this time, logistics was a military discipline with important applications during the World War II. In companies, logistics is simply seen as a necessary cost. The development of logistics took place in the 50s and 60s. Logistics begins to attract the attention of entrepreneurs for 4 reasons: Changes in the attitude (more demanding) and distribution (more concentrated in cities) of consumers, pressure of the costs in the industry (economic recession after the WWII), progress in computer technology, and influence of military experience.

From the 1970s onwards, transport prices rise (due to oil crisis), maintenance and storage costs also rise (period of high inflation), and the importance and the research in logistics were intensified. The concept of integrated logistics emerges as joint analysis of the entire logistics system including all processes related to the flow of products, material management and physical distribution, as well as their interconnections with production systems. At that time, reverse logistics appears as the process of efficiently planning, implementing and controlling the flow of materials, inventory in progress, finished products and related information, from the point of

view of consumption to the origin to recover its value or give it an appropriate destination.

Nowadays, logistics is a very important part of ecommerce in Europe. A few figures can be used to illustrate this assertion. Logistics make up 14% of total gross domestic product in EU countries. Total goods transported in the European Union are estimated at 4 billion tkm. (1 tkm is 1,000 kgkm and a kgkm means moving 1 kg of cargo a distance of 1 km). More than 11 million people are employed in the European logistics sector and almost a quarter of these jobs can be found in the post and courier branch. The road is the biggest carrier of goods in terms of tonnage, with over 46 million tonnes carried daily (Ecommerce News, 2011).

Logistics is a branch of engineering that is responsible for two basic tasks: it is responsible for the management of materials, as well as the flow and supply of raw materials and components in manufacturing processes or manufacturing of goods or services, and it is also responsible for the distribution management consisting of packaging, inventory control of both finished products and raw materials, through all processes of material handling, storage and transport until the delivery of the finished product to the customer (Swamidass, 2000).

Logistics was responsible for studying how to carry out the placement of media and services in order to carry with them the following characteristics (Swamidass, 2000):

- Deliver the goods to the customers in the appropriate place.
- Economic prices.
- Goods must arrive in adequate conditions.

These characteristics make companies comply with the requirements of their customers and thus in this way, to obtain greater profitability.

Logistics is currently a very important science because in the industry there are increasingly complex processes that require good management to meet customer expectations. The reduction of the time of production and transport and handling of raw materials or the so-called work in process (WIP) is an activity that is reduced to save money and increase the efficiency of practically any process. More and more companies are investing in the improvement of their logistics processes, as well as in the development of mathematical models that minimize the distances travelled or the time needed to carry out any activity (Swamidass, 2000).

Logistics infrastructures are part of national and local (company) levels. The national logistics infrastructure consists of a nation's air, motor, rail, and shipping systems, i.e. miles of improved highways, miles of railroad tracks, miles of navigable waterways, operating ports with adequate loading and unloading equipment, miles of gas and oil pipeline, and commercial airports in operation. The real importance of a well-established national logistics infrastructure is that it allows both people and materials to travel from point to point at relatively low cost. It enables farmers to readily get their crops to market; lumber, minerals, and other raw materials to be easily transported for processing or refining (Swamidass, 2000).

Every firm, manufacturing or service, must effectively manage movement and storage activities to support production and to provide adequate levels of customer service.

Logistics core elements include different services or activities (Ghiani et al., 2004; Lai and Cheng, 2016):

- **Customer services** or the quality to manage the flow of goods and services. It can be described using the seven rights (7Rs), i.e., the ability to deliver the right product to the right customer at the right place, in the right condition and right quantity at the right time, at the right (lowest possible) cost. Unfortunately, however that description does not do justice to the amount of effort that has to go into a logistics supply system and the multitude of ways that supply systems can go wrong (Fernie and Sparks, 2004).

- **Order processing** is strictly related to information flows in the logistics system and includes several specific operations. It is the means by which firms in the logistics processes exchange order information. Once the order is filled by customers, it is sent and checked (after verifying that the product is available and customer's credit status). Goods are packed and delivered along with their shipping documentation. Customers are informed about the status of their orders. Order processing has usually been a very time-consuming activity (up to 70% of the total order-cycle time).

- **Inventory management** is a key issue in logistics system planning and operations. Inventories are stored goods, prepared to be manufactured, transported or sold, such as semi-finished products (work-in-process), merchandise (in-transit inventory), finished products stored in a DC, and finished products stored by final consumer.

- **Transportation** is about the ways in which physical items (materials, components and finished products) are moved between different parties (raw materials suppliers, distributors, retailers and end customers) in a supply chain.

A supply chain is a complex logistics system in which raw materials are converted into finished products and then distributed to the final users (final users can be consumers or companies). It includes many elements such as suppliers, manufacturing centers, warehouses, distribution centers (DC) and retail outlets (Ghiani et al., 2004).

A general supply chain is shown in Figure 1. In this case, production and distribution systems have two stages each. In the production system, components and semi-finished parts are produced in two manufacturing centers and finished goods are assembled at a different plant. The distribution system consists of two central distribution centers (CDC) supplied directly by the assembly centre, which in turn replenish two regional distribution centers (RDC) each (Ghiani et al., 2004).

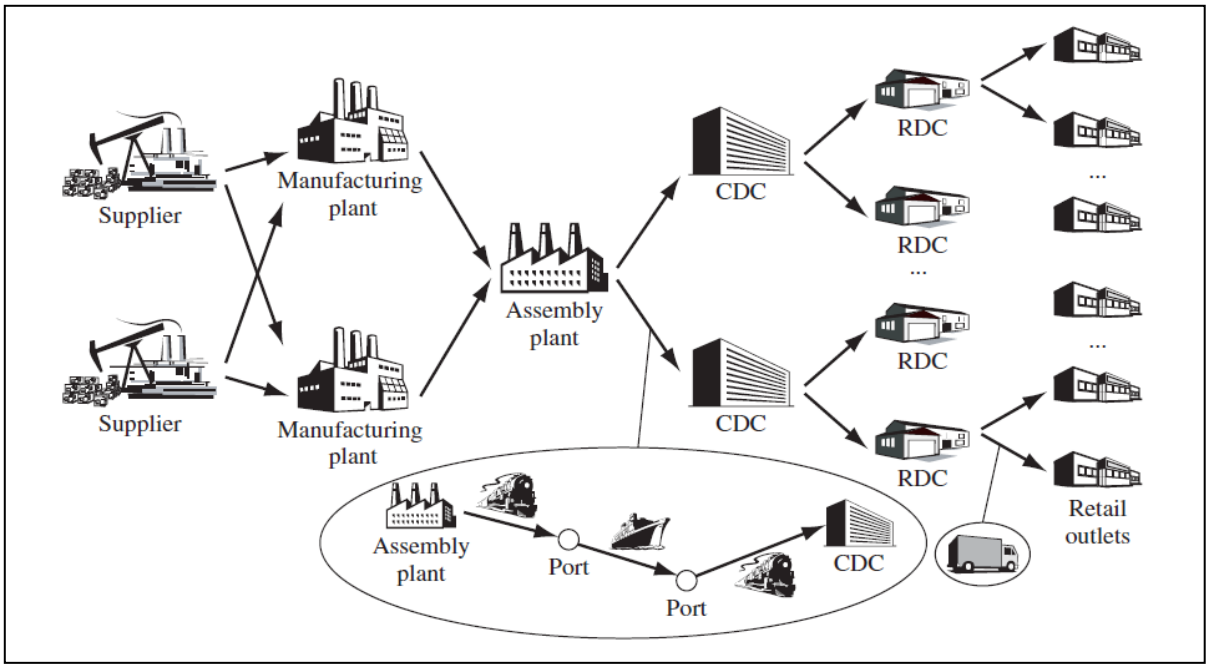

Figure 1: Supply chain with its elements (Ghiani et al., 2004).

Characteristics such as product and demand may be taken into account to design a supply chain without separate manufacturing and assembly centres, without RDCs or with different kinds of facilities.

Each of the transportation links in Figure 1 could be a simple transportation line (e.g. a truck line) or of a more complex transportation process involving additional facilities (e.g. port terminals) and companies (e.g. truck carriers). Similarly, each facility comprises several devices and subsystems (Ghiani et al., 2004).

When distributing a product, three main strategies can be used:

- Direct shipment: Goods are shipped directly from the manufacturer to the end-user (Figure 2, a), so expenses of operating a DC are eliminated and lead times reduced.
- Warehousing: Goods are received by warehouses and stored in tanks, pallet racks or on shelves (Figure 2, b). Warehousing includes reception of the incoming goods, storage, order picking and shipping.

- Crossdocking or just-in-time distribution: A transhipment facility in which incoming shipments (usually from several manufacturers) are sorted, consolidated with other products and transferred directly to outgoing trailers without intermediate storage or order picking (Figure 2, c).

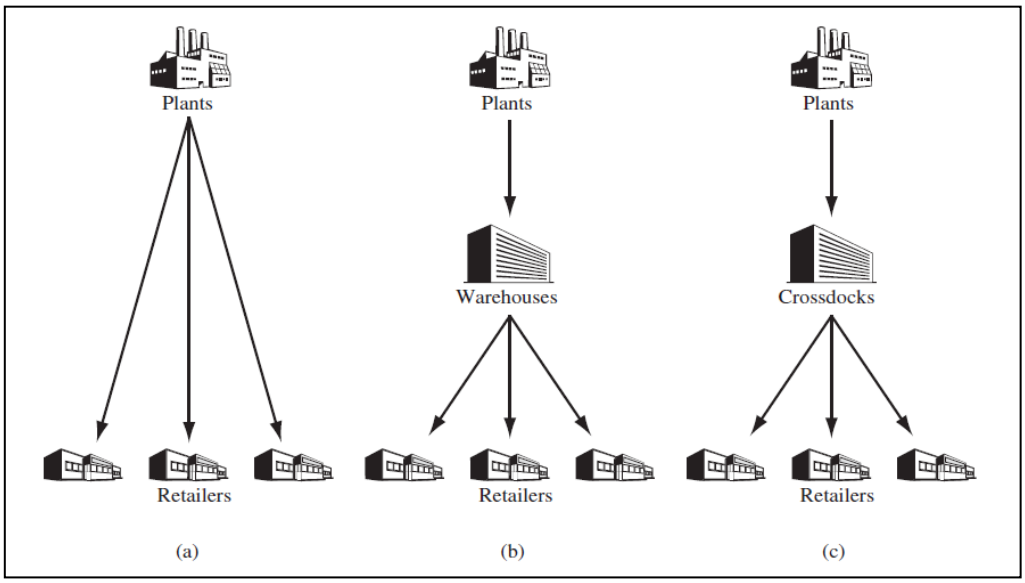

Figure 2: Different distribution strategies (Ghiani et al., 2004).

Logistics management is considered a part of supply chain management that plans, implements, and also controls the efficient, effective forward and reverse flow and storage of goods, services, and related information between the point of origin and the point of consumption in order to meet customers' requirements. Logistics management activities typically include inbound and outbound transportation management, fleet management, warehousing, materials handling, order fulfilment, logistics network design, inventory management, supply–demand planning, and management of third-party logistics services providers. To varying degrees, the logistics function also includes sourcing and procurement, production planning and scheduling, packaging and assembly, and customer service. It is involved in all levels of planning and execution—strategic, operational, and tactical. Logistics management is an integrating function, which coordinates and optimizes all logistics activities, as well as integrates logistics activities with other functions

including marketing, sales manufacturing, finance, and information technology (Taylor, 2007).

We can classify logistics into four different sections, according to the stage of the production process:

Provisioning logistics: This is the kind of logistics that ensures that the company receives the necessary materials for production in the appropriate time. Among the main functions of supply logistics are:

- Choose providers.
- Ensure that deadlines are met.
- Inventory management.
- Analyse the production needs of the company.
- Study the trends of the items that are purchased.
- Ensure the quality of provisions.

Procurement logistics is an essential point of the productive process. It is very important that there is good communication between all the parties to buy raw materials at a better price, of better quality and within the time considered. If this section does not work well, the company will lose money. It could happen that the supply is greater than is expected, arrives late, arrives in poor condition, etc. All these are losses for the company.

Storage logistics: Also known as internal logistics. It ensures that all supplies arriving at the company are properly stored and duly registered. Among the tasks or functions that are responsible are:

- Update inventories.
- Record of the place where they are stored.
- Plan the storage areas according to the type of product.
- Facilitate the incorporation of supplies to the production process.

- Indicate how each of the supplies will be transported.

In short, storage logistics deals with the phase of the production process that goes from the moment when the supplies enter the company, until they are incorporated into the production process.

Production logistics: Ensures that the raw materials or supplies pass from one phase to another of the transformation until the end of the product. Production logistics is also part of internal logistics. Since supplies are received from the warehouse until they leave it, they are managed by the production logistics department. There are many companies, which transform the products in several phases. For example, to produce a car one need to build several pieces and then put them together until having the complete car.

Among the main tasks attributable to production logistics are:

- Transform products.
- Transport the intermediate products to the next phase of transformation.
- Ensure that the transformation following the quality standards.
- Prepare the final product to be distributed.

It will be possible to incur higher costs and lower quantity produced when this logistics is not well implemented.

Distribution logistics: is responsible for transporting the final products to their destination. This destination can be points of sale (owned by the company itself), other companies or the final consumer. Depending on who is the final customer of this phase, the logistics will have different characteristics. However, in general, distribution logistics are responsible for:

- Type and size of packaging.
- Vehicles in which it is transported.
- Areas where it is distributed.

Distribution logistics is the responsible of transport selection. In addition, the transport chosen will depend on the type and size of packaging and the location.

The three variables are interrelated. If we have several types of products (some very fragile and others more robust), we must be careful not to mix them so that they arrive in good condition. The vehicle must also be conditioned.

Reverse logistics: deals with the opposite process to all the types of logistics described above. That is, to manage all possible waste (reusable or not), products in poor condition or sent by mistake. This section could be part of the after-sales service. However, reverse logistics is much more than that. Not only is responsible for returning the products that customers return. It also ensures that the surplus material in other phases of the production process is reused, recycled or properly disposed of the products that must be taken to a landfill.

One of the activities that plays a key role in logistics system management is **transportation planning**. This is because it allows production and consumption to take place at locations that are several hundreds or thousands of kilometres away from each other. Freight transportation often accounts for even two-thirds of the total logistics cost and has a major impact on the level of customer service. A distributor can choose among three alternatives to transport its materials: private transportation (the company operates a private fleet of owned or rented vehicles), contract transportation (a carrier may be in charge of transporting materials through direct shipments regulated by a contract), or common transportation (the company contracts a carrier that uses common resources to fulfil several client transportation needs) (Ghiani et al., 2004).

There are five basic modes of transportation: ship, rail, truck, air and pipeline. These different modes can be combined in several ways in order to obtain door-to-door services.

Merchandise is often consolidated into pallets or containers in order to protect it and facilitate handling at terminals. Common pallet sizes are 100×120 cm^2, 80×100 cm^2, 90×110 cm^2 and 120×120 cm^2. Containers may be refrigerated, ventilated,

closed or with upper openings, etc. Containers for transporting liquids have capacities between 14,000 and 20,000 l.

When selecting a carrier, a shipper must take two fundamental parameters into account: price (or cost) and transit time. The overall aim of logistics is to achieve high customer satisfaction. It must provide a high quality service with low – or acceptable – costs. The cost of a shipper's operated transportation service is the sum of all costs associated with operating terminals and vehicles. Air is the most expensive mode of transportation, followed by truck, rail, pipeline and ship. According to recent surveys, transportation by truck is approximately seven times more expensive than by train, which is four times more costly than by ship (Ghiani et al., 2004). Figure 3 shows the performance for freight transport from 1995 to 2016 in Europe. The most used mode of transport is truck; followed by ship, rail, and the rest to a lesser extent. Logistics increases its value by making products available in the right place and at the right time. If a product is available at the place where it is needed, logistics is said to have added place utility; if it is delivered at the right time, logistics has added time utility (Waters, 2003).

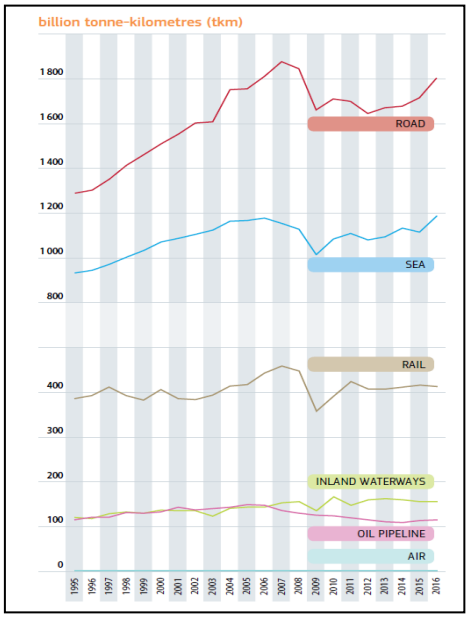

Figure 3: EU-28 Performance for freight transport 1995-2016 (European Union, 2018)

A more detailed description of the different transport modes is included below:

Rail. The advantage of this transportation is that it is not expensive (especially for long-distance movements), relatively slow and quite unreliable. As a result, the railroad is a slow mover of raw materials (coal, chemicals, etc.) and of low-value finished products (paper, tinned food, etc.). This is due mainly to three reasons (Ghiani et al., 2004):

- convoys transporting freight have low priority compared to trains transporting passengers;
- direct train connections are quite rare;
- a convoy must include tens of cars in order to be worth operating.

Road. Trucks are used mainly for moving semi-finished and finished products. Road transportation can be truckload (moves a full load directly from its origin to its destination in a single trip) or less-than-truckload (shipments are not completed), which is slower than truckload trucking (Ghiani et al., 2004).

As a consequence of the increased use of road transportation, the quality of roads has been improved in recent years. Figure 4 shows the significant difference between the length of motorways and the rest of roads (in the European road network).

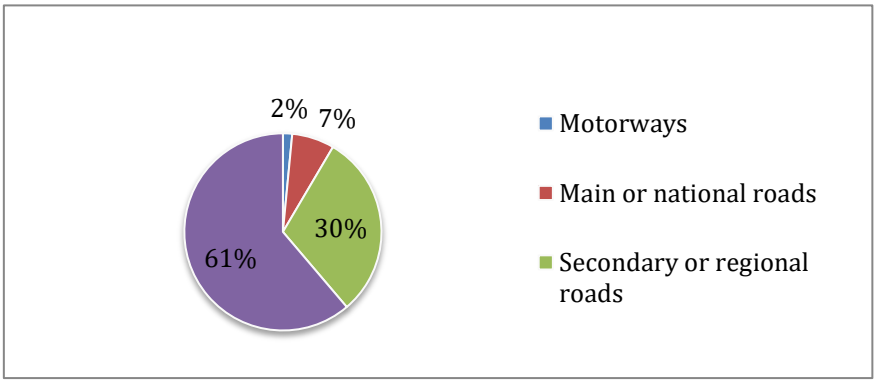

Figure 4: Diagram representing the percentages of length of road network by type in Europe at the end of 2016 (data from European Union, 2018).

Air. Air transportation is usually used together with road transportation in order to provide door-to-door services. While air transportation is in principle very fast, it is slowed down in practice by freight handling at airports. So, air transportation is not competitive for short and medium haul shipments. In contrast, it is quite popular for the transportation of high-value products over long distances (Ghiani et al., 2004).

Intermodal transportation. The use of more than one mode of transportation can lead to transportation services having a reasonable trade-off between cost and transit time. Although there are several possibilities to combine the five basic modes of transportation, in practice only a few of them turn out to be convenient. The most frequent intermodal services are air–truck transportation, train–truck transportation, ship–truck transportation. Containers are the most common load units in intermodal transportation and can be loaded directly on a train, a ship or an airplane, or can be loaded on a truck and the truck is then loaded onto a train, a ship or an airplane (Ghiani et al., 2004).

The European commission is preparing the European transport area for the future

Transport is considered fundamental to EU economy and society. Mobility is vital for the internal market and for the quality of life of citizens as they enjoy their freedom travelling. Transport enables changes in economy such as economic growth and job creation. Transport is global, so effective action requires strong international cooperation. The transport systems of the eastern and western parts of Europe must be united to fully reflect the transport needs of almost the whole continent and our 500 million citizens (Commissie, 2011).

New technologies for vehicles and traffic management will be key to lower transport emissions in the European Union as in the rest of the world. The race for sustainable mobility is a global one. Delayed action and timid introduction of new technologies could make EU transport industry not to evolve positively. The EU's transport sector faces growing competition in fast developing world transport markets.

Many European companies are world leaders in infrastructure, logistics, traffic management systems and manufacturing of transport equipment – but as other world regions are launching huge, ambitious transport modernisation and infrastructure investment programmes, it is crucial that European transport continues to develop and invest to maintain its competitive position (Commissie, 2011).

We could enumerate some new trends in logistics:

- Integration of new technologies: Internet, product identification, equipment to manipulate materials, telematic systems, e-commerce.
- Industrial concentration: development of international logistics.
- Greater complexity: ever wider ranges, increasingly larger product lines, different components in each final product (changes in the tastes of consumers).
- Rhythm of high innovation: very frequent changes. Time is increasingly critical.
- High fuel costs and maintenance.
- Standardization: tendency to use compatible equipment (eg standard containers).
- Greater regulation of transport.
- New infrastructure.

In recent years, further market opening has taken place in aviation, road and to a lesser extent in rail transport. The Single European Sky has been successfully launched. The safety and security of transport has increased. New rules on working conditions and on passenger rights have been adopted. Transeuropean transport networks have contributed to territorial cohesion and to build high-speed railway lines. International ties and cooperation have been strengthened. A lot has also been done to enhance transport's environmental performance. But still, transport system is not sustainable (Commissie, 2011).

Multiple-Choice Questions:

1) **What are the responsibilities of a logistician?**
a) Primary role of a logistician is to manage the supply chain, transportation and storage of material and transportation management.
b) As engineer he/she must take care of all processes in the company.
c) The only responsibility is transportation management.
d) Primary and unique role of a logistician is to manage the supply chain, together with all workers.

Answer: a

2) **What is CDC?**
a) Central division of control.
b) Control of devices in a company.
c) Consensus for distribution to customers.
d) Central distribution centre.

Answer: d

3) **What is RDC?**
a) Rail diesel contribution.
b) Regional distribution centre.
c) Region of development and complaint.
d) Rural distribution to customers.

Answer: b

4) **What is cycle time?**
a) The time consumed to get and order from order entry to the shipping dock.
b) The time to finish a product.
c) Free time for logistics employees.
d) The time consumed to load a truck depending on truck capacity and arrival time.

Answer: a

5) **A characteristic of logistics is:**
a) To ensure that workers and the director find a good agreement for transportation of goods.
b) To be sure that everything works efficiently.
c) To ensure that goods arrive in adequate conditions.
d) To get the better prize for row materials.

Answer: c

6) What is the meaning of WIP?

a) Workers in process of dismissal.
b) Work in pause.
c) Want internal performance.
d) Work in process.

Answer: d

7) The national logistics infrastructure consists of:

a) The set of transportation modes at European level.
b) A nation's air, motor, rail, and shipping systems.
c) The infrastructure of workers in a private company.
d) The well known pyramidal work in an efficient company.

Answer: b

8) The quality to manage the flow of goods and services can be described using the seven rights:

a) The right product to the right customer at the right place, in the right condition and right quantity at the right time, at the right distributor.
b) The right product to the right customer at the right place, in the right condition and right quantity at the right time, at the right cost.
c) The right 7 distribution centres.
d) The right product distributed by the 7 right companies in Europe.

Answer: b

9) Logistics core elements include different services or activities: Customer services, order processing, transportation and

a) Inventory management.
b) Supply chain.
c) Workers.
d) Ports.

Answer: a

10) According to the stage of the production process, we can classify logistics into four different sections: Storage, production, distribution, and

a) Reverse logistics.
b) Provisioning logistics.
c) Green logistics.
d) Sustainability.

Answer: b

11) There are five basic modes of transportation: rail, truck, air, pipeline, and

a) By highway.
b) On foot.
c) Product launch.

d) Ship.

Answer: d

12) What is a common pallet size?

a) 100×120 m^2
b) 90×00 cm^2
c) 120×120 cm^2
d) 100×100 cm^2

Answer: c

True-False Questions

13) There is no difference between logistics and transport. There are the same concepts.

☐ True
☐ False

Answer: False.

14) The concept of logistics is not a new term. The term "logistics" had been coined in 1960, specifically to refer to air transportation as efficient mode of transport.

☐ True
☐ False

Answer: False.

15) The term logistics was first used by the military to describe the activities associated with maintaining a fighting force in the field and, in its narrowest sense, describes the housing of troops.

☐ True
☐ False

Answer: True.

16) Logistics refers to the process of planning, implementing, and controlling the efficient, effective flow and storage of goods, services, and related information from point of origin to point of consumption while meeting customer requirements.

☐ True
☐ False

Answer: True.

17) WIP is the reduction of the time of production and transport and handling of raw materials.

☐ True
☐ False

Answer: True.

18) The real importance of a well-established national logistics infrastructure is that it allows both people and materials to travel from point to point at relatively low cost

☐ True
☐ False

Answer: True.

19) Customer services are not considered as part of core elements logistics.

☐ True
☐ False

Answer: False.

20) Logistics management is an integrating function, which coordinates and optimizes all logistics activities, as well as integrates logistics activities with other functions including marketing, sales manufacturing, finance, and information technology.

☐ True
☐ False

Answer: True.

21) Reverse logistics is responsible for returning the products that customers return.

☐ True
☐ False

Answer: True.

22) Containers are always refrigerated, ventilated, closed and with upper openings.

☐ True
☐ False

Answer: False.

23) Containers for transporting liquids have capacities between 14 and 20 kl.

☐ True
☐ False

Answer: True.

Other Type of Questions

24) What is the different position a person can work in logistic industry? (more than 1 answer is correct)

a) Logistic supervisor.
b) Product seller.
c) Logistic engineer.
d) Logistic specialist.
e) Database administrator.

Answer: a), b) and d).

25) What are the important aspects of transportation and fleet management? (more than 1 answer is correct)

a) Partial instead of a full truck load.
b) Transport Planning.
c) To work together with co-workers.
d) Fleet maintenance and Scheduling.

Answer: b) and d).

(Some question are available at CareerGuru[99])

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Authors:

Gamze YÜCEL ISILDAR

Deniz ISILDAR

Donald Romaric Yehouenou TESSI

1.2. Impacts of Logistics

As comprehensive and concrete importance to the business, current logistic industry is the mainstay of the national economy. Logistics have a great extent added to the financial advancement of nations around the world. Data economy, organize economy, new economy, gave the coordination field of "contemporary information, networks and new administration thought; triggered the advancement of the logistic sector business in the specialization and scale. However, the development of the logistics industry is also double-edged sword. There are extensive acknowledgments that logistics activities produce the sought after benefit and an inevitable negative ecological effect at the same time (Thiell et al. 2011). These benefits and paradoxes are summarized in Table 1.

Table 1: Paradoxes of green logistics (Kumar 2015)

Dimensions	**Outcome**	**Paradoxes**
Cost	Cost reduction by developing packaging and minimizing waste	Cost of packaging are lower than that of environmental costs
Time/Availability	Development of integrated supply chains and JIT affords adequate distribution system.	Expanded generation, higher deals and conveyance framework needs more space, more vitality and emits CO2 discharges.
Network	Raising the adequacy of the system by changes in network.	Impacts on local communities
Security	Adequate, effective and on time transport system	Negative impacts are caused by trucks and planes.

Storage	Decreasing the for private warehouses	Increase in congestion on the roads are caused by continuous use of roads.
E-commerce	Increasing the number of business alternatives and increase in types of supply chains.	Energy consumption may increase.

As Xin Guan (2015) mentioned, “due to the enormous increase in the amount of logistics, logistics management and logistics facilities and the change of tools, impact of logistics system on ecological environment is increasingly becoming more and more serious.”

Through its activities like transportation, storage, inventory management, materials handling and all the related information processing, logistics system have a great impact on our environment. Logistics is responsible for a variety of externalities, including air pollution, noise, accidents, vibration, land-take, and visual intrusion. While measuring the environmental impacts of logistics differentiation of direct and indirect effects are it is important. Direct environmental impacts are those directly associated with freight transport, warehousing, and materials-handling operations where indirect impacts may arise in different forms from logistics (Maja Piecyk, Sharon Cullinane and Julia Edwards, 2015).

It is stated by Edgar E. Blanco and Yossi Sheffi (2017), as products goes from origins to final places through the logistic network, they are moved in transports (e.g., planes, trucks, ships, cruisers) controlled by petroleum derivatives (e.g., diesel, oil). During the motor burning procedure, noticeable and imperceptible gasses are radiated through fumes pipes that effect the neighborhood, territorial, and worldwide barometrical arrangement, running from nearby air, water, or soil contamination to worldwide environmental change. Vitality utilized during stockpiling and treatment of merchandise additionally impacts the climate, but not in every case legitimately, yet in a roundabout way through nonrenewable vitality use. The vehicle transports likewise create clamor and vibration as they explore streets, interstates, and

conduits, in this way influencing human and untamed life personal satisfaction. At long last, extra bundling and materials are utilized to safeguard the trustworthiness of items before they arrive at clients. Lacking transfer or an overabundance misuse of this extra defensive bundling is another potential natural effect of logistic.

Transportation is the one that have serious impact on the nature in which carbon dioxide (CO_2) and other greenhouse gases (GHGs) emissions from cars, airplanes, and vessels used causes environmental pollution, frequently known as one of the major sources of the global warming. Additionally, relevant logistic activities cause water pollution, air pollution, solid garbage disposal and fuel consumption problems (Lin et al. 2011). Transport and storage activities were responsible for 10.9% of emissions of three greenhouse gases, carbon dioxide, nitrous oxide and methane, in European Union in 2013 (Eurostat 2016).

Along this line, first, impacts of transportation will be explained in terms of climate change, biodiversity, noise pollution, waste, air quality, water pollution, soil pollution and biosecurity in the coming sections. Then impacts of warehousing and packaging will be discussed.

1.1.1. Impacts of transportation

1.1.1.1. Climate change

As global warming is now considered to be the most serious environmental problem that human being faced, the major focus will be on greenhouse gas (GHG) emissions from freight transport (Maja Piecyk, Sharon Cullinane and Julia Edwards, 2015). Transport activities as the main component of logistics activities maintain a direct relationship between its expansion and greenhouse gas emissions. According tot he Intergovernmental Panel on Climate Change (IPCC) (2016) results, three direct greenhouse gases: carbon dioxide (CO_2), methane (CH_4), and nitrous oxide (N_2O) are produces due to transportation activities.

Freight transport is responsible for approximately 90% of the total greenhouse gas emissions originating from logistical activities (McKinnon et al., 2015) and the

environmental impacts of a single activity depend by far on the vehicle used for transport. Many researchers found out that the transports sector continue highly to contribute to the emissions of the greenhouses gases. The persistent of those gases in the atmosphere increase their concentrations and their effects on the climate. There are three principle supporters of the expanded CO2 outflows and moving emanations shares. To start with, notwithstanding development in the volume of exchange, the development in the normal pulling separation will likewise imply that products should be moved over longer separations between primary exchanging accomplices, bringing about more fuel consume.

The estimation of the International Transport Forum (ITF) on international trade-related freight transport accounts for around 30% of all transport related CO_2 emissions from fuel burning and more than 7% of global emissions. (Figure 5)

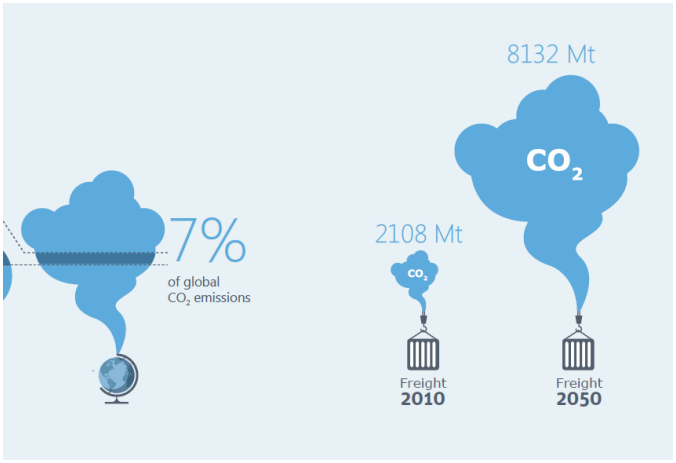

Figure 5: CO_2 emissions from freight transportation

By using fossil fuel in the means of transport like road, maritime and railway transports, there is a continual emission of greenhouse gases. Each mode of transport, direct GHG emissions can be breakdown into:

• activity — total passenger-km / yr or freight tonne-km / yr having a positive feedback loop to the state of the economy but, in part, it is affected by personal environmental friendly behaviours;

• system infrastructure and modal choice (NRC, 2009);

• energy intensity — directly related to vehicle and engine design efficiency, driver behaviour during operation (Davies, 2012), and usage patterns; and

• fuel carbon intensity — changes according to different transport fuels such as electricity and hydrogen. (IPCC 2014)

Currently road transport is responsible for over a half of trade-related freight CO_2 emissions (International Transport Forum, 2015), while airfreight is the most carbon intensive freight method measured with the tonne-metre relationship (Dey et al., 2011). The increasing demand for quicker transport has negative effects on emissions as the quicker forms of transport are much more emission intensive. By 2050 the share of air transport of the total international trade-related freight emissions is forecasted to grow due to the growing trade volumes and airfreight's competitive advantage to carrying high value goods. At the same time, the share of road freight of the emissions is forecasted to grow by 3 percentage points to 56% while the share of maritime freight is estimated to fall from 37% to 32% and rail freight to remain stable at 3%. (International Transport Forum, 2015). Maritime transport is responsible for about 2.5% of global greenhouse gas (GHG) emissions (https://ec.europa.eu/clima/policies/transport/shipping_en)

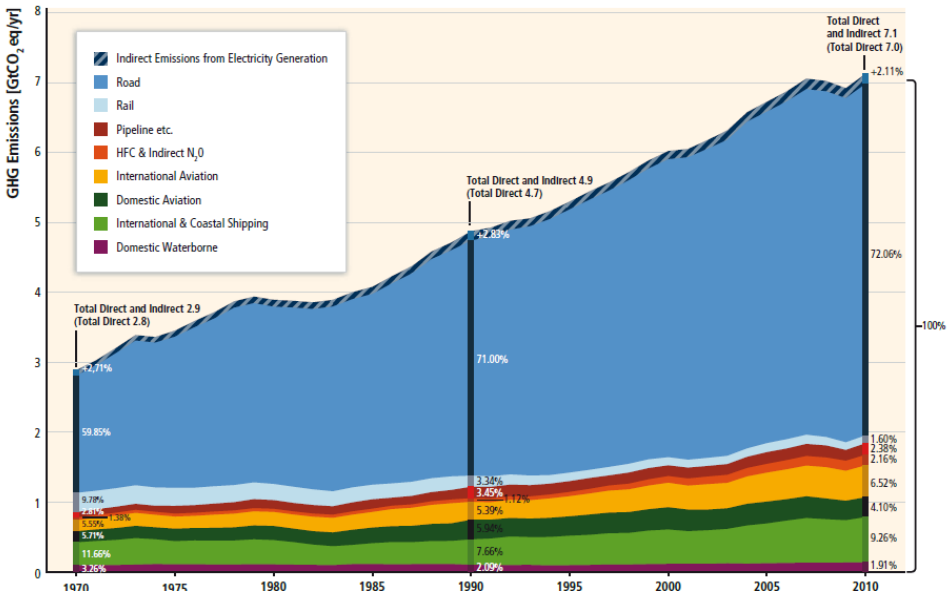

Figure 6: Direct GHG emissions of the transport sector (rose 250 % between 1970-2010)

Source: Transport, Climate Change 2014: Mitigation of Climate Change (IPCC)

In the European Union, road transport causes more than two-thirds of EU transport-related GHG emissions and over one-fifth of total emissions of CO_2 (European Commission 2016).

1.1.1.2. Biodiversity

Research found out that there is a multiple impact of supply chain on biodiversity and ecosystems. The impact can be direct or indirect but lead to the change of biodiversity life cycle.

Transportation, infrastructures, and most road networks are blamed for highly contributing to the decrease in both the quantity and the quality of natural habitat, posing a threat for the conservation of biodiversity. They cause both a direct and an indirect loss of habitat. The direct loss refers to the physical presence of roads, railway tracks, distribution facilities or terminals and the conversion of the greenfield land into a built-up area. Geneletti (2003) stated“the indirect loss refers to the fragmentation and/or degradation of ecosystems due to the presence of transport infrastructure, which reduces the capability of an ecosystem to sustain its original biodiversity (Geneletti, 2003).“ The ecological effect of transportation is large and include mostly the creation of unsuitable areas for species. In some areas, the development of roads, rails networks and transportations infrastructures affect the landscape and wildlife and lead to deforestation. This direct impact causes degradation of priority habitats and conservation sites, fragmentation or loss of habitats, creation of barriers to the movement and genetic interchange between populations. Due to habitats lost and fragmentation phenomenon, animal species that need more space or land to develop their population become endangered species. Transportation activities establishment can disturb also ecosystems functioning, per example, in case of reducing of wetland areas. Transportation sector activities affect protected species that become isolated, reduced in terms of size of

population, and lead to the extinctions of the most vulnerable of them. The problem of invasive species is also associated to transportation activities due to the movement of trucks, car, and good and the introduction of new species by the transport of their seeds. It creates a way to spread new diseases and pests. Factors like noise, light pollution and contaminated run-off disturbs habitats and species life. In most cases, there is no evaluation on biodiversity after construction of transport infrastructures.

1.1.1.3. Air quality

Non-CO2 greenhouse gas emissions, black carbon, and aerosols

The high concentrations of air pollutant emissions from logistics activities are responsible for the persistent problems of air quality that harm human health. Those air pollutants are emitted from the usage of internal combustion engines in the logistics transportation sector including trucks, airplanes, ships, and railways engines. The most known of the air pollutants are carbon monoxide (CO), nitrogen oxide (NO, NO2), sulfur oxide (SO2), hydrocarbon (CxHy), lead (tetraethyl lead or Pb, Sulfur hexafluoride (SF6). Methane emissions are mostly originates from the leakages of natural gas production and the filling of compressed natural gas vehicles; internal combustion engines emits VOCs (Volatile Organic Carbon), NOx and CO; and F-gas emissions generally from air conditioners in the vehicles and refrigerators. As Fuglestvedt et al. mentioned (2009), “contrails from aircraft and emissions from ships also impact on the troposphere and the marine boundary layer, respectively.” Emissions from airways can also impact on cloud formation and thus have an indirect effect on climate change (Burkhardt and Kärcher, 2011). And Boucher et al. (2013) stated that, “black carbon and non-absorbing aerosols, emitted mainly during diesel engine operation, have short lifetimes in the atmosphere of only days to weeks, but can have significant direct and indirect radiative forcing effects and large regional impacts.”

Depending on short or long-term exposures, the impacts of the pollutants present a wide range of diseases: neurotoxic effects, cancer, respiratory problems.

Pollutants are associated with some specifics harms. Carbon monoxide (CO) when breathed decreases the accessibility of oxygen in the circulatory framework and can be very harmful. Nitrogen dioxide (NO2) emitted from transportation sources lessen lung work, influence the respiratory safe barrier framework and expands the danger of respiratory issues. The discharges of sulfur dioxide (SO2) and nitrogen oxides (NOx) in the climate structure different acidic intensifies that when blended in cloud water causes acid rain. Acid rain precipitation adversely affects he built environment, reduces agricultural crop yields and causes forest decline (Rodrigue, 2017).

Transport is also a important emitter of primary aerosols that prevent light and gases that goes chemical reactions to form secondary aerosols. “Primary and secondary organic aerosols, secondary sulphate aerosols formed from sulphur dioxide emissions, and secondary nitrate aerosols from nitrogen oxide emissions from ships, aircraft, and road vehicles, can have strong, local, and regional cooling impacts (Boucher et al., 2013).”

1.1.1.4. Noise pollution

Noise can be emanated from vehicles, motor operations and dynamic loads. Noise can also be produced from moving parts, fans and loading equipment. The environmental impacts of traffic noise differ from those of GHGs or air pollutants in the fact that most of the noise effects are restricted to the time of emission (Doll and Wietschel, 2008).

In any case, road traffic will in general be nonstop and, in this manner, considered a more significant issue than commotion brought about by other vehicle modes (for example railroad or air ship clamor), which are irregular. (Piecyk et al, 2015). It has been recognized through research that noise from traffic affects people’s health both directly and indirectly. According to McKinnon et al. (2015), immediate unfavourable impacts of noise incorporate disturbance, correspondence troubles, loss of rest and weakened intellectual working bringing about loss of work profitability; longer-term, physiological and mental medical problems may likewise emerge. Children living in areas with significant levels of noise pollution display

higher levels of anxiety and problems with school behaviour (Matsuoka et al, 2011). Traffic noise also has negative impacts on residential areas in terms of sale and rent prices (Efthymiou and Antoniou, 2013).

WHO Report (2011) focused that, there are strong correlations between noise and cardiovascular diseases and cognitive impairment, sleep disturbance, tinnitus, and annoyance. There is a serious risk of high blood pressure and myocardial infarction in populations exposed to high noise levels. Sleep disturbance is related to a long list of problems, affecting walking motor performance of brain, memory consolidation, creativity, risk-taking behaviour, signal detection performance and risk of accidents. Individuals exposed to high noise levels, particularly intermittent noise during the night, don't understand the explanation behind their rest unsettling influence yet at the same time feel its belongings (WHO, 2011).

1.1.1.5. Waste

Through logistics activities, there are multiple processes that produce waste in the supply chain. There is the waste of raw materials during manufacturing operations, waste of transport trucks (used engine oil, scrapped vehicles), waste of energy, waste from overproduction characterized by hills of waste products, underutilized equipment, trailer demurrage, and other transportation wastes. Toxic waste can cause water, air and soil pollution; illnesses (cholera, Typhoid, dysentery) among the people who reside in the surrounding area of presence. They can also damage animals and plants habitats. By burning the wastes of products, people can be subject to deadly disease like cancer.

1.1.1.6. Water pollution

From maritime transport, various type of waste is generated. With the high concentrations of toxics components and their long life cycle, those wastes create the contamination of the aquatic ecosystems, causes damages to vulnerable species, and affect also the food chain. Evacuation of waste from vehicles, cars, trucks through conduit, canalization cause contaminations of lake, rivers, wetlands and

oceans. Accident during shipping activities through road, sea and airplane constitutes also a serious threat for pollution of the environment. Indeed, many litters are released during sea transportation accident. “According to OCED (1997), transport maritime causes water pollution through: routine discharges of oily bilge and ballast water from marine shipping; dumping of non-biodegradable solid waste into the ocean; accidental spills of oil, toxics or other cargo or fuel at ports and while underway; port and inland channel construction and management; and ecological harm due to the introduction of exotic species transported on vessels.“

1.1.1.7. Soil quality

Impact of transport activities on soil consist in the damages created by the pollutant released by the different means of transport. In terms of contamination of the soil, there are acidification and build-up in soil by pollutant like hydrocarbons (methane, isopentane…) and nitrogen oxides (NOx). Discharging from transport industry, chemicals products, fuel, oils and other toxics materials enter into the soil and causes its degradation. From this introduction, it affects also the groundwater. Occupation of the soil by trucks, cars, vehicles, their regular movement and heavy traffic damage the structure of the soil, leading to its increasing packing down, with consequences of low circulation of water and oxygen.

1.1.1.8. Biosecurity

In terms of biosecurity, movement of vehicles can be the vectors of diseases and migration of new organisms. Their crossing through different regions can be the sources of invasive species and their expansion.

1.1.2. Impacts of Warehouses

The environmental impact of warehousing has received only little attention by research although significant amount of carbon dioxide emissions logistic-related is caused by storage and material handling processes in warehouses, prior research mostly focused on the transport elements. A warehouse, also referred to as distribution centre, storage facility and logistics service centre. They are used for

different operations such as product distribution, cross-docking and composite storage. Nevertheless, carbon emissions caused by material handling activities in logistics buildings, constituting warehouses and separation facilities, are important and account for 13% of overall supply chain emissions (World Economic Forum, 2009).

Warehousing facilities generates important need of use of energy, water and land. They cause various impacts on nature and people, which are associated with impact of land use, atmospheric emissions, waste management, traffic and congestion, public transport, visual intrusion and ecology. (Peter Baker and Clive Marchant, 2015).

Methodology to evaluate the environmental impact of warehousing is given in Figure 7. which helps us to understand the possible/alternative sources of the problems.

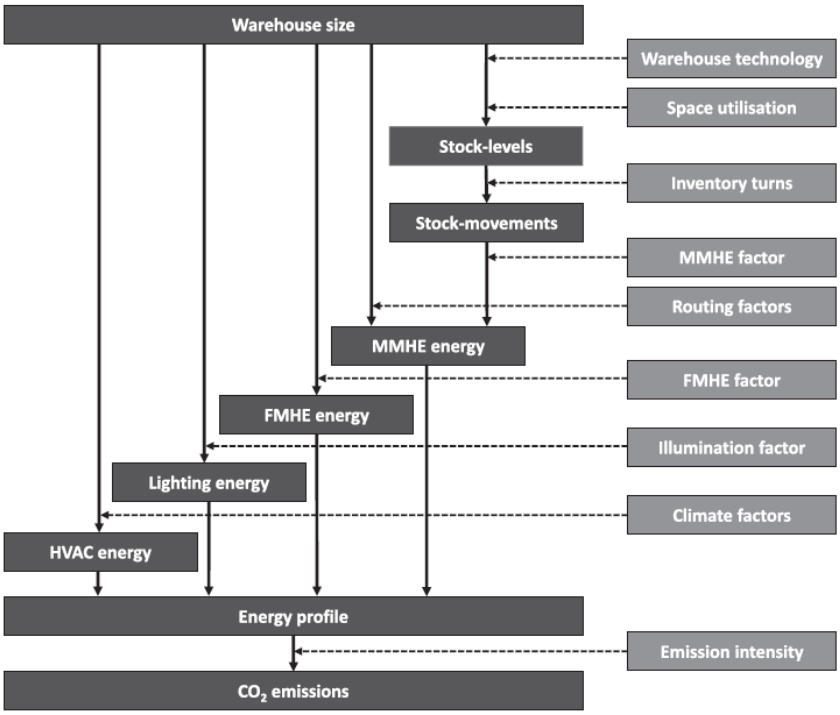

Figure 7: Methodology to assess the environmental impact of warehousing (Ries et al, 2017)

1.1.2.1. Climate change and air pollution

By analysing of the impact of the supply chain on environment, it has been found the fact that warehouses require a significant amount of energy like electricity consumption of goods storage, due to lighting, heating, cooling and air condition as well as fixed and mobile material handling equipment (Ries et al., 2016). This energy consumption leads to a considerable amount of carbon dioxide emissions. As warehouse is associated to buildings, offices and factories, the World Resources Institute estimated that on a global scale, “commercial buildings emit 5.25 percent of all greenhouse gases (GHG) and 65 percent of this come from energy consumption (such as electricity).“

Also, with the use of fluorinated gases for refrigeration, warehouses can be sources of other pollutants because they often handle hazardous materials, and there is a trade-off between the marginal release of pollutants and the output handling of hazardous materials. (Dasaklis et al., 2013)

1.1.2.2. Biodiversity and habitat lost

With the increase of logistics activities to be more efficient, there is also the increasing of the number and size of the area occupied by warehouse making many more infrastructures to build. They are located in city centres, residential areas. In order to offer quick services to customers, minimize distribution costs, the excessive development of warehouse systems causes noise pollution and congestion in the environment they are installed, the degradation of ecosystems and their function; stresses on fauna and flora due to the pollution events or incorrect waste disposal. Huge amounts of item sitting inactive in warehouses may appear to be negligibly polluting, yet distribution centres regularly take up significant land and devour assets, even in a static state (White, 2007).

According to Colicchia et al. (2013), many logistics service providers have adopted the practices related to eco-friendly warehouse design, including energy-efficient heating and lighting systems, using renewable energy sources, creating sustainable workplace for employees, reducing waste and using alternative or

recycled construction materials. Also keeping inventory levels at minimum can affect positively on a company's carbon footprint as smaller inventory quantities reduce the need for logistics facilities and property-related energy consumption (Dey et al. 2011).

1.1.3. Impacts of Packaging

Packaging is everywhere present in human daily life and play an important role of facilitation, protection of the integrity and easiness in distribution of goods. It serves many purposes and used in all sector of activities: food transportation, delivery of products, and presentation of new products in market to be more attractive. It is made with different materials mostly from natural resources (tree, petrol, etc.) converted in a specific form following some process: plastic, wood, carton…. They are useful but has many negative impacts on our environment.

The negative impact of packaging is estimated in terms of the production of a lot solid waste after uses, production of toxics pollutants, liquid and gaseous, during the process of manufacturing.

1.1.3.1. Pressure and waste of resources

With the rise of consumption, there is a necessity to produce more to meet human needs. Due to the fact that packing materials are made from natural resources, there is a huge pressure on those resources. In delivery sectors, per example the excessive uses of cartons as packing materials to ship products leads to the increasing rate of deforestation, as wood is the fundamental material used to produce them. Wood is also use directly as packaging material as crates and pallets. Moreover, production of plastics is based on limited natural resources like oil, natural gas and coal. There is also the called PVC There is a non-sustainable use of the resources based on the excessive production of packaging materials and the waste of the natural resources.

1.1.3.2. Climate change and air pollution

In the process of production of packaging materials, a lot of energy is consumed, and the emissions of greenhouse gas and other pollutants has been found. The heating of raw materials to produce glass and steel packaging emits carbon dioxide and other greenhouse gases, contributing to overall global greenhouse gas emissions. Production of plastics also contributes to climate change because, aside from the plasticizers, additives and other pollutants released during manufacturing and incineration of plastics, GHGs which contribute to global warming are also emitted in the energy required to transport packaging materials. (Manoj, 2010). Emissions from plastic production processes creates also damage to human health. The contribution of packaging factory to global warming is an evidence due to their intense activities from extraction of raw materials using engines that consumed tons of fossil fuel, to the conversion of them by non-ecological process with permanent emissions of gas, solid and liquid waste.

Production of PVC (Polyvinyl Chloride), raw material of the tape, and used in the manufacturing of some plastics causes emissions of toxic pollutant like polyvinyl chloride monomer and other carcinogenic substances. Indeed, PVC is used in packaging, for water and oil bottles, snack packages, and the so-called "blister pack"—the combination of clear plastic front on cardboard backing that is often seen on drugstore and hardware items. Researches about its potential impacts found out that: (a) incineration of PVC- including waste produces hydrogen chlorine, dioxins and heavy metals that are given to air, or harm incinerator ashes or filter residuals; (b) serious potential impact areas of exposure to the carcinogenic vinyl chloride monomer in the work environment and the dioxins effluents (Christiansen et al, 1990).

1.1.3.3. Soil and water pollution

As most of packaging materials are for single-use, after good consumption and uses, they generate solid waste. Landfill of these wastes will bring in problems such as land occupancy and pollution on soil, and the incineration will produce

detrimental substances (for instance, dioxin) which cause air pollution. (Zhou et al., 2013). Incineration can also pollute groundwater because the 40 percent of wastes that remain as ash after incineration (ash contains high concentrations of heavy metals and dioxins) can be sent to landfills where the ash may potentially leach into the soil and pollute the groundwater beneath. (Manoj, 2010). Pongrácz (2007) pointed out, “Some of the packaging materials (plastics materials, metal, glass…) take many years to degrade and become inevitably factor of soil pollution and water pollution prior degradation. Water pollution occurs also from wastewater discharge of some packaging material manufacturing or related activities. One of the basic water-polluting activities is paper production, releasing biological oxygen demand (BOD), chemical oxygen demand (COD), volatile suspended solids (VSS), and total suspended solids (TSS)“.

1.1.3.4. Biodiversity and land occupancy

Abandoned packaging materials in aquatic and terrestrial ecosystems cause serious problem of pollution; even fade the growth of certain plants (due to maybe their toxic contents, chemical residues). Packaging (glass, metal, plastics…) are associated to marine debris that affect species and their habitats. The litter of packaging from both land and sea sources (beach activities, dumping at sea, and ocean crossing…) may be ingested by a wide range of organisms and may cause adverse physical effects. Moreover, Plastic particles breaking down into nano-sized particles may also impact the bottom of the food web upon which the ocean and global climate depend. (GEF, 2012). Hectares of forest destroyed every year to serve packaging factory are a threat of biodiversity survival and habitats lost for many species. The mining of raw materials like bauxite ore to produce aluminium represent also many threats and production of waste. The disturbance creates by those activities have impacts on surrounding ecosystems.

It has been stated that the material handling and logistics industry could benefit from new vehicle technology and reduced energy consumption (Gue et al., 2014), and due to technological development, environmental pressure and rising costs, the average fuel consumption of road freight is forecasted to decrease.

Alternatively, fuelled vehicles are already available, although these options are discouraged by higher purchase prices and operating costs, limited range and lack of refuelling infrastructure (McKinnon, 2015). However, renewable energy is forecasted to become more popular as the research and development and distribution networks of biofuels will increase, and their wider use will also be promoted by the provided tax incentives and rising costs of fossil fuels. Also, EU regulations on the maximum CO_2 emissions for trucks are expected, following the examples of Japan and USA (Liimatainen et al, 2015). In Japan the exhaust emission limits for vans were introduced already in the 1970s and the limits have continuously been tightened (McKinnon, 2015). Despite these expected improvements, the global carbon dioxide emissions originating from international trade-related freight transport are forecasted to grow by 290% by 2050, even when assuming simultaneous technological development and efficiency improvements (International Transport Forum, 2015).

Multiple-Choice Questions:

1) **Which of the following is NOT direct greenhouse gases emitted by transportation activities?**
a) Carbon dioxide (CO_2)
b) Ozone (O_3)
c) Nitrous oxide (N_2O)
d) Methane (CH_4)

Answer: b

2) **Which mode of transportation has the lowest environmental impact?**
a) Road
b) Aviation
c) Shipping
d) Railways

Answer: a

3) **Which of the following statements is true**?
a) Carbon monoxide (CO) when inhaled reduces the availability of oxygen in the circulatory system and can be extremely harmful
b) Methane effect the respiratory immune defence system
c) Transport is not a significant emitter of primary aerosols
d) Aviation emissions can also impact on acid rain

Answer: a

4) **For each mode of transport, energy intensity is directly related to;**
a) Vehicle
b) Engine design efficiency
c) Driver behaviour during operation
d) All of the above

Answer: d

5) **Which one of the following gases are NOT emitted by internal combustion engines?**
a) NOx
b) CO
c) CO_2
d) VOCs

Answer: c

6) **Approximately what percentage of carbon dioxide emissions can be attributed to transportation activities in EU?**
a) 5 %
b) 10 %
c) 30 %
d) 50 %

Answer: b

7) Idling, or letting the engine run when parked or not in use, does which of the following:

a) Increases consumption of fuel
b) Causes vehicle wear and tear
c) Emits toxic pollutants into the environment
d) All the above

Answer: d

8) Which component of green logistics has the highest environmental harm?

a) Warehousing
b) Data management
c) Packaging
d) Transportation

Answer: d

True-False Questions

9) Logistic acitvities cause indirect loss of habitat.

☐ True
☐ False

Answer: False. (direct and indirect)

10) The problem of invasive species is also associated to transportation activities.

☐ True
☐ False

Answer: True.

11) Carbon emissions are largely associated with leakage from the production of natural gas and the filling of compressed natural gas vehicles.

☐ True
☐ False

Answer: False. (Methane)

12) Railway traffic noise tends to be continuous and thus considered a more serious problem than noise caused by other transport modes.

☐ True
☐ False

Answer: False. (road)

13) Transportation affects also the groundwater pollution.

☐ True

☐ False

Answer: True.

14) Keeping inventory levels at maximum can affect positively on a company's carbon footprint

☐ True
☐ False

Answer: False. (minimum)

15) Although a significant amount of logistic-related carbon dioxide emissions is caused by packaging, it has received only little attention by research so far.

☐ True
☐ False

Answer: False (warehousing).

16) All green measures, particularly those in warehouses, reduce emissions of air pollutants and their associated health impacts.

☐ True
☐ False

Answer: True.

17) It is important to use the type of oil recommended for your engine because different engine oils can either raise or lower fuel economy.

☐ True
☐ False

Answer: True.

18) Development of the logistics industry is double-edged sword.

☐ True
☐ False

Answer: True.

19) With the use of fluorinated gases for refrigeration, warehouses can be sources of other pollutants

☐ True
☐ False

Answer: True.

Other Type of Questions

20) Ecological impacts of transportation; (more than 1 answer is correct)

a) Reduction of wetland areas
b) Reduced waste
c) Loss of habitats

d) Creation of suitable areas for species
e) Decrease in biodiversity

Answer: a), c) and e).

21) Operating large and highly technological warehouses causes a significant amount of energy consumption due to :

a) Lighting
b) Heating
c) Cooling
d) Combustion
e) Land use

Answer: a) and b) and c).

22) Green Transportation helps to: (more than 1 answer is correct)

a) Decrease in carbon footprint
b) Satisfaction of social needs of drivers
c) Development of pooling and hiring system
d) Increase competitiveness
e) Brand recognition

Answer: a) and b) and d).

23) Which of the following is one of the paradoxes green logistics? (more than 1 answer is correct)

a) Environmental costs are often much higher than cost of packaging.
b) Improved financial performance
c) Access to clean water and clean energy
d) Development in harmony with culture and available resources
e) Continuous use of roads, causing increased congestion on the roads.
f) Green image

Answer: a) and e).

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Authors:
Gamze YÜCEL ISILDAR
Deniz ISILDAR
Donald Romaric Yehouenou TESSI

1.2. Need for Green Logistics

It is expected to have different countries have differences and similarities specific to LOGISTIC sector in the implementation, legislations, policies, problems, solutions, bottlenecks, etc. Similarly, education system for logistics changes in some respects as country-wise. However, it is for sure that, transition to green logistics practices should be ensured urgently for all countries.

Along this line, it is aimed to evaluate results of partner countries' National Reports and findings of SWOT Analysis to be able to analyse the need for green logistics and wrap up the common points in this part of the book.

All partner countries mentioned that; "logistic" is very important for economic development and will continue to gain importance in the future. Demand is increasing, there are many investments. For example, in 2016, the economic weight of the logistics sector represented 2.8% of the GDP of the Spanish economy.

However, the majority of freight transport is based on road systems which has the greatest impact on the environment; greenhouse gas emissions from logistics activities especially from the transport sector. In Austria, between 1990 and 2017, GHG emissions from the transport sector rose from 13.8 million tonnes to 21.7 million tonnes (+ 58%). Road transport is the largest source of GHG emissions in Italy. In contrast to the industry and public electricity and heating sectors, transport emissions are still just above 1990 levels, but emissions from international shipping and aviation have doubled in the same time. In Slovenia, GHG emissions from transport increased by 166% by 2014 compared with 1986. According to the 2009 emissions inventory, GHG emissions from the transportation sector represented 17% of total emissions in Turkey, GHG emissions from transport sector in Turkey have increased almost %80 between 1990 and 2009. Only in Spain, decreasing of greenhouse

gases emission can be appreciated, from a total amount of 102,219kt in 2005 to 86,2kt in 2016. All these numbers clearly indicating that, in line with climate change mitigation measures, efforts for decreasing GHG emissions should have priority in all partners' countries. 'Green logistics' are promising in all partner countries because great importance of this issue is also demonstrated by various researches, expositions and works published in these years to collect data, analyse the situation and potential evolution.

1.2.1. Need for Green Logistics Training

Generally, training on logistics is offered in formal and informal education courses in academia and as in-service training, in-house training by the logistic companies. There is no specific "green logistics" program in all of the partner countries. Sustainability and green issues are included in broader logistic courses such as '**Reverse Logistics Quality and Environmental Strategies'; 'Inverse Logistics, Green Logistics and Environment' in Spain, 'Reverse and Green Logistics', 'Hazardous Wastes Transport' in Turkey.** There are a few courses related to Green Logistics in a few undergraduate and graduate programs.

Since world's future will mostly be shaped by its capacity to maintain sustainable energy development, there will be high demand for the graduates who have deep knowledge of green logistic technologies and sustainable energy, water and environment. Therefore, there is an obvious requirement for updated and enriched curricula about green logistics.

These findings from National Reports are also supported by the analysis of strengths, weaknesses, opportunities and threats (SWOT) that was adopted in the framework of LOG IN GREEN PROJECT. Participants were asked strengths, weaknesses, threats and opportunities considering 'green logistic' and other 'environmental' aspects. Findings indicate that participants have knowledge and consciousness about environmental issues. But they are not so knowledgeable in relatively specific areas, such as Green Logistics (green packaging, green warehouses. Ecological footprint, procedures etc.) They are willing to increase their

training opportunities in this field. This is an opportunity for both the Log in Project and the participants themselves. Finally, “insufficient public policies and limited training opportunities “are gives as threats coinciding with National Reports.

In this framework, The World Economic Forum identified eight megatrends in logistics that will change logistic activity in the future (WEF, 2018) The report notes that, there will be a lack of logistical competencies, and the training of future competent logistics with an interdisciplinary knowledge is even more important. The entire logistic process is under the pressure of green thinking, which dictates the creation of comprehensive green logistic platforms.

After specifying the need for green logistics especially in terms of climate change and emphasizing the need for education, it is useful to discuss the factors that will affect the implementation of this concept positively or negatively (drivers and barriers). Although these factors and their priorities vary according to countries, they are given below in general framework.

1.2.2. Factors Affecting Green Logistics Applications

- Increasing importance of green investments,
- Internationally operating companies have so far begun to deal more intensively with climate and environmental protection
- Small and medium-sized companies in the sector do not yet see any acute need for action.
- Regulatory measures
- Customer requirements will force **Green Logistics**
- Higher investment costs
- investment incentives (changes acc to partners, barrier for Austria, driver for Italy and Slovenia (EU funds).
- Lack of internal knowledge and competences to manage green logistics (Lack of qualified personal)

- Lack of comprehensive logistics strategy: Absence of a clear environmental policy aimed at creating socio-economic value, together with the lack of long-term strategic planning and the continuous changes in fiscal stimulus policies.
- Weak R & D system
- Higher percentage of highways usage

Good examples are discussed in Chapter 6 indicating the economical, ecological and social benefits of GREEN LOGISTICS.

Authors:
Gamze YÜCEL ISILDAR
Deniz ISILDAR
DONALD ROMARIC YEHOUENOU TESSI

2. What is Green Logistics?

A part from the fact that logistics systems is fundamental for development and a necessity for world economics, its presents numerous negative impact on the environment through its activities. As a result of globalization demands and of global business activities increasing, logistics systems show multiple negative impacts on the environment (GHG emissions, biodiversity loss, waste, air, soil and water pollution, important ecological footprint of companies and industries) and mankind's survival and social development. Since awareness of environmental problems and a global warning came out from government public opinion, the sectors of logistics have been pointed out and asked for change. It is becoming a big challenge for organizations, companies and enterprises to respect the environment, coordinate their logistics activities and assure their services. To avoid those environmental issues, it has been thought a new concept of logistic systems that will be more environmentally friendly, sustainable and respect social development. Green logistics concept emerged around 80's and 90's and for several years, and its implementation gains more attention to the problem of global warming and pollutions issues.

The objectives of this concept is to bring green aspect into all the different components of logistics systems. It means green the sourcing raw materials, green the manufacturing, green warehousing, green the transportation, green the package, green the distribution and manage the waste from the system.

"Green" has become the word of choice to describe activities connected to environmental awareness such as actions that aim to reduce the impact of mankind on the environment. But from many definitions, the goal of green logistics is not only to protect the environment and reduce pressure on natural resources but also to

increase economically companies, the expansion of their market occupancy and to meet and satisfy customer needs. Green logistics can be defined as a convergence between the terms: “green” (environmental efficiency, recycling, compliance) and “logistics” (distributional efficiency, save time/money/energy).

In literature, different studies have focused their attention on this concept and there are alternatives definitions for it.

According to Wu and Dunn, (1995), “green logistic (GL) is a logistics system which cares about the nature and it included both the green forward logistics process, from handling and acquiring raw material, production, packaging, transportation, warehousing and finally the distribution to the end customer, and the reverse logistics of the waste recovery and disposal.” More recently, Larsen et al. (2007) defined Green Logistic as “The attempts to understand and minimize the environmental impact of logistics activities, these activities are incorporated in a proactive structure for dismantling.” Green logistics activities include also measuring the environmental impact of different distribution strategies, reducing the energy usage in logistics activities, reducing waste and managing its treatment (Sibihi & Eglese, 2009). Implementation of green logistics is not only driving by the decrease of ecological footprint and the rising consciousness of environmental importance by customers but also some others drivers like the increasing of the cost of waste disposal; means of competitive differentiation between companies, respect of government legislation in term of reducing the carbon footprint…

2.1. Green logistic and sustainable development

According to Dekker et al. (2012), green Logistic is the study of applications aiming to decline environmental externalities, focusing on greenhouse gas emissions, noise, and accidents, of logistics operations and therefore develop a sustainable balance between economic, social and environmental goals. Based on that definition and the fact that the word “green” characterizes environmental sustainability, green logistic can be related to sustainable development. In another

word, the application of green logistics strategies and requirements will help sustainable development to achieve its objectives.

Sustainable development defined as “development that meets the needs of the present without compromising the ability of future generations to meet their own needs” (Karagulle, 2012), can become a kind of standard for green logistics to discuss issues concerning nature protection, social and economic development. Green logistics can be defined as “producing and distributing products in an environmentally friendly way, considering environmental and social factors together” from the sustainable development point of view (Sibihi & Eglese, 2009).

By applying the three pillars of sustainable development to green logistics (Oksana Seroka-Stolka (2014); Shahbari, 2015), the tools for the proper operation of this concept aims to achieve three main objectives (Mariusz Jedliński, 2014):

- ecological – meaning preserving nature and environment and reducing risks,
- economic – communicating in fulfilling fundamental material needs of human kind by utilizing systems and innovation that doesn't wreck nature, and
- social and helpful - that is to verify the social least (finishing yearning, wretchedness and destitution), human services, improvement of the otherworldly circle (culture), wellbeing and instruction.

Representing the three main sections of green logistics by the following Figure 8, it proves that the implementation of this concept in a particular enterprise should be supported by the principles of economic, ecologic and social responsibility. (Vasiliauskas et al.)

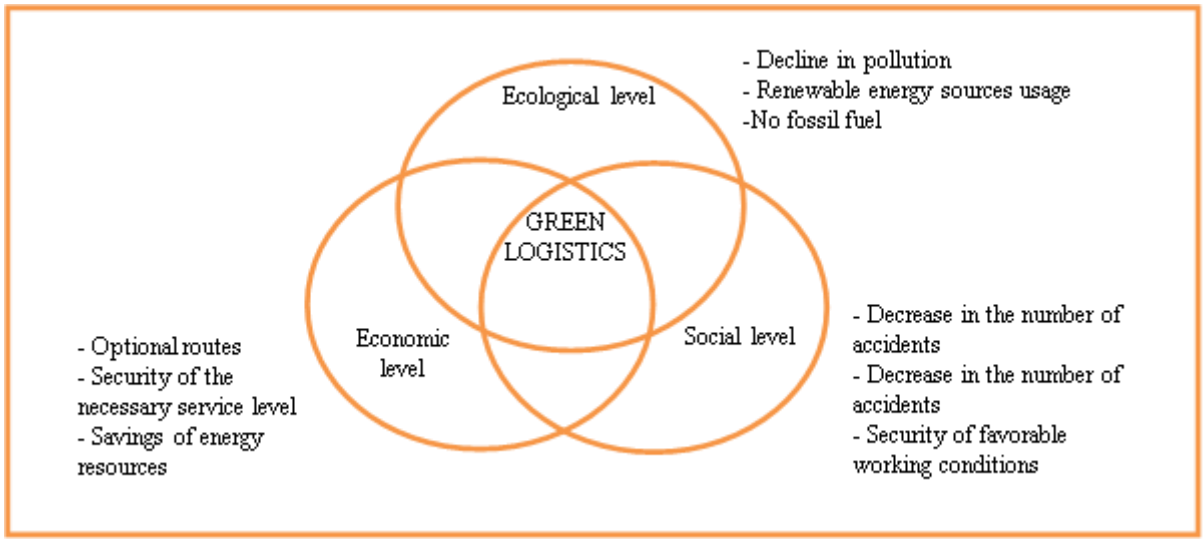

Figure 8: Key goals of green logistics

"In the context of companies or organizations, green logistics is one sustainable development concept that can solve environmental problems while maintaining the activities and economy of that organization and country within the processes of exchange goods and services (Zhang et al. 2012)." Additionally, green logistics also contributes companies to achieve effectively connected environmental protection and logistics development relationship and a balance between economic, environmental and social interests. (Xiu et al., 2011).

From the different definition, it could be concluded that, the green logistics aiming to reduce emissions of pollutants, reduce resource consumption, and eventually realizing sustainable development with an eco-friendly (Chunguang et al., 2008).

Green logistics is correlated to two others concept that focus on environmental issues in the context of supply chain: green supply chain management and reverse logistics

Green logistics and reserve logistics

Sometimes, the term *green logistics* is often used interchangeably with *reverse logistics*, but it should be clearly distinguished that; green logistics includes

logistics activities that are first motivated by environmental considerations in contrast to reverse logistics (Scott et al., 2011) which refers to (logistics) activities all the way from used products no longer required by the user to products again usable in a market (Fleischmann et al. 1997)". This term is used by Rogers and Tibben-Lembke by taking into account the differences between those two concepts (Figure 9) and use the term reverse logistics, while referring to the efforts in supply chain to reduce its environmental impacts. On the one hand, reverse logistics includes the efforts which were made to recapture value, when moving the goods from the typical place of disposal. On the other hand, green logistics or ecological logistics, refer, in the view of Rogers and Tibben-Lembke (2001), to the understanding and thus, the minimization of the ecological footprint of logistics, including the following activities: the measurement of the environmental footprint of different modes of transport, the ISO 14000 certification, and the reduction of energy usage for logistics correlated activities and materials usage. (Codruța et al., 2015).

Reducing operational costs and increasing value by reselling or recycling natural resources to cover any potential losses or operational costs included in reverse logistics concepts (Voigt & Thiell, 2004).

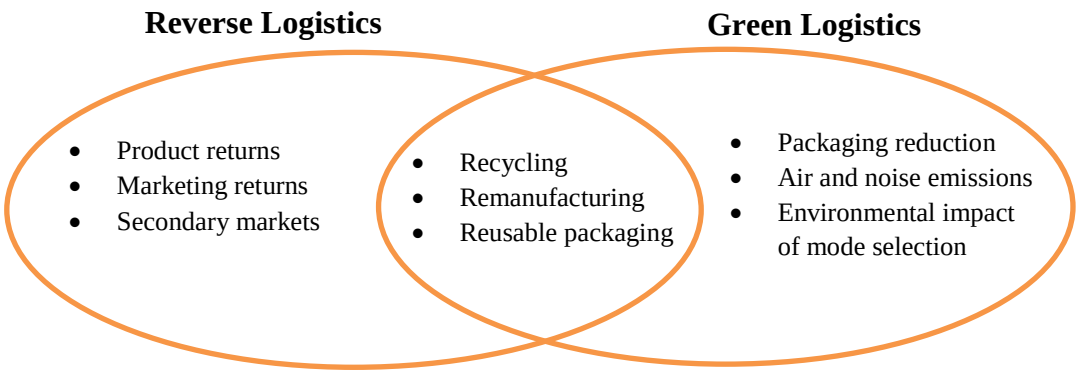

Figure 9: Comparison of reverse and green logistics (Rogers and Tibben-Lembke 2011).

Green logistics and green supply chain management

Based on the literature review, Green logistics and green supply chain management are two close concepts and even, sometimes the first concept is considered as a part of the second one. Indeed, Green supply chain management can be defined by the application of green logistics mentality concept through the supply chain management. As customers' awareness about environmental issues is increasing, companies need to adopt some changes and consider environmental impact problems over the different stages of their supply chain to satisfy their clients and even their governments.

Green supply chain management plans to limit or take out wastages including toxic substances, discharges, vitality and strong waste along store network, for example, item structure, material resourcing and determination, fabricating process, conveyance of definite item and end-of-life the executives of the item (Chin et al., 2015). It has been likewise characterized as 'coordinating ecological suspecting into green supply chain management, including item structure, material sourcing and determination, fabricating forms, conveyance of the last item to the shoppers just as end-of-life the executives of the item after its helpful life'.(Shrivastava, 2007)

Green supply chain management addressees respect and integration of environmental management within supply chain management to minimize the impact of the activities' negative externalities. At this stage, companies recognize and consider in their policies and mode of functioning, impacts of extraction of raw materials, transportation, manufacturing, distribution and other operational process through the supply chain on the environment.

Questions :

1) Which of the following is *not* a component of green logistics?
    a) Warehousing
    b) Transportation
    c) Supply chain security
    d) Waste management

Answer : c

2) Why are companies looking to have a green logistics instead of conventional methods?
    a) For sustainability for future generations
    b) For advertising for potential customers
    c) For reducing their impact
    d) All of these answers are correct

Answer : d

3) Which one of the followings are NOT one of the aims of the green logistics?
    a. Packaging reduction
    b. Air and noise emissions
    c. Environmental impact of mode selection
    d. Product returns

Answer : d

4) The goal of green logistics is to apply ecologically responsible practices that are encourage positive brand awareness for your business.

    a) True
    b) False

Answer : a

5) Implementation of green logistics is not only driving by the decrease of ecological footprint and the rising consciousness of environmental importance by customers.

    a) True
    b) False

Answer : a

6) Green logistics focuses on two main constituents: transportation and warehousing.

a) True
b) False

Answer : b

7) The application of green logistics strategies have no direct relationship with sustainable development.

a) True
b) False

Answer : b

8) Green logistics includes logistics activities that are first motivated by environmental considerations in contrast to reverse logistics.

a) True
b) False

Answer : a

9) Green logistics is a mean of competitive differentiation between companies, respect of government legislation in term of reducing the carbon footprint.

a) True
b) False

Answer : a

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Author :

Helmut PRENNER

2.2. Fields of action, stakeholders and requirements

The Fraunhofer Working Group for Supply Chain Services SCS published relevant figures on the topic "TOP 100 in European Transport and Logistics Services 2017/18":

The European logistics industry (considering 28 EU countries plus Norway and Switzerland) grew by 2.7% per year in 2015 and by around 2% per year in 2016. 2017 and 2018 were also forecast at around 2 %. A volume of 19 billion tons of goods was transported in the 30 European countries. In total, the logistics industry had a volume of around EUR 1,050 billion in 2016, and in 2015 logistics was above the growth in GDP of the European Union (Eurostat statistics at 2.2%). In 2016, logistics growth was in line with that of the European Union (Eurostat statistics 1.9 %).

Climate change, which includes man-made emissions of greenhouse gases affecting the energy balance of the atmosphere through the absorption of infrared radiation, is being addressed in detail.

The Austrian Federal Environment Agency discusses this as follows: This natural greenhouse effect causes the earth's temperature to rise to a global average of around +15°C. Without greenhouse gases, the temperature in the air would only be -18°C and life on this planet would not be possible. Climate-changing gases are: Carbon dioxide (CO_2), methane (CH4), nitrous oxide (N2O) and fluorinated gases (F-gases). Released greenhouse gases rise slowly in the atmosphere and can remain effective for a long time. The emission of greenhouse gases leads to global warming. Greenhouse gases from the use of fossil fuels for transport, buildings, agriculture, energy and industry are mainly responsible for global warming. The emission of

greenhouse gases has been increasing steadily worldwide since the beginning of industrialization. In 2015 a total of 78.9 million tonnes of greenhouse gases were emitted. In 2015, the main sources of Austrian greenhouse gas emissions including emissions trading were the following sectors: energy and industry (45.3%), transport (28.0%), agriculture (10.2%) and buildings (10.1%). These sectors are responsible for approximately 93.6% of greenhouse gas emissions.

Already in 2007, the Intergovernmental Panel on Climate Change (IPCC) mentioned that the transport sector is one of the main sources of CO2 emissions in logistics.

Central trends for sustainable logistics ;

1st trend: "Logistics is what counts - it is not a mass product".

The logistics industry is of great strategic importance for the development of a low-carbon economy. At present, logistics services are seen as a mass product, which must be exclusively cost-effective. In the future, the awareness of politicians, customers and the economy will increase, so that logistics services can provide solutions for a sustainable contribution. Logistics service providers become competent consulting partners who support their customers in improving the required CO2 balance. Leading providers will be those who can offer this type of service and not the cheapest solution. With environmentally friendly and efficient supply chains that create sustainable products, the logistics industry with its network industry can be seen as a partner in CO2 reduction. Customers also expect an (internal and external) orientation of logistics activities with regard to CO2 reduction. By optimizing supply chains, CO2 balances can be improved, costs reduced and quality improved. New market opportunities can be exploited.

2nd trend: "Technological change is achieved by the close cooperation of companies, financial institutions and the public sector".

Technological changeover is expensive. Business and politics are aware of the importance of sustainable solutions. Technological innovations for development are inevitable. However, only a single area is not able to switch to new technologies on its own. Therefore the promotion and cooperation of financial institutions, politics, business and the public sector is inevitable. A rethink is needed, longer payback periods for energy-saving measures must be accepted, politicians must create tax incentives and introduce appropriate environmental requirements that reward companies for CO2 reduction, financial institutions must promote sustainable business concepts.

3rd trend: 'Cooperative approaches are increasingly seen as levers for sustainability; even competitors will work more closely together'.

The more consciously the concern to reduce CO2 emissions is perceived, the more close cooperation develops. This is possible in existing supply chain cooperations between customers, suppliers and vendors. However, cooperation between companies that are perhaps even competitors also offers potential for CO2 reduction. Possibilities are: common warehouses and consolidated deliveries. This reduces costs, optimizes overcapacity and lowers CO2 emissions. However, the conditions are: compliance with the competition rules to ensure legal certainty.

4th trend: "The business models of logistics companies are changing as sustainable innovations open up new business opportunities".

The use of new technologies opens up new business models. E.g. the possibility of digital purchase of books and music, the use of e-vehicles which are legally allowed to be on the road at night in urban areas or Hyb-rid letter services which are transmitted in digital form to a mail distribution centre near the recipient.

5th trend: "CO2 labels are being standardised".

Buyers bring about change through their purchasing decisions. Buy sustainable solutions that are more expensive than non-sustainable ones and

demand more transparency about the product. Logistics companies will therefore recognise their common interest in recognised standards and work together. Governments will support this and promote international standards and labels for improved CO2 emissions.

6th trend: "CO2 emissions are being priced

As the importance of CO2 reduction increases for companies, customers and the public sector, emissions will become a fixed factor for price calculations. Therefore, the demand for a CO2 price is expected.

7th trend: "CO2 pricing will lead to stricter regulatory measures

Fair competitive conditions (common standards and rules) in the public sector are a prerequisite for companies to accept the CO2 pricing.

The logistics industry will be confronted with all these trends in the coming years.

This increasing value should strengthen the logistics provider as a partner for transport and network optimization in supply and distribution networks.

Stakeholders and their requirements

Experts now assume that Green Logistics will have a long-term impact on the logistics value chain.

The four **primary stakeholder groups** and their requirements for Green Logistics are:

Companies, customers, politics and society.

Stakeholders who can drive development forward are ;

Politics, political goals such as the efficient use of energy or the reduction of greenhouse gas emissions will lead to an internationalisation of costs in the future.

The state is able to exert pressure on logistics service providers and other companies through legislation to promote sustainable ecological development. Examples could be: carbon accounting, biofuels, border/access regulations to avoid empty runs, restructuring of air traffic control, promotion of renewable energies.

Companies which, out of responsibility and conviction, are themselves organising their logistics in a sustainable manner.

Society is demanding more corporate responsibility, and the tolerance for mobility restrictions and environmental pollution is decreasing.

Increasingly, customers are demanding certification proofs from companies, new possibilities such as measuring their own CO2 footprint and the development of energy costs and transport infrastructure.

Important criteria that can drive the rapid development of Green Logistics are

- State regulation (measures can put pressure on companies and the logistics sector - e.g. motorway tolls)
- The increasing customer requirements (certification proofs are required).
- The availability of natural resources.
- Social responsibility (awareness of environmental and resource protection is increasing; employees want to work in a socially and economically managed company).

The increasing awareness of the population will influence the actions of companies in the future. Companies will pay attention to lower emissions in the future.

Schaltegger and Sturm define the economic sensitisation of stakeholder groups, which are assigned to the various stakeholders, as follows:

- Logistics activities such as transport, handling and storage lead to resource consumption, emissions, distance/space consumption, infrastructure pollution and land consumption.
- Logistics managers expect financial losses in the future if they do not react to the trends in time. Losses can be cost increases due to loss of sales, lost revenues or profits. Additional costs are expected for the purchase of CO2 certificates in the case of CO2 trading in logistics. Industries with high energy and raw material consumption, complex transport structures and high delivery speeds will be particularly affected.
- Science and practice are showing increasing interest in sustainable logistics.
- Stakeholder pressure can be cited as a key driver.

What opportunities / risks result from green logistic ;

Chance:

- Efficient use of resources (cost savings)
- Consideration of ecological action as a differentiation strategy
- Sustainability strategies as a corporate goal
- Improvement of transparency in the supply chain
- Employee retention in the company

Risks :

- Benefits of Green Logistics investments difficult to measure
- Ecological action promotes a holistic and process-oriented view
- Missing standards (e.g. CO2 calculation)
- Cost increase due to too much consideration of the ecological aspect
- Implementation of Green Logistics is not possible at all hierarchical levels
- Corporate culture must exist or be created
- Long-lasting implementation process

Questions :

1) What is an opportunity from green logistic?
   a) Efficient use of resources (cost savings)
   b) Cost increase due to too much consideration of the ecological aspect
   c) Implementation of Green Logistics is not possible at all hierarchical levels
   d) None of the answers is correct!

Answer : a

2) What is a risk of green logistic?
   a) Improvement of transparency in the supply chain
   b) Missing standards (e.g. CO2 calculation)
   c) Improvement of transparency in the supply chain
   d) None of the answers is correct!

Answer : b

3) What is an opportunity from green logistic?
   a) Efficient use of resources (cost savings)
   b) Implementation of Green Logistics is not possible at all hierarchical levels
   c) Corporate culture must exist or be created
   d) Long-lasting implementation process

Answer : a

4) What is a risk of green logistic?

a) Cost increase due to too much consideration of the ecological aspect
b) Implementation of Green Logistics is not possible at all hierarchical levels
c) Employee retention in the company
d) None of the answers is correct!

Answer : b

5) Name a trend in sustainable logistics
   a) CO2 emissions are priced.
   b) C02 Emissions are prohibited by law
   c) CO2 emissions are recorded in statistics.
   d) None of the answers is correct

Answer : a

6) What is a primary stakeholder group?
   a) Suppliers
   b) Society.
   c) Tax office
   d) None of the answers is correct

Answer : b

7) Which factor does not belong to triple bottom line?
   a) Ecology
   b) Tax system.
   c) Economy
   d) None of the answers is correct

Answer : b

8) What is not a primary stakeholder group?
   a) Customers
   b) Society.
   c) Tax office

d) Policy

Answer : c

9) What is a risk of green logistic?

a) Efficient use of resources (cost savings)

b) Consideration of ecological action as a differentiation strategy

c) Sustainability strategies as a corporate goal

d) None of the answers is correct

Answer : d

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3. Components of Green Logistics

Author:

Helmut PRENNER

3.1. Green Transport

Transport has an influence on CO2 reduction. Between storage and transport an optimal means must be determined. For example, effective route and capacity management can improve sustainability performance and at the same time save costs by deploying the vehicle fleet accordingly.

Low-CO2 logistics services and flexible transport modes are not yet sufficiently available. A changeover from road to rail, for example, is only possible if the corresponding rail infrastructure is available.

Air freight and long-distance transport are challenging, as is the lack of alternative technologies. Produced products must reach the end customer. Therefore, an appropriate distribution network must be created. Relevant are the geographical locations of the distribution centres and warehouses as well as the choice of means of transport in order to reach all logistical nodes accordingly.

In order to be able to act sustainably, transport, warehouse management and their CO2 emissions must be taken into account.

For example, London Heathrow Airport commissioned DHL to operate a consolidation centre. Consolidations, security checks, booking of goods, deliveries to restaurants and retailers are carried out via this centre. Ecological and operational advantages were recorded.

3.1.1. Modal split

Mode of transport (railways, road transportation, air)

In transport science, the modal split refers to the share of individual means of transport or the distribution of total transport among the individual modes of transport. Another common term in passenger transport for Modal Split is "choice of means of transport". The modal split is the result of the mobility behaviour of people and the economic decisions of companies on the one hand and the transport offer on the other.

Modal split in the EU

Modal split of inland freight transport in 2012-2017: road transport continues to carry three quarters of freight in the EU

Road transport continues to have the largest share of EU freight transport performance among the three inland transport modes. In 2017, road transport accounted for over three-quarters (76.7 %) of the total inland freight transport (based on tonne-kilometres performed). This share increased by 0.5 percentage points (pp) compared with the previous year. The share of road has remained stable at around 75 % in recent years, fluctuating between 74.6 % in 2012 and 75.3 % in 2015.

Between 2012 and 2016, the share of rail in the inland transport performance remained relatively stable (between 18.5 % and 17.6 %). In 2017, rail transport accounted for 17.3 % of the EU total, slightly lower than the previous year (-0.3 pp). Between 2012 and 2017, the share of inland waterways in EU freight transport fluctuated between 6 % and 7 %, recording a share of 6 % of the total inland transport performance in 2017. Even though the modal split between the different modes of transport does not tend to change radically from year to year at EU level, changes are sometimes more noticeable at country level. As can be seen in Figure 2, the modal split at country level varies considerably. In particular, the modal split obviously depends on the availability of a given mode. Only 18 of the Member States report freight data on inland waterways. In particular, Cyprus and Malta do not have either railways or navigable inland waterways; thus, for these two Member States the share of road freight transport is 100 % by default.

Quelle: https://ec.europa.eu/eurostat/statistics-explained/index.php/Freight_transport_statistics_-_modal_split#Modal_split_in_the_EU

If the transport mix is planned efficiently, CO2 emissions or noise pollution can be significantly reduced. Speed and costs are always relevant, as is the sustainability concept in the form of CO2 emissions. Since in our time everything has to be done quickly (online ordering - delivery is expected promptly), the logistics industry has to go new and optimized ways. Since each means of transport has different characteristics, the optimum route must be found.

	Transport costs	Speed	CO2 Efficiency
Air	High	Fast	Less
Road			
Train			
Water transport	Low	Slow	High

The CO2 emissions from aircraft are high compared to other modes of transport, but they are expensive but very fast. Ships, on the other hand, have the lowest CO2 emissions but are cheap but very slow. Product-specific consideration must now be given to how to proceed.

Practical example: A lottery company in Montreal, Canada produces tickets for Christmas. The producer experiences a bottleneck and production is postponed by just under three weeks.

The order is placed on the basis of shipment to Hamburg, followed by transport by truck to the central warehouse in Wiener Neustadt.

Three weeks were planned by the logistics department as a safety buffer to start picking on time for an Austria-wide delivery. Since sea freight is now subject to another risk, namely the uncertainty of the weather (storms, no departure from the ports, no arrival at the port - subsequent postponed customs clearance, etc.), the

fixed promotion start was scheduled in good time before Christmas (TV, radio, print, etc.), it was decided to have the scratch tickets flown in.

The lots were now in the central warehouse before the planned delivery date, and the high transport costs were shared between producer and customer. The only disadvantage was the much higher CO2 emission.

Air cargo

Thanks to technological improvements in recent decades, the energy efficiency of aircraft has been improved. However, there has been an increase in air travel and air freight transport. Concepts for optimised network structures, improved capacity utilisation and the use of modern aircraft are constantly being worked on. The long lifecycles of aircraft that often far exceed 30 years are challenging. The "Open-Rotor"-Technology will be tested, which are engine architectures with opposing rehearsals. In this case, the reduction in energy intensity of around 25 - 30 % can be achieved. The disadvantages are the lack of compatibility with the current air traffic infrastructure, lack of certifications and availability, longer travel times and increased maintenance costs.

Rail transport

Trains are low CO2 means of transport. Each tonne-kilometer produces 24 grams of CO2 in rail freight transport, 88 grams of CO2 in trucks and 665 grams of CO2 in aviation. The better the load on trains, the better these values will be. Many governments are therefore aiming to accelerate the shift from road to rail.

Freight trains are often defined as slow means of transport associated with high noise pollution. In addition, they are bound to the fixed rails and therefore inflexible.

Considerations to transport goods by rail, e.g. from China to Europe (e.g. Beijing to Hamburg) over 10.000 km and 6 countries in 15 days is a big challenge like

different track gauges, different customs and security regulations. Nevertheless, this could already be implemented in the summer of 2013.

Road freight transport

Road freight transport is most frequently discussed in public. The transport sector is affected in the area of a process chain that is as emission-free as possible. There is already a large number of available or soon market-ready technologies which, when combined, can lead to a reduction in CO2 emissions: From 2030 Denmark wants to promote a ban on the sale of diesel and petrol cars and the use of electric vehicles.

From 2035, no new hybrid vehicles will be on the roads; Great Britain and France have already announced that no new diesel and petrol vehicles will be registered from 2040. The Danish government was criticised for increasing taxes on electric cars in 2016, which reduced sales of these vehicles. Denmark was one of the pioneers in the field of wind energy and wants to operate without fossil fuels by 2050. On 9 September 2018, the EU Environment Council under Austrian leadership reached an agreement on CO2 reduction for passenger cars and vans by 2030. A 35 percent reduction in pollutant emissions for cars was defined. The aim of CO2 reduction is to achieve a reduction in greenhouse gas emissions of at least 40 percent by 2030 compared with 1990 (Paris climate targets).

Shipping

Emissions from shipping are primarily caused by the emission of greenhouse gases and pollutants into the air atmosphere during the operation of motor ships. Ship emissions contain various types of pollutants, including sulphur oxides (SOx), nitrogen oxides (NOx), carbon dioxide (CO2), soot particles and particulate matter. The concentration of the emitted pollutant emissions depends on the fuels used, currently mainly heavy fuel oil (HFO) is used. Ship exhaust fumes also contain heavy metals, ash and sediments.

Worldwide, shipping is responsible for the emission of about one billion tons of carbon dioxide, which corresponds to 3% of total man-made CO2 emissions. In addition, it accounts for about 15 % of global nitrogen oxide emissions and 13 % of sulphur dioxide emissions, and the trend continues to rise. This is accompanied by environmental and health damage, especially in heavily polluted port cities or conurbations near port areas, where ship emissions are among the most important sources of pollutants. In order to reduce pollutant emissions in shipping, exhaust gas aftertreatment systems are being used in some cases, or more sulphur-reduced fuels (MDO) or low-emission fuels such as liquefied natural gas (LNG) are being used.

3.1.2. Technical developments for green transport

Rail transport

E-mobility on the rails

One possibility is to increase the degree of electrification of the lines. A future research focus could be the decarbonization of the railway (battery or fuel cell for transaction purposes).

Autonomous trains in France: tests to start in 2023

France develops prototypes for regional and freight trains. 57 million euros will be invested in the development of autonomous trains jointly financed by the state railway operator SNCF, the French state and industry. Existing models will be equipped with appropriate sensors and computer systems. Savings and punctuality on heavily frequented routes are expected as a result. For TGV high-speed trains, only acceleration and braking are to be automated for the time being. Companies such as Bosch, Thales, Spirops and Ansaldo are involved in the development of technology for autonomous trains. It is more complex than that of closed systems such as underground trains or airport shuttle trains. Autonomously running trains should recognize obstacles on the track and react accordingly.

Further considerations lie in laying freight trains underground in track pipe systems. They wouldn't be seen, heard or smelled. Many advantages such as fast

technical and legal realization without violation of citizen interests, simple implementation in traditional traffic systems and logistics concepts (compatibility), operational profitability, efficient and expandable, timely, weather-independent, minimized risk potential towards third parties, environmentally friendly (no pollution of environment and people during construction and operation), space-saving, environmental and health protection for the population through - reduction of traffic jams, accidents, air, noise and CO2 emissions and fine dust pollution are named by one of the manufacturers.

Road traffic

Hybrid and electric vehicles

Hybrid vehicles

The technology: The combustion engine is supported by a powerful electric motor. The battery of the electric motor is charged by the combustion engine. Fuel consumption is reduced by completely switching off the combustion engine at no or low drive power and at low driving speeds (city). When starting up and accelerating to approx. 20 km/h, fuel consumption is usually the highest, which also represents the greatest environmental and climate impact. The kinetic energy (rising heat) from the braking process is used to charge the energy accumulator and the energy accumulator is charged. This enables a regenerative braking system. Inefficiencies due to underutilization can be reduced. The reason given for this is that the internal combustion engine is smaller and less powerful, and the electric motor supports optimum speed ranges.

The corresponding area of application in the urban area is for smaller trucks (7.5 to 12 t) which make frequent stops and drive less kilometres. The possible savings potential is between 15 and 30 percent (depending on the manufacturer and application).

In long-distance traffic, where fewer stops and higher continuous speeds are driven, the hybrid drive is therefore less suitable. Hybrid cars are much more expensive to buy than ordinary cars. Currently, the lower fuel consumption will not

compensate for these additional costs. The following aspects have a negative impact on the life cycle assessment: As these vehicles have a double drive train, which provides more weight, this has a negative effect on fuel consumption during longer journeys. The tank is usually smaller than on standard models. This results in shorter ranges. The battery needs space, therefore, the boot volumes are often small. The biggest problem is the production of the electric motor with its batteries which requires raw materials that are dwindling (rare earths) and massively polluting during mining.

Production is very energy-intensive, after a few years they have to be replaced and recycled. For hybrid cars that are fuelled with electricity (plug-in), it is also relevant which electricity (green electricity, nuclear electricity) is being fueled. (The electric motor of hybrid vehicles is usually not charged at charging stations, the motor charges while driving via a dynamo). Meanwhile, there are gasoline hybrid and diesel hybrid vehicles. Fuel savings are low and less nitrogen oxides are emitted than with pure diesel engines. Compared to an electric car, you don't have to rely on electricity charging stations.

Electric vehicles

By 2015 more than 1 million electric vehicles were on the roads worldwide, and by 2016 more than 2 million. More than 1.2 million were sold in 2017.

A study by virta says: "China has made remarkable investments in electric mobility. The number of registered e-cars increased by 69% in 2015 and 2016". By comparison, the US electric vehicle market grew by 38%. In Europe, e-cars have so far only been popular in a few countries: Norway, the Netherlands, Great Britain, France and Germany. Norway in particular is a pioneer and presents electric vehicles that pay off even at cold temperatures and long distances.

In the first quarter of 2017, 80 % of sales in this vehicle segment covered only four brands (Renault, Nissan, Tesla and BMW). The criteria for the purchase of an electric vehicle are falling prices, increased range, larger model selection and improved charging structure.

Electric cars cost about a third more than the same models with combustion engines. According to the Virta study, purchase price parity is to be achieved between 2022 and 2025.

New models with better ranges are constantly coming onto the market. Tesla is currently the leader; other manufacturers focus on battery optimization or the development of faster chargers. The manufacturers focus on the diversity of variants. In 2020, it will be possible to purchase vans with ranges between 80 and 600 kilometres as well as electric sports cars. Government and companies are constantly investing in the lack of charging infrastructure in order to expand it further. In Europe, the most important incentives for buying an electric vehicle are mainly financial aspects. Norway already supports e-drivers with goodies such as the use of bus lanes or special parking spaces.

Electric trucks

Trucks powered by electricity are also continuously tested. The advantages of using these vehicles are that neither noise nor exhaust emissions are produced, and the consumption of diesel is reduced. In economic terms, the total cost of living of electric vehicles is higher than that of diesel vehicles.

One obstacle is the lack of charging infrastructure. For charging vehicles to be able to be charged with electricity overnight, charging stations in consolidation centres or depots would have to become the standard. Work is still in progress on range and performance. MAN, the truck manufacturer, has handed over nine electric trucks to customers from 18 companies (trade, production and logistics). In 2019 the trucks are to go into small series with 50 to 100 units, by 2021 the goal is to produce four figures. Under optimum conditions, a range of up to 200 km can be achieved. The fast charging time is one hour. Compared to a diesel-powered truck, a reduction of 40 percent in CO2 emissions has been defined, and the noise level has been reduced by 19 percent.

Fuel cell vehicles

In fuel cell technology, a chemical reaction between hydrogen and oxygen generates electricity. This is forwarded to the engine and drives the vehicle. The hydrogen with which the fuel cell is operated can be generated from wind and solar energy, which means a 100% CO2 reduction.

High costs and technical uncertainties accompany this technology. The investment in a vehicle is six times as high as the investment in a conventional vehicle. The lack of refuelling facilities, the need to store hydrogen in vehicles and safety concerns in the handling, storage and production of hydrogen are challenges. The fuel cell is quiet and completely emission-free, only water vapour is produced. Because of these challenges, Magna developed a hydrogen hybrid, FCREEV (Fuel Cell Range Extended Electric Vehicle) vehicle. It is a battery-operated vehicle with a fuel cell range extender. This car can be refuelled in only 4 minutes, the advantages of the higher energy density of hydrogen were combined with the existing charging infrastructure of electric charging. Long ranges can thus be achieved.

Alternative fuels

Alternative fuels are constantly being tested. The aim is to find technologies that are more economical and environmentally friendly. One of the reasons is that the use of small electric vehicles is more effective than the use of electric propulsion in the case of polluters with high CO2 emissions, such as lorries. Case study: Deutsche Post: 20% of the vehicle fleet consists of trucks, but these are responsible for 80% of the Group's total emissions. Natural gas vehicles were introduced to the market as early as 1995. This technology combines the lower carbon dioxide emissions of diesel engines with the lower nitrogen oxide emissions of petrol engines. At the same time, a significant reduction in noise emissions was achieved. Since high initial investments and high fuel consumption were combined with additional maintenance costs and a loss of payload capacity, this technology was not successful at the time. This technology has been continuously developed and today natural gas cars are

produced in two designs (monovalent or bivalent). This means either with pure CNG drive (Compressed Natural Gas) or with additional combustion engine.

Biofuels

Biofuel" means a liquid or gaseous fuel for transport, produced from biomass, used as a fuel or fuel component for the operation of internal combustion engines of vehicles.

Body design

The size and weight of vehicles influence fuel consumption and greenhouse gas emissions. If the vehicle weight is reduced by 20% - 35%, fuel consumption could be reduced by 12% - 20%. Many vehicle components can be designed more cost-effectively and efficiently. Capacity optimisation projects are also carried out on an ongoing basis where existing trailers and semi-trailers are integrated into a longer and heavier truck. Loading capacity is increased, truck traffic is reduced overall and emissions are reduced. The infrastructure is problematic here - such as roundabouts that are too narrow or narrow bridges. These solutions would be ideal for hub-to-hub transports or connections to ports.

Aerodynamics

Air resistance is responsible for a considerable proportion of greenhouse gases in truck transports. This represents approx. 40 % of the fuel consumption. This is particularly evident at faster speeds such as on motorways. Therefore, the manufacturers continuously optimize the design of the trucks in order to optimize loading capacities and minimize fuel consumption. Trailers, for example, are higher than usual at the front and lower at the rear. The aerodynamics are improved by side sliding tarpaulins.

The investment costs of approx. 10,000 € amortize over a period of approx. two and a half years, the CO2 efficiency is improved by approx. 11.3 %.

Self-propelled trucks

The company Volvo presented a prototype of a self-propelled all-electric and autonomous electric truck without a driver's cab.

Source: Volvo in: http://www.autobild.de/artikel/e-lkw-konkurrenz-fuer-tesla-e-truck-3922499.html, (18.9.2018)

This truck is to be used for short distances in urban areas, e.g. for the removal of goods from large logistics centres or in the vicinity of ports. As advantages Volvo mentions, the trucks can operate around the clock because they are quiet and do not require human drivers. Trucks on the same route can exchange traffic data with each other in order to further optimise the flow of goods. The autonomous truck fleet is controlled from a central point at the starting point. Here, important data such as battery charge or charge should be visible at all times. In the future, the concept could be extended to other logistics scenarios.

A study by PwC shows cost savings of 47 percent for the use of automated trucks. This means that logistics costs could be almost halved by the year 2030. By 2030, autonomous trucks could be on the move 78 percent of the available time instead of 29 percent today. This is justified by the elimination of rest periods for drivers and the elimination of idle times due to the use of algorithms. A saving of approx. EUR 30,000 per vehicle can be achieved by eliminating the driver's cab. Although the necessary technologies for autonomous driving have incurred additional costs of approx. EUR 23,000 per truck, the study shows that prices for trucks will fall by approx. 7% overall.

Shipping

Ship propulsion by wind power

The oil needed to power the ships will become increasingly scarce and expensive in the future. The technological development of ships, as in land transport, deals with the innovation of propulsion systems, alternative fuels and hydrodynamic design. Fuel technologies represent a possible approach to minimising ship emissions and are therefore already being used commercially. There is no mass production of maritime fuel cells, the short service life and the high investment costs are hurdles.

Wind power can therefore be regarded as an optimal alternative. The disadvantage of wind power is its difficult use in inland navigation. The confrontation with bridges and power lines presents a challenge when navigating canals and waterways.

The Hamburg company SkySails used the cheapest, most environmentally friendly and strongest energy source on the water - wind. Modern cargo ships use the wind as a source of propulsion, save considerable fuel costs and thus reduce emissions. This is done using a towing kite with rope, a take-off and landing system and a control system for automatic operation. Installation is possible on newbuildings or existing ships. The SkySails-System pulls the ship using large, dynamically flying

towing kites, which generate up to 25 times more energy per square metre than conventional sail propulsion systems. This corresponds to a drive power of up to 2,000 kW in good wind conditions. One kilowatt hour of power costs only 6 US cents, half the cost of one kilowatt hour of the main engine. A study shows that this technology can save up to 100 tons of climate-damaging CO2 emissions worldwide. The operation is carried out by the crew via the control panel, the take-off and landing process is partially automated and takes approx. 15 minutes.

Picture: SkySails

Source: SkySails (2018), https://www.skysails.info/skysails-marine/skysails-antrieb-fuer-frachtschiffe (18.10.2018)

The folded towing kite is lifted out of the towing kite stowage with the telescopic mast, the telescopic mast extends - the kite unfolds, the launch takes place.

During flight operation, the towing kite is permanently controlled automatically. The autopilot program lets the towing kite fly defined manoeuvres depending on wind direction, wind force and ship speed, so that optimal propulsion is generated.

Sail rotors

The sail rotor technology works with the Magnus effect: When the wind blows against the rotating cylinders, it is accelerated. The wind is braked on the opposite side of the cylinder. The combination of faster and slower flow generates power. The Danish shipping company Moller Maersk is currently testing a novel sailing ship together with the Finnish company Norsepower, the oil company Shell and the British energy agency ETI. Two carbon sails in the form of a cylinder are installed on a tanker. By means of rotation, they should reduce the fuel consumption of the 110,000 ton tanker by around 10 percent.

Pure Sail Freighter

Pure sail freighters such as the Atlantis Zeilende Handelsvaart" are also used. However, containers cannot be transported here. These are CO2-free, but dependent on the wind.

3.1.3. Organisational measures for green transport

Route planning

Route management systems have been developed as the majority of transport takes place by road. The aim of these is to optimise transport routes, drive only the actual kilometres required, provide the truck with real-time information quickly, cost-effectively and in an environmentally friendly manner, taking into account traffic jams, diversions and additional pick-up orders. In addition, this system makes it possible to meet with other networked vehicles and exchange goods at certain points at the optimum time. This Smart-Truck system thus enables a reduction in mileage, improved service quality and, above all, a reduction in CO2 emissions of approx. 10 - 15 %. Every avoided driving kilometre reduces pollutant emissions. Also through the

use of simpler positioning and communication technology, dispatchers can obtain information at any time about where which vehicle is located. Thus, short-term orders can be solved efficiently, and the total mileage of the vehicle fleet is minimized.

Eco-driving

To a large extent, the driving style is decisive for influencing fuel efficiency. References to current fuel consumption or emissions can influence the driver's awareness of the consequences. Start-Stop systems support stopping the engine where it is necessary and restarting it quickly. Indications of whether the appropriate gear has been selected to achieve maximum fuel efficiency support the driver. Another positive effect is that the risk of accidents and stress can be minimized. Technically, eco-driving can reduce fuel consumption by up to 20%, in practice the effect is around 7%, as people often revert to their old habits. There are modules that can be installed in the vehicle that collect information about the driving behaviour by means of sensors and only allow the driver to call up a report online.

Empty trips

Many logisticians aim to optimally utilise means of transport such as trucks, trains or containers. Sustainability can be found in the optimisation of the loading factor in both the economic and ecological spheres. However, every carrier has to decide for himself whether he wants to invest more time in loading and consolidation times or in the amount of payload. Empty runs result from various circumstances such as poor planning and coordination of purchasing and sales, fluctuations in demand, restrictions on vehicles, just-in-time deliveries or restrictions on transfer to other countries. Cooperation between different companies can be supportive with regard to high fuel prices and vehicle utilisation (e.g. suppliers in a supply chain).

Optimal use of loading space

Another possibility of green transport is to use the loading space more efficiently. Two different areas are distinguished here:

- the double-deck loading,
- and the self collection in the factory traffic.

With double-deck loading, two or more pallets can be stacked on top of each other in the loading space of a truck. This is done by means of a separating device. However, it is essential to ensure compliance with the EUL standards (Efficient Unit Loads) in order to guarantee a smooth process.

In the case of self-collection, the trading partner collects the goods from the producer himself using his own fleet in the factory transport... The transport bundling is carried out by the industry. This means a common delivery, which is to take place by means of pooling and the use of common warehouse locations. Thus, the product is already bundled by the industry and a joint delivery to the trade takes place.

Use of Ecocombi /Gigaliner

The EuroCombi is a truck with a total length of 25.25 metres. This has the possibility to transport a total ton weight of maximum 60 tons, whereby the demand for increased volume is significantly greater than for increased tonnage. This corresponds to 56 pallet spaces. The calculation here is: three trucks become two trucks (EuroCombi). Due to the necessary safety distances between all road users, the EuroCombi requires significantly less space for the same number of goods than trucks currently require.

The introduction of the EuroCombis (Gigaliners) is generally considered worthy of support, although this would only make sense on certain sections of the route where the necessary infrastructure already exists (crossings, roundabouts, bridge loads, etc.).

However, it should be said that both in simulations and in reality, the EuroCombi is only suitable for long distances in the range between 300-800 km (warehouse-storage traffic), since certain infrastructure challenges must be met. This includes, among other things: intersections, roundabouts, bridge loading, creation of suitable parking spaces, etc.

The EcoLiner has been approved in Sweden and Finland since 1970 and is currently being tested in the Netherlands, Germany, Belgium, Denmark and France.

The biggest problem with the EuroCombi, however, is its social and political acceptance.

Combined transport

The following systems belong to the combi-traffic:

Ro/Ro	Roll on/Roll off
WAB	Swap bodies
ROLA	Rolling Road
Container	Container traffic

Within the transport chain, the goods themselves remain unaffected by this process, so that one can speak of door-to-door traffic. All these superstructures are during the whole transport sometimes part of the truck, railway wagon, ship.

As a further point, the individual advantages and disadvantages of combined transport, i.e. the combination of two or more modes of transport, were listed, which are now discussed in more detail in this chapter.

The first question was why combined transport should be used at all. Reasons for combined transport include the following:

- Driving bans (overnight / peak times)

- Reduction of road taxes / tolls

- Public opinion against transport (especially road transport)

- congestion

- Development of energy costs

- Ecological Footprint

- lack of drivers

- Additional loading capacities with fixed departure and transit times

- Environmentally friendly transport alternative

- No driving ban at night, on weekends or on public holidays

- Higher capacity utilization (up to 36 Euro pallet spaces or 29 tons) loading weight)

The use of combined transport is seen as a positive instrument for sustainable transport for distances over 300 km. Further requirements are for this:

-infrastructure of the terminals

-Sufficient capacity of wagons

-Technical equipment

-Competitive rates for rail and terminal services

-Time flexibility (e.g.: evening delivery / night jump)

Case examples green transport

DB Schenker - Green Logistics ECO Program

DB Schenker has set itself the goal of reducing specific CO2 emissions by 20% by 2025. This is achieved by the following main measures:

- Modern vehicles,
- Increasing renewable energies,
- Networking and relocation,
- Environmentally friendly products,
- Energy-saving driving style and optimized capacity utilization.

These are the building blocks for less CO2 on land, at sea and in the air. Under the names Umwelt-Plus and Eco Plus, Deutsche Bahn offers its customers a wide range of CO2-free offers in both passenger and freight transport and turns its customers into climate protectors - from freight transport, to travel to and from various events and natural areas, to school trips and business trips. DB purchases electricity generated from renewable sources and feeds it into the traction power grid.

There, renewable energy replaces electricity from other sources. In contrast to compensation measures, no CO2 emissions occur in the first place.

Thus, the Green Logistics Network was founded, which includes the following subareas:

- Green Road,
- Green Rail,
- Green consulting,
- green monitoring
- Green terminals.

For example, Green Consulting calculates and analyses CO2 emissions for the customer and works out ways to reduce them.

Under the Green Road and Green Rail concepts, existing transports are diverted to less CO2-causing modes of transport. This results in a positive effect in the form of a CO2 balance both for DB Schenker and for the customer.

Mars Austria

The food manufacturer MARS Austria has introduced a new method to measure and present the effects of different ordering and distribution processes on CO2 emissions.

The concept called Green Order was developed by MARS in the Netherlands.

The aim here is to reduce CO2 emissions during the delivery of goods through improved coordination between all partners in the logistics chain. Thus, the CO2 emission is measured with each transmission. This data is collected from all deliveries and then used. This means that a common catalogue of measures can be drawn up on the basis of these measurements, which can reduce CO2 emissions.

Some collaborative measures are already in place to help minimise the environmental impact.

Forwarding company Schachinger

With the transition to the next generation, sustainable economic activity has been expanded since 2005 through the following measures:

- Participation in all renowned committees for sustainable logistics in Austria.

- Efficient sidings for the most important warehouse locations.

- New construction and refurbishment for best process and energy efficiency.

- Preparation of the most ecologically & socially innovative high-bay warehouse in Europe.

- Supply of all beverage and coffee vending machines as well as company kitchen with mostly regional and >50% organic/fair trade food.

Under the title "Green Distribution Initiative", the logistics service provider Schachinger has integrated brands & fresh relevant measures in the area of food logistics into an overall sustainability process and implemented them step by step.

1st measurement: The CO2 emissions per pallet delivered are recorded both on the delivery note and as a whole in a monthly sustainability report based on the number of delivery tours.

2. control: Due to the high bundling rate of over 90% for the food delivered, direct distribution largely eliminates the need for a CO2-intensive on-carriage from a regional transshipment point.

3rd design: The existing refrigerated truck fleet was optimised by a bundle of technical efficiency measures and gradually converted to regional vegetable oil.

4th optimisation: Through co-packing activities directly at the logistics locations and increased capacity utilisation through consignment bundling and the use of double-deck technology, truck journeys can be avoided. In addition, returnable transport systems are used.

Truck WALTER - Green Transport

LKW WALTER has been dealing with environmentally friendly transport solutions since the early 1980s. Trucks, trains and ships are intelligently linked together. This makes LKW WALTER one of the largest participants in European combined transport.

By shifting road transport to rail and ship in combined transport "rail/road" and "short sea", a major contribution is being made to reducing CO2 emissions. LKW WALTER achieves a CO2 reduction of over 114,500 tons per year.

The brand "GREEN Transport" stands for the following contents:

- Increased use of low-noise and low-emission trucks (EURO 5/6)

- Ongoing investments in state-of-the-art combined transport equipment

- Continuous expansion of the rail/road combined transport network

- Even greater use of the environmentally friendly "Short-Sea Shipping" transport alternative

- Optimisation of transport planning - further reduction of empty kilometres

Questions:

1) **What is the modal split?**
   a) Distribution of traffic between the different modes of transport
   b) Share of road transport in total traffic volume
   c) Share of rail transport in total transport volume
   d) Share of air transport in total traffic

Answer: a

2) **Which modes of transport have a high Co2 efficiency?**
   a) Road traffic
   b) Rail transport
   c) Air traffic
   d) Maritime transport

Answer: d

3) **Which mode of transport has the fastest speed?**
   a) Road traffic
   b) Rail transport
   c) Air traffic
   d) Maritime transport

Answer: c

4) **Which means of transport has the lowest speed?**
   a) Road traffic
   b) Rail transport
   c) Air traffic
   d) Maritime transport

Answer: d

5) **Which modes of transport produce the most costs?**
   a) Road traffic
   b) Rail transport
   c) Air traffic
   d) Maritime transport

Answer: c

6) **Which modes of transport produce the lowest costs?**
   a) Road traffic
   b) Rail transport
   c) Air traffic
   d) Maritime transport

Answer: d

7) What is Open Rotor Technology?

a) This is a new technology to improve aircraft engines.
b) This is a new technology to improve engines on ships.
c) This is a new technology to improve engines in railway locomotives.
d) This is a new technology to improve engines in trucks.

Answer: a

8) Which mode of transport produces the most CO2 overall?

a) Road traffic
b) Rail transport
c) Air traffic
d) Maritime transport

Answer: a

9) How much CO2 does shipping produce worldwide?

a) 1 %
b) 3%
c) 5%
d) 8%

Answer: b

10) What is meant by hybrid technology in vehicles?

a) Motor is driven by current
b) Combustion engine supported by electric motors
c) Motor is driven by hydrogen
d) none of the answers is correct

Answer: b

11) How much C02 can be saved with an electric truck compared to a diesel-powered truck?

a) 30%
b) 40%
c) 50%
d) 60%

Answer: b

12) By how much can the noise be reduced with an electric truck compared to a diesel truck.

a) 5%
b) 19%
c) 24%
d) 28%

Answer: b

13)How do fuel cell vehicles work?

a) A chemical reaction between hydrogen and oxygen produces electricity.
b) A chemical reaction between hydrochloric acid and oxygen produces electricity
c) A chemical reaction between nitrogen and oxygen produces electricity.
d) A chemical reaction between carbon and oxygen produces electricity

Answer: a

14) What are biofuels?

a) Biofuels are liquid and gaseous fuels produced from natural gas.
b) Biofuels are liquid and gaseous fuels produced from biomass.
c) Biofuels are liquid and gaseous fuels produced from hydrogen.
d) Biofuels are liquid and gaseous fuels produced from crude oil.

Answer: b

15) 30% reduction in vehicle weight can reduce the fuel consumption of a truck by how much?

a) 3%
b) 5%
c) 12%
d) 28%

Answer: c

16) What is tour planning?

a) Plan transport routes in order to only drive the kilometres actually required
b) Plan transport routes to optimize delivery times.
c) Plan transport routes in order to optimise the utilisation of vehicles
d) All answers are correct

Answer: d

17) What is the start-stop system?

a) Traffic light controlled traffic control
b) Congestion warning
c) Slow driving on the motorway
d) Automatic engine shutdown to save fuel

Answer: d

18) What is double-deck loading?

a) Loading of 2 pallets on top of each other
b) Loading of 3 pallets on top of each other
c) Loading of 4 pallets on top of each other
d) Loading of 2 pallets on top of each other with separating device

Answer: d

19) How many tons can you transport with a Euro Combi truck?

a) maximum 20 tonnes
b) maximum 30 tonnes
c) maximum 40 tonnes
d) maximum 60 tonnes

Answer: d

20)How many pallets can you transport with a Euro Combi truck?

a) maximum 20
b) maximum 30
c) maximum 40
d) maximum 56

Answer: d

21) What is Ro/Ro Transport?

a) Container transport
b) Transport with trucks
c) Transport by rail
d) Roll on Roll off Transports

Answer: d

22) At what distance is the combined transport sustainable?

a) 100 kilometres
b) 200 kilometres
c) 300 kilometres
d) 400 kilometres

Answer: c

23) At what distance is Gigaliner transport sustainable?

a) 100 kilometres
b) 200 kilometres
c) 300 kilometres
d) 400 kilometres

Answer: c

24) Which mode of transport has the lowest CO2 efficiency?

a) Road traffic
b) Rail transport
c) Air traffic
d) Maritime transport

Answer: c

25) Which mode of transport has the best CO2 efficiency after sea transport?

a) Road traffic
b) Rail transport
c) Air traffic
d) Maritime transport

Answer: b

26) Which mode of transport has the lowest CO2 efficiency after aviation?

a) Road traffic
b) Rail transport
c) Air traffic
d) Maritime transport

Answer: a

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Author:

Helmut PRENNER

3.2. Green Warehouse

Using energy efficiently has not been a top priority in the operation of logistics centres up to now. As a rule, storage facilities have been designed primarily for high performance. However, due to extremely fluctuating energy prices and increased environmental orientation of companies, the issue of efficiency is increasingly coming to the fore. Pure high performance without efficiency is out. More and more companies are checking the energy consumption of their activities. Some for cost reasons, others to protect the climate with publicity. For example, the mobile communications provider O2, together with its service provider DHL, put the first "climate-neutral logistics centre" into operation on November 2018.

In addition to sales areas, production and transport, the warehouse is the fourth large.

Energy consumers in the supply chain. A recent study by Deutsche Post showed, for example, that 24 percent of greenhouse gas emissions (CO2) from parcel deliveries are caused by parcel and sorting centres, 76 percent by transport logistics.

Energy efficiency in the warehouse can save cash and contribute to climate protection: there is a lot of potential for savings both in the structural conditions and the intelligent warehouse management as well as in the use and procurement of new industrial trucks.

The ideal goal of Green Logistics in the field of storage is the so-called Green Warehouse, a warehouse, which, through the sum of all environmental measures, has become a profit for the environment.

In the theory of this model, a subdivision into a macro-perspective is discussed, which captures the concerns of environment and society (one could also

a horizontal plane), on the other hand a micro-perspective (one can speak of a could also speak of a vertical level), which would make the measures on and in the storage and thus allows classification into the respective level.

The macro-perspective includes above all the choice of location and its effects on land use (sealing, water management and recycling), the environment (choice of location, impairment of the landscape and mobility concept) and ecology (biodiversity, landscape design). Particularly noteworthy for logistics in general is the

The choice of location, which will be discussed below.

In addition, on a second evaluation level, the so-called micro level, there is a cate the warehouse stages, which are based on the criteria of energy, water, and the land or building fabric. Three different stages are subdivided into divorced:

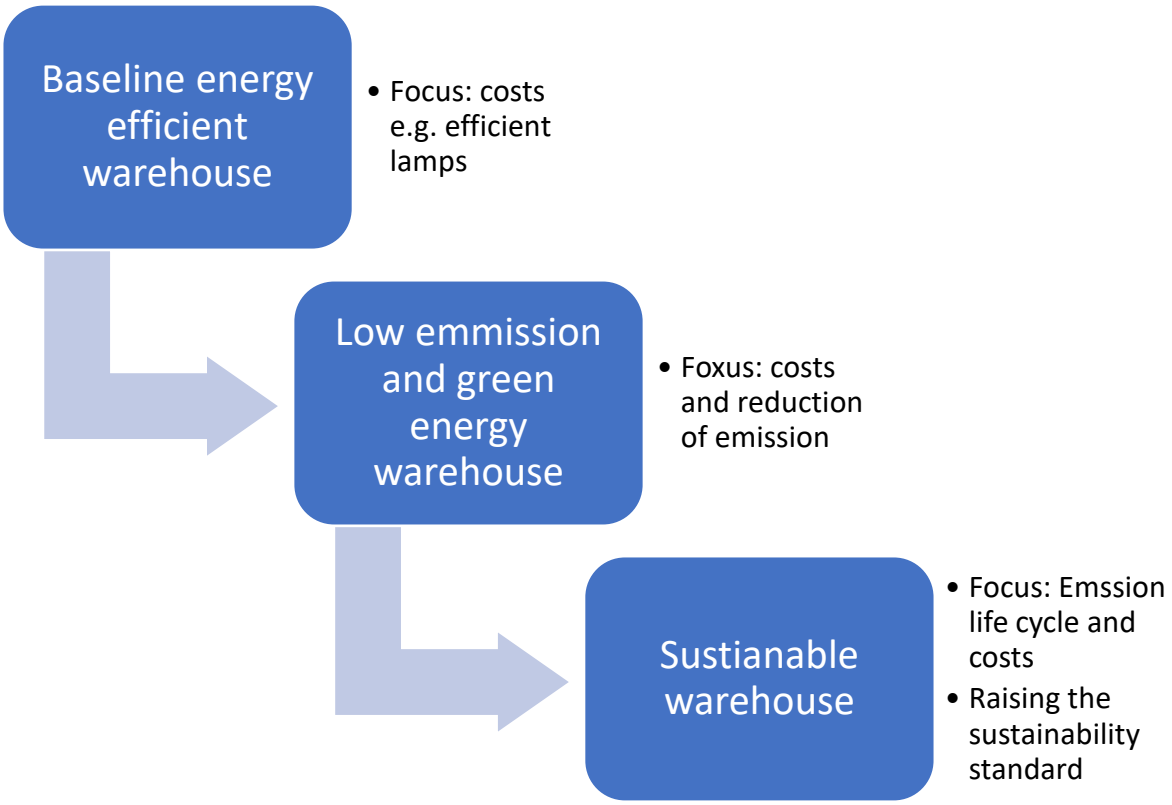
1. Baseline energy efficient warehouse: At this stage, energy efficiency is the most important issue.

   İn the foreground, i.e. the idea that emissions should be reduced through the efficient use of energy resources (light, water, heating) can be reduced. The kus lies on the costs, which are to be reduced in such a way, that it is possible for every of the company is of interest to strive for storage in this category.

2. Low-emission and green energy warehouse: This storage stage expands the range of focus on reducing the emissions of a storage. Emissions should be avoided by using energy from regenerative energies which are have a better CO2 balance (e.g. solar and wind energy). Likewise, through training of employees and environmentally friendly materials of the working the emission of the storage can be reduced.
3. Sustainable warehouse: This storage stage represents the entire life cycle of the warehouse.

Emissions and cost reduction, Water and heat recovery, energy generation from renewable energies, regional origin of and use of energy-efficient materials and supply chain management while raising sustainability standards at the same time are the measures used by green logistics for sustainable storage.

The following diagram illustrates that warehouses are located in different countries to the steps. Depending on which measures a company implements the next higher level can be reached.



3.2.1. Macro perspective: location selection

Before a company decides to set up a warehouse, the question remains as to where the warehouse should be located. The choice of location is a fundamental decision. Wrong decisions can lead not only to unnecessarily long transport routes.

Reduce customer satisfaction and increase CO2 emissions. In order to select an optimal warehouse location, various influencing factors must be taken into account.

Selection of a storage location such that:

- the operational requirements
- to one location and
- the actual characteristics
- of a site
- are optimally matched to each other.

5 phases of task fulfilment:

Catalogue of determinants/influences/"factors" on which the suitability of a site depends

o Location factor catalogues

o Desired levels / directions

o The determinant values

o Company specific requirement profile

Identification of all potential operational sites

Usually pre-select a smaller number of potential sites to be shortlisted.

Evaluation of all locations according to the requirement profile

Selection of a location with the best possible suitability profile

Benefit analysis

Value analyses are a proven tool for decision-making. Very often, the terms scoring models or point evaluation procedures are also used as synonyms for utility analyses.

The utility value analysis can be characterized as a decision-making procedure that arranges action alternatives with respect to multiple objectives,

regardless of their monetary quantifiability, and according to the preferences of the "evaluators" (decision makers), whereby the order is represented by utility values.

Procedural steps

(a) The definition of criteria for the evaluation of each alternative

(b) Weighting of the criteria

(c) Evaluation of possible characteristic values of the criteria

(d) Determination and evaluation of the characteristic expressions of the individual alternatives

(e) Model verification (sensitivity analysis)

(f) Assessment of the result

Definition and order of criteria

There are different procedures for defining the criteria. Brainstorming is a frequently used method. Another approach is to derive a criteria system from a target catalogue. In this process, successive objectives are operated, whereby a hierarchical criteria structure is advantageous by superimposing and subordinating the objectives. This systematic approach is to be applied especially when a high number of evaluation criteria is to be expected.

Weight

Criteria weights indicate the relative importance of each objective in relation to all other objectives.

The weighting of the individual criteria is one of the main difficulties in applying the utility analysis, as the user is forced to bring subjective values into a quantitatively unambiguous weighting scheme.

When weighting the individual criteria, a distinction can be made between an intuitive and a systematic-rational one. With the former, a "purely emotional"

allocation takes place and is characterized by the fact that the mental procedure is usually not comprehensible. In order to prevent the associated possibilities of manipulation, systematic procedures are proposed in the literature.

a) Direct weighting

The criteria are first ranked and then given weights according to their subjective importance.

b) Absolute weighting

The first step is to define weighting standards and then to assess the criteria according to their importance and provide them with appropriate weights.

c) singular comparison

In comparison to the previous procedures, a so-called intermediate weighting step takes place after the ranking, whereby the criteria are given weighting figures measured against an overall objective. The most important criterion receives 1, and then descending. Then the factors are to be normalized in such a way that their sum results in 1.

d) Matrix procedure

In a first step, the individual target criteria are written among each other and compared in pairs. In the process, it is noted which criterion is preferred in the direct comparison. The weighting of a criterion is calculated from the ratio between the number of entries of a criterion and the total number of all entries.

Calculation of utility values

The calculation of the utility values is done by multiplying the criteria evaluation with the corresponding weighting of all alternatives. The alternative with the highest utility value is preferred. Details about the analysis are provided by the so-called sensitivity analysis. To put it simply, it examines how the result affects the

change in the data by one unit, which provides information about the stability of the solution found.

In contrast to many other methods, the utility value analysis also includes subjective criteria in the decision selection in addition to objective criteria. This also corresponds to practice. Hardly any decision is made only on purely objective, clearly measurable factors.

Another practical point is that not all factors are equally important when deciding whether or not to buy a forklift truck. Probably the cost factor will have a higher weight than the design of the vehicle, etc.

Example: Warehouse Location Evaluation

A company is planning to build a warehouse. Four locations can be considered, which are evaluated according to six different criteria, each with a different weight. Each site is rated on a scale of 1 (poor) to 9 (very good) for the individual criteria. The following table summarises the ratings.

		Evaluation			
Criterion	**Weighting**	**A**	**B**	**C**	**D**
Labour market	0,25	9	5	6	8
Transport routes	0,20	6	6	5	4
Proximity to suppliers	0,20	3	4	4	6
Proximity to sales market	0,15	7	4	6	5
Quality of life	0,10	3	4	6	1
Tax burden	0,10	3	7	7	5

3.2.2. Micro-perspective: Buildings

Internal building efficiency.

This perspective includes energy-efficient lighting technology and heating and cooling systems equipped with intelligent control (Burn Less), as well as the use of electricity from renewable sources such as wind, hydro, solar and biomass (Burn Clean).

Concrete measures in this respect are: Intelligent lighting and control systems, efficient heating and air-conditioning systems and energy-efficient design of buildings.

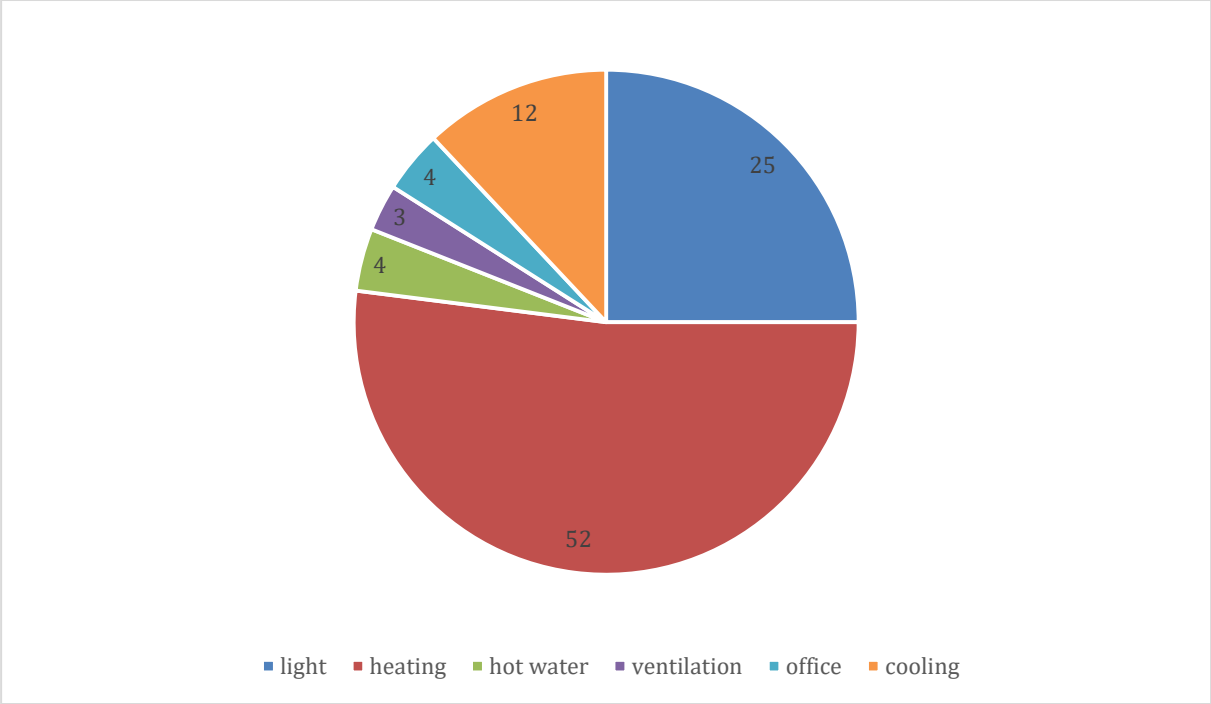
Micro-perspective: In-house building optimization

The focus for a so-called Green Warehouse is not only on the area used for the construction of the warehouse, but also on energy efficiency. According to a study carried out by the World Economic Forum (WEF) in 2015, about 10% of the 2,800 million tonnes of greenhouse gas emissions generated annually by logistics activities are caused by logistics buildings. Especially in the field of energy (which includes not only electricity for lighting and conveyor systems, but also heating systems) and waste/recycling, many successful innovations have been implemented in recent years. Off This is the reason why the aspects energy and waste or recycling are discussed in the following.

Micro-perspective: Energy

A decisive factor for the evaluation of environmental measures is the question as to how the consumption in a warehouse. Not only the rising energy costs are a reason why companies should deal with energy issues in the long term, but also an increasing pressure from society and politics on companies to use energy efficiently.

Around that accounts receivable in the aftermath of environmental measures, it is important to recognize which processes and processes in a warehouse are energy intensive. The energy consumption is distributed as follows:



A decisive factor here is the interior lighting of warehouses. Lighting alone accounts for almost 25 % of total energy consumption.

Two starting points are to be considered: On the one hand, it is possible to start with the new construction of a storage in mind, for example, to use as much daylight as possible. A special feature is that these warehouses are not only active during the day, but also at night.

On the other hand, solar or photovoltaic systems can be installed on the roofs of buildings installed in order to store energy sustainably for the night and not on the ground to have to access conventional energies.

But not only energy in the form of electrical lighting is required for energy savings.

The heating system also plays a decisive role in the warehouse in order to be able to demonstrate long-term energy savings. The storages are usually heated with oil, gas or district heating.

An alternative model is geothermal heat, which can be used not only for heating but also for cooling by means of a heat pump. In order to keep the heat in the building for as long as possible, automatic quick-release shutters could be installed and thermal insulation glazing and plastic frames could be used for window installation.

As a first step towards greater energy efficiency, it is a good idea to use simple to introduce organisational regulations in order to reduce energy consumption in the long term reduce. You can either make further investments by replacing illuminants with energy-saving lamps, for example, or by installing intelligent light cut-offs or automatic cut-offs. This is how it is guaranteed, that energy is only used if employees in the respective department stop it. Furthermore, it is also possible to introduce more cost-effective or free measures by training employees in the efficient use of energy.

Checklist for energy-efficient storages

a) What does the delivery and dispatch of goods look like?

This is where most of the energy is lost in many companies.

What happens when goods arrive at the warehouse?

- Do all roller shutters close correctly and are they tight?
- Are there seals that tightly enclose the trailer or the towing vehicle?
- Are these systems operational and are they used correctly?
- What does the docking process look like?
- Is the door only opened when the truck is standing in front of it?
- What is the thermal insulation situation?
- Do all windows and doors close correctly?

- Are the doors between different climate zones working properly and are they being operated correctly?
- Are all insulation materials on walls and ceilings in order?

b) Industrial trucks

- Are all devices technically ok? Poorly adjusted motors and heavy wheels due to inadequate storage lubrication are real energy guzzlers.
- Do the forklifts have brake energy recovery systems?
- Do the forklifts have recovery systems that feed the battery when the load is reduced?

c) Storage facilities and their control systems

- Do your control systems work optimally?
- Do these, for example, combine storage and retrieval machine movements in a meaningful way?
- Or is a new trip initiated for each order? If this is the case, consult with the system manufacturer to see if anything can be done.
- Is the energy generated by load reductions recovered in your systems or is it only "burnt" via load resistors?

Case study Green warehouse

Sustainable management has long been an essential part of the corporate philosophy of the logistics service provider Schachinger. For the traditional family group, this ranges from IT-controlled processes and transport ecology to environmentally friendly warehouse locations.

And exactly such a lighthouse project with exemplary consistency in the areas of construction ecology and energy efficiency was to be the 10,000 m2 central warehouse for Metro Cash & Carry as well as the 850 m2 integrated office wing for the Metro Task Force. The company Metro, which went hand in hand with the logistics specialist in the project development regarding sustainability and economy,

stores around 4500 food and non-food items in the 14 meter high building. From there, Schachinger supplies the Metro stores throughout Austria.

Wood brings advantages for warehouse logistics

With the construction of the high-bay warehouse in wood, Schachinger deliberately deviates from the steel and concrete construction methods usually used in warehouse construction. Because the advantages of solid wood in terms of advanced prefabrication, room climate conditions or the variability of use due to high spans are characteristics that the company wanted to take advantage of.

Solid wood columns, for example, support the primary beams and the secondary roof structure made of laminated wood trusses at an axial distance of 22 metres and an axial distance of five metres. A lightweight wood wall construction closes the support fields of the warehouse, while the office wing is made of solid wood panels.

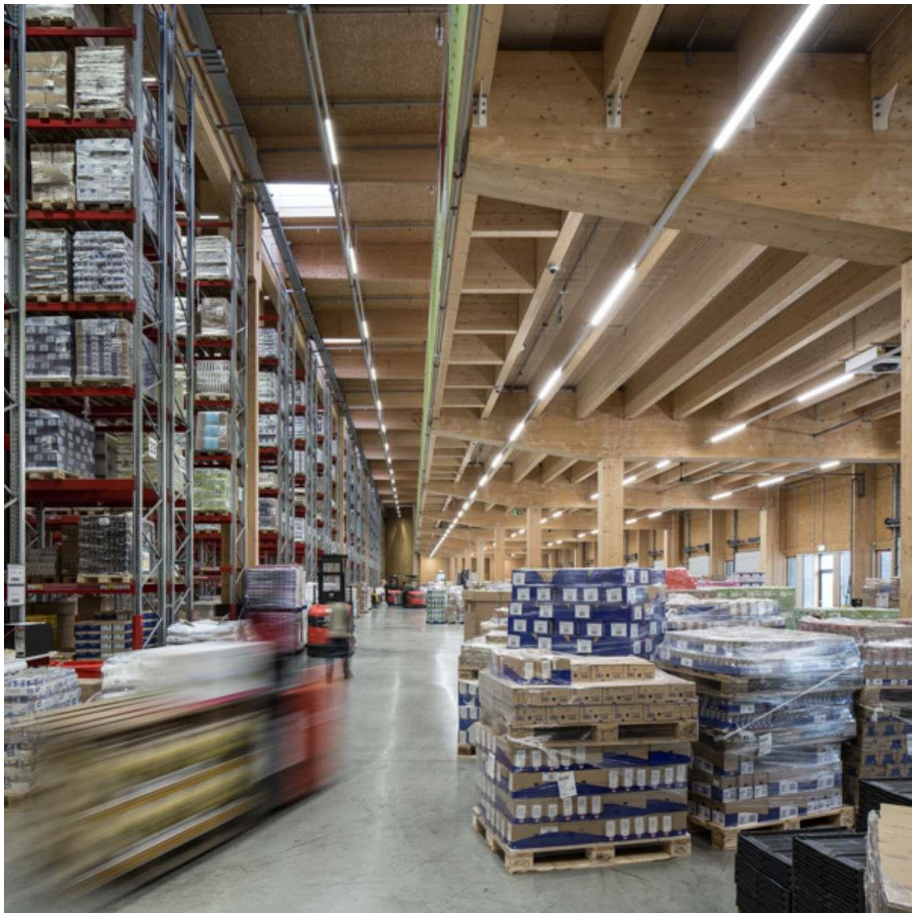
However, wood not only dominates the supporting structure and the roof and wall structures but was also used as a visible sign of the project philosophy as a facade material (based on a barcode, the central technology of logistics).

An all-round package of ecology and energy efficiency

The energy consumption of the temperature-controlled hall (14-18°C, 40-60% humidity) with a daily goods turnover of several hundred tons (the storage capacity comprises 20,000 Euro pallets) is minimised by the quality of the building shell and the LED technology. With an energy index of 10.3 kilowatt hours per m2 per year (equivalent to a fifth of the consumption of conventional and comparable halls), the project is in line with the passive house standard. The necessary energy for heating and cooling is extracted from the groundwater. Where concrete was necessary, as in civil engineering, low-CO2 concrete was used.

The logistics hall of the company Schachinger in Linz-Hörsching is a high-bay warehouse built in ecological construction and is the largest wooden warehouse in Central Europe. Within the framework of the tight temperature and humidity requirements that the hall must meet, the entire building services concept was designed for maximum energy efficiency. Geothermal energy is used for both heating and cooling.

A PV system with 199 kWpeak ensures a high proportion of the building's own electricity supply. Particular attention was paid during the planning phase to aspects relating to building biology and building ecology, the optimisation of total life cycle costs and workplace quality with a high level of comfort for the employees.



Facts:

- Type of building: New construction of a timber logistics hall
- Completion: 2013
- Special features: Largest wooden logistics hall in Central Europe
- Energy key figures
- Heating demand 2.3 kWh/m³a (OIB)
- externally induced cooling demand 0.5 kWh/m³a (OIB)
- Primary energy requirement 72.6 kWh/m²a (OIB)
- CO2 emissions 11.6 kg CO2 /m²a (OIB)
- Supply technology: controlled ventilation with rotary heat exchanger; groundwater heat pump with free-cooling circuit; photovoltaic system with an annual yield of approx. 207,000 kWh; LED lighting; water-saving sanitary systems.

Questions:

1) **What is a macro perspective in the development of a green warehouse concept?**
a) Location selection
b) Energy savings
c) Packaging
d) Optimize lighting

Answer: a

2) **What is a micro perspective in the development of a green warehouse concept?**
a) Choice of location
b) Energy savings
c) Electric trucks
d) None of the answers is correct

Answer: b

3) **Which activity consumes the most energy in a warehouse?**
a) Cooling
b) Heating
c) Lighting
d) None of the answers is correct

Answer: b

4) **What is the least energy consuming activity in a warehouse?**
a) Cooling
b) Heating
c) Lighting
d) None of the answers is correct

Answer: d

5) **What percentage of CO2 emissions does warehouse logistics cause in relation to transport logistics?**
a) 5%
b) 24%
c) 44%
d) 55%

Answer: b

6) What is a macro perspective in the development of a green warehouse concept?

a) Influence on landscape appearance
b) Energy savings
c) Packaging
d) Optimize lighting

Answer: a

7) What is a macro perspective in the development of a green warehouse concept?

a) Ecology
b) Energy savings
c) Packaging
d) Optimize lighting

Answer: a

8) In the base line during the development of a green warehouse concept, the focus is on which factor is to be taken into consideration

a) Exclusively economic factors
b) Energy savings
c) Ecology
d) None of the answers is correct

Answer: c

9) In a green energy warehouse concept, the focus is on which factor?

a) Exclusively economic factors
b) Costs and reduction of emissions
c) Ecology
d) None of the answers is correct

Answer: b

10) In a sustainable warehouse concept, the focus is on which factor?

a) Exclusively economic factors
b) Costs and reduction of emissions
c) Emission life cycle and costs
d) None of the answers is correct

Answer: c

11) What is an example of a measure in the base line concept for the development of a green warehouse?

a) Efficient lamps
b) Reduce heating emissions
c) Dispose of packaging material correctly
d) None of the answers is correct

Answer: a

12) Which of the following answers is a possible factor in the choice of location?

a) Energy costs of the building
b) Costs for warehouse personnel on site
c) Number of stackers in the warehouse
d) None of the answers is correct

Answer: b

13) Which of the following answers is a possible factor in the choice of location?

a) Packaging costs in the warehouse
b) Customer locations
c) Number of gates in the warehouse
d) None of the answers is correct

Answer: b

14) Which of the following answers is a possible factor in the choice of location?

a) Heating costs in the warehouse
b) Transport infrastructure at the site
c) Number of stackers in the warehouse
d) None of the answers is correct

Answer: b

15) Which of the following answers is a possible factor in the choice of location?

a) Energy costs of the building
b) Taxes
c) Number of stackers in the warehouse
d) None of the answers is correct

Answer: b

16) Which factors are important for energy efficiency in the warehouse?

a) Size of the storage
b) All roller shutters close correctly, and they are tight?
c) Height of the storage
d) None of the answers is correct

Answer: b

17) Which factors are important for energy efficiency in the warehouse?

a) Doors between different climate zones work properly
b) Volume of the storage
c) Height of the storage
d) None of the answers is correct

Answer: a

18) Which factors are important for energy efficiency in the warehouse?

a) Number of stackers
b) Volume of the storage
c) Forklifts have brake energy recovery systems
d) None of the answers is correct

Answer: a

19) Which factors are important for energy efficiency in the warehouse?

a) Height of the storage
b) Door only opened when the truck is standing in front
c) Number of employees
d) None of the answers is correct

Answer: b

20) Which factors are important for energy efficiency in the warehouse?

a) Insulation materials on walls and ceilings are ok
b) Length of the storage
c) Number of employees
d) None of the answers is correct

Answer: a

21) Which factors are important for energy efficiency in the warehouse?

a) Number of stackers
b) Length of the storage
c) Number of employees
d) None of the answers is correct

Answer: d

22)What is the special feature of the green warehouse of the company Schachinger storage?

a) Number of forklifts
b) Size of the storage
c) Largest wooden logistics hall in Central Europe
d) None of the answers is correct

Answer: c

23) How much of a warehouse's total energy consumption does lighting contribute?

a) 25%
b) 30%
c) 35%
d) 50%

Answer: a

24) How much of a storage's total energy consumption does cooling account for?

a) 12%
b) 22%
c) 32%
d) 42%

Answer: a

25) How much of a warehouse's total energy consumption does hot water production account for?

a) 1%
b) 3%
c) 4%
d) 5%

Answer: b

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Authors:

Altan DIZDAR

Ertuğrul DIZDAR

Cağan DIZDAR

3.3. Green Packaging

In logistic sector, when the packaging is performed according to the green & environmentally friendly way, this will lead to a more convenient & successful carriage of the transports and at the same time this will mean a less consumption of the nature & the environmental resources by using less amount of paper, plastic & cardboard. By Green packaging, which is also known as sustainable packaging, recycling is easily done and beneficial for the individuals and for the environment, and supply safety for the nature, leading to a greener world for the society and for the future coming generations.

Sustainability in packaging means the use of packaging that includes greater use of life expectancy and life expectancy assessment to help guide packaging use that results in increased sustainability and reduces harmful impacts on the green footprint and environment. Packaging also means the activity of designing, evaluating and producing packages and can be defined as a coordinated system for transport, storage, logistics, sales and preparation of goods for the end use (Wikipedia).

Figure 10: Different types of packaging

Ref: https://unsplash.com/search/photos/green-packaging

European Union firstly introduced rules for packaging waste management around the year 1980's. 85/339/EEC EU Directive gave the restrictions about the producing, selling, using, making the recycle and refilling of packing materials of liquids for people's consumption and on the disposal of used packing materials for supplement of 3R's, REDUCE, REUSE and RECYCLE as much as possible.

Afterwards, the latest EU Packaging and Packaging Waste Directive contained the following rules:

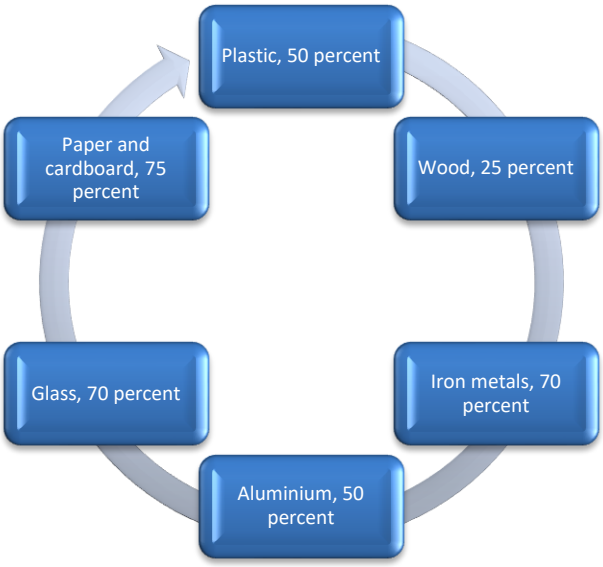
Stop producing the waste of packaging,

Support the recycling, reuse & recovery for waste of packaging, stop for a disposal, contribute for the circular economy.

(Where Circular Economy means to minimize the original input, waste, energy leakage & emissions. It is opposite to a economy that is consuming the resources & using them & throwing them away)

The rules covered all the packaging made at EU market and all other packaging wastes, either it is used or discharged at business places, bureau, commercial, industrial, service, shop, household or at any other place, free from the material type used.

In Europe, by 2025, it is aimed to have minimum 65% of recycling of the weight of all packaging must be performed. The objective for recycling of each material are as follows:



(Ref: https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=LEGISSUM:l21207)

While making the packaging to place on the market, it must meet the below essential requirements:

Volume and Heaviness of the packing is important, make it minimum to satisfy the necessary amount of reliability, sanitation and admissibility for the users,

Decrease as minimum as possible, the content of dangerous materials in the packing,

Use convertable & reusable packing materials.

Pictures Ref: https://unsplash.com/search/photos/packaging

Figure 11: Use of recycled material for green packaging

Ref: https://unsplash.com/photos/fyaTq-fllro

Every country must follow the systems for reuse or recovery including the return, collection & recycling of used packaging and / or packaging waste.

Following precautions must be taken for green packaging:

- **Decrease using the plastic carrier bags**

500 plastic bags are averagely used every year & they are only used once and thrown away. Because of the low weight & small size of the plastic bags, they are not caught at the waste management & go to the marine environment & therefore they can be got rid of from the environment after hundreds of years.

Some countries took precautions to decrease the consumption of plastic bags by taking money for the usage of them or by making negotiations with the retail business sector and putting bans on certain types of bags. But, up to now, there is no obligation brought by European Union.

Figure 12: Plastic bags

Ref: https://unsplash.com/search/photos/plastic-bags

- **There must be a greater visibility for biodegradable packing**

It is also an intention to combine ideas on the suitability of present necessities on biodegradability & composability in the green packing. There is no adequate

differentiation between biodegradable materials that are biodegrading in natural environments & compostable materials that are only biodegrading in industrial composting plants.

So, it is compulsory to combine the ideas on the economic, social & environmental effects from the improvement of the biodegradability necessities of the packing materials taking into consideration of the visibility of biodegradable packing to users.

Figure 13: Biodegradable Paper Products Packaging

Ref: (indiamart.com) https://www.indiamart.com/proddetail/biodegradable-paper-products-packaging-disposable-19212422530.html

How to make a Green approach in environmental management:

There are three green approaches in environmental management: Reactive, Proactive and Value Generating.

In the reactive approach, environmentally sensitive practices in the businesses are at minimum level and most of these activities arise from the necessity created by the legal laws.

In the proactive approach, it is seen that businesses are turning to green practices because of their thought of providing a competitive advantage among their competitors.

In companies that took Value Creative approaches, green policies are taken & the related practices are accepted & implemented in all processes in the supply chain.

In reality, making and implementing strategic decisions with an environmental approach increases the power of businesses and provides a competitive advantage. Because environmental awareness is a concept that directly addresses the customer and where the customer's satisfaction is one of the most important issues that need to be addressed by businesses today. Even if the green logistics practices that will be put into practice with strategic decisions will lead to extra costs for the businesses in the short term, it will increase the profitability and market shares of the businesses as a result of the customer satisfaction that will be created in the long term and accordingly and will provide a competitive advantage among other businesses.

Precautions that could be held for the supplement of green logistics are given as follows:

• Transport of products in larger groups rather than in small groups,	• Reduction of general packaging & materials used,	• Use of recycled materials instead of plastic materials,
• Sustainable use of pure (unmixed) products,	• Environmentally friendly recycling,	• Training of personnel in cognitive and affective fields,
• Customer awareness,	• Promotion of reverse logistics programs.	• Use of environment friendly efficient transportation & distribution systems.

Packing materials which are Recyclable & Biodegradable:

On earth, there are lots of materials which are recyclable & biodegradable. Here are some examples:

- Cardboard & Paper; they can be recycled & reused & they are also biodegradable. In the usage of them, there are a lot of advantages in green packaging of the materials & a lot of manufacturing companies use them in their packings.
- The other useful material is the corn starch, materials produced from corn starch are biodegradable & excellent for the use of takeaway service. They are very good for packings & they are also protective coverings while making the delivery.

Figure 14: Examples for corn starch packings

Ref: https://myzerowaste.com/2009/07/is-cornstarch-plastic-packaging-pla-compostable-or-recyclable/

https://www.packagingstrategies.com/articles/87473-additive-clears-up-polypropylene

- Bubble wraps which are used in packaging are made of polythene that can be recycled & they are also degradable.
- Plastics which are biodegradable are used as plastic bags & also when making a stacked pile of materials. They dissolve under the daylight & much more better than the plastics traditionally used ones.

Creation of Your Environment Friendly Packing Methods;

For the packaging, you can create environment friendly ways of recyclable packaging methods by yourselves at home & some of them are as follows below:

- Best materials to be used are newspapers & magazines, they are recyclable and biodegradable.
- In the packing of foods, you can use packaging materials twice which are used previously as a packing material in some other foods. By reusing these materials, you can save wastes from landfills.
- Try using reusable packaging, for example using fabric bags will help you in your shopping to carry your materials in a environment friendly way.

- Try to keep containers & large cardboard boxes in order to use them again. This will help to environment & will be a good way for money saving either.

Packaging makes pollution in our environment:

Creates pollution in solid waste

A lot of waste will be produced by packing & consuming of the resources in high amounts. Today, 10 000 000 tons of solid waste are generated annually all around the world & 1/3 of this amount corresponds to the packing materials where they are paper, glass, metal, plastic & others. In order to get rid of this solid waste, a lot of manpower, financial resources & materials are needed. They will also make a dangerous pollution & will make a serious distortion in the environment & will affect the survival of the next generations seriously.

Figure 15: Solid-waste pollution

Creates Pollution in Liquids & Gases:

Chemical spoils will make a dangerous pollution in water & soil effecting the life of plants in the environment. This pollution will be harmful to all living bodies in the world.

Harms of the diffusion of pests & bacteria:

While realizing the international logistics, the packing material can convey many types of bacteria & crop pests, diffusing danger & poison for the environment, crops & local forests & also effect human beings' life.

Using Green Packaging to get rid of the Pollution:

So, to get rid of the pollution, green packaging has a great importance & existing principle of green packing which are called the 4R1D principles must be applied;

4R1D means to reduce, reuse, reclaim, recycle & being degradable. Conversation of the environment & renewable resources are the main 2 elements of green packing and these are realized by 4R1D principles.

Reduce is making a reduction in the packaging material. It means to use as little material as possible. For the supplement of correct amount of packing, the logistic organisation must use light, thin & recyclable packing materials.

Reuse is to use the packing material again and again. For example, containers are reused easily after cleaning them & this will help a lot for the reduction of waste in the environment.

Reclaim is in other words meaning of recycling where it is to make use of packaging waste combustion for obtaining new energy sources avoiding creating a second pollution. Performing the recycling of packaging waste means the achievement of renewable goods & supporting the reuse of the materials. As an example, the use of thermal burning, composting & other actions will make an improvement in the waste treatment systems.

Recycle means to use the material in a cycling manner. Try to realize the cost, power, pollution as low as possible in packing materials & try to use always recycled materials & this will reduce the environmental pollution protecting the raw

materials & for example using recycled paper board & plastic will help in the conservation of the nature & environment a lot.

Degradable means a type of packaging material where it cannot be made reuse of, is able to be degradable in the nature, it is perishable & does not create a permanent waste. For example, selecting biodegradable packaging materials of paper as more as possible will be the perfect application of green packaging.

Therefore, for the supplement of Green packaging, lightweight, reuse, recycling, recyclable, biodegradable materials must be chosen & non ecological materials must never be used. For a long-lasting sustainability of the green packaging, the government can set a legislation preventing specific packaging materials use, forming a refund system for storage, giving importance to reuse & recycling directives. If the people do not obey to the directives, it can make an increase in the tax, put a limit for over-packaging & evaluate the packing materials putting obligations to promote the use of new packaging materials.

At business level, packaging & containerization must be performed by using proper & green packaging materials, using the materials which are recyclable & also by developing new packing materials & equipment. It is also prerequisite for the companies & organisations to obey to the rules of ISO 14000 certification obligations of green packaging.

(ISO 14000 is a standard concerning the environmental management to show way to the organizations how they can minimize their operations that are affecting the environment in a negative way; its directives & rules are in compliance with the existing applicable regulations, laws & other environmentally accepted requirements. Ref: Wikipedia)

In addition, by efficient packing (shape & size), the material used in packing & as well as the transport activities will be reduced. As a result of proper & good packaging, vehicles will be loaded in the best way and the number of trips & also the amount of fuel burned will be reduced.

Therefore, finally it can be said that, the improvement in green packaging, conservation of the ecological environment & supporting the sustainable economic development already became the common understanding in the world's packing industry in many of the industrialized countries.

Figure 16: Solid-waste treatment station in Istanbul

Questions:

1) **Which one is not correct?**
   Packaging refers to the system of preparing goods for;
   a) transport,
   b) warehousing,
   c) logistics,
   d) waste bins

Answer: d

2) **Countries should ensure that systems are set up to provide for the return & collection of used packaging & packaging waste.**
   a) True
   b) False

Answer: a

3) **Green & efficient packaging (size, shape) will increase the material used in packaging & increase transport activities as well.**
   a) True
   b) False

Answer: b

4) **Which one of the below is not correct for the materials used in green packaging?**
   a) Biodegradable plastics,
   b) Non-recycled materials
   c) Plant-based plastics,
   d) Recycled polyethylene bags

Answer: b

5) **The principles of 4R1D include the following:**
   a) to reduce, reuse
   b) to reclaim,
   c) to recycle
   d) All of them

Answer: d

6) **3R's, REDUCE, REUSE and RECYCLE principle is not used in green packaging.**
   a) True
   b) False

Answer: b

7) **A circular economy means to minimize the resource input, waste, emissions & energy leakage.**
   a) True
   b) False

Answer: a

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Author

Helmut PRENNER

3.4. Green Logistics Data Collection and Management

The increasing relevance of greening at company level means that environmental management is becoming a cross-cutting task to which every operational function has a contribution to make. While terms such as "Green IT" or "Green Logistics" have long since spread in some functions, a comparable greening in controlling has not yet taken place.

Green topics have relevance for controlling

Controllers see the current discussion about "greening" as an ongoing development

Controllers see their own active role in supporting greening. They should methodically and instrumentally support the ecological orientation of the companies, if already initiated, or actively introduce and advance the topic, if there are opportunities and risks to achieve the corporate goals.

Against the background of rapidly changing external conditions, ecological and economic interrelationships must be continuously scrutinized and transparently presented by controlling.

The most important task of green controlling can be seen in proving the economic viability of ecological strategies, monitoring their achievement and enabling a transparent and objective approach to green issues with the help of the "right" indicators. The first step is to identify green information needs, collect information company-wide, analyse it uniformly and interpret it in line with economic and social information.

This first challenge represents the need for green information generation and assessment. Only on this basis can the status quo of ecological performance be

determined, and possible opportunities and risks identified, which enables a green strategic positioning.

The second challenge is then to ensure the green use of information. This includes the integration of green information, in the form of targets, key figures, etc., into corporate management. Only if it is possible to integrate this new ecological information into all information and decision-making processes as an equal target can an ecologically and economically balanced decision-making and behavioural orientation be achieved within the company.

While the green generation of information can be fulfilled by a separate eco-controlling (perceived by the environmental management actors), the assurance of a green use of information requires an integration of this information into the tasks and processes of the company controlling.

This can be illustrated by the example of reporting: to integrate information on green target achievement and current environmental performance into internal reporting in order to create awareness, highlight deviations and thereby influence decisions and bring about changes in behaviour. Similarly, investments should also be assessed in terms of their CO2 impact, for example, and not solely in terms of their economic benefits. Other such decision-making processes are the determination of product prices, the selection of suppliers or the allocation of financial and human resources to projects.

For example, developments in carbon controlling form the right basis for making ecological information available across product life cycles. By introducing an environmental management system or a company environmental information system, ecological information on material and material flows can be obtained. In the form of carbon controlling, emissions are converted into CO2-adequate figures, and the status quo of the company's environmental performance for the company, the value chain or the life cycle of a product can be determined (CO2 footprint) using such a peak figure. This enables the formulation and implementation of corresponding optimisation targets and the integration of the CO2 footprint as a key performance

indicator in corporate management. It should be noted, however, that CO2 emissions are only part of the environmental performance and therefore cannot fully reflect ecological strategies. Further approaches are therefore needed.

3.4.1. Seven trends in the green Logistics Data Collection

1) Logistics is what counts - it is not a mass product. Logistics is not only an important engine of global trade and a structural component of value creation - it is also an industry of strategic importance for the development of a low-carbon economy.

2) Technological change is achieved through the solidarity of business, financial institutions and the public sector. As new technologies are more expensive, the mutual support and long-term planning of all actors is crucial.

3) Cooperative approaches are increasingly seen as a lever for sustainability; even competitors will cooperate more closely. The more importance suppliers, business customers and logistics companies attach to CO2 reduction, the more often vertical and horizontal cooperation along the supply chain will emerge.

4) The business models of logistics companies are changing as sustainable innovations open new business opportunities.

5) CO2 labelling will be standardised. The CO2 consumption statement allows customers to compare "green" products. Transparency provides a better decision-making basis for logistics customers and end consumers.

6) CO2 emissions are priced. With the increasing importance of CO2 reduction for the public sector, companies and their customers, emissions are becoming an integral part of internal calculation and decision-making processes. This will increase the demand for a price for CO2 emissions.

7) CO2 pricing will lead to stricter regulatory measures. Companies will only accept a price for CO2 emissions if the public sector ensures fair competition.

The company's environmental protection is based on the development of various ecologically oriented concepts and systems with the aid of innovative technologies.

The environmental aspects to be considered are the central object of consideration and area of influence of operational management, which can be implemented in the form of an environmental management system (EMS). Management systems basically have the task of playing a decisive role in the professionalization of corporate management through formalization, systematization and articulation. In this context, topic-focused management systems, such as environmental and quality management systems, have emerged in the past that meet the differentiated requirements of stakeholders.

The objective of the EMS is to improve the relative quality of the environment by reducing environmental impacts. The environmental management system, as an operational environmental concept, forms the framework and procedure for the creation and design of operational structures and procedures for dealing with company-related environmental impacts. In this way, the effects of one's own actions on the natural environment can be managed and controlled in a responsible and precautionary manner. An environmental management system is thus designed in such a way that the relative improvement of environmental impacts also achieves the highest possible degree of eco-effectiveness.

In general, the introduction of an EMS for a logistics company initially offers greater legal certainty with regard to environmental protection requirements and cost reduction potential that can be achieved by uncovering inefficiencies. During operationalization, critical material and energy flows can be determined, which create increasing operational ecological awareness and motivation through the progressive involvement of employees. In the course of the constant repetition, the operational performance in environmental protection is to be continuously improved.

3.4.2. ISO 14001 certification

When we talk about standardized and comparable environmental management systems, we primarily refer to the Environmental Management and Audit Scheme (EMAS) from 1993 and the ISO 14001178 certification from 1996. According to the globally valid ISO 14001, an environmental management system is understood as a superordinate instrument that "encompasses the organisational structure, planning activities, responsibilities, methods, procedures, processes and resources for the development, implementation, fulfilment, evaluation and maintenance of environmental policy".

Logistics companies certified according to ISO 14001 differ from organization to organization with regard to the design of the EMS and must be specifically considered in terms of their company-specific characteristics.

The three main reasons for implementing an EMS in accordance with ISO 14001 include

1. Instrument of entrepreneurial self-control

The EMS is an effective instrument for the simultaneous pursuit of economic and environmental interests.

2. Basis for external verification

With the help of an EMS, companies have the opportunity to evaluate the implementation of a self-defined environmental policy and concrete objectives and to prove them externally.

3. Promoting environmental protection as an overarching objective

Environmental protection and the prevention of environmental pollution should be supported in conjunction with socio-economic requirements.

The structure of ISO 14001 is based on the Plan-Do-Check-Act cycle (PDCA), which aims at a continuous improvement process. A not inconsiderable advantage of

ISO 14001 is the concept of organization, which can encompass several locations and is therefore not tied to individual logistics operations. There is, however, for each permanent establishment, the local accountability.

The clarification of responsibilities and responsibilities along all functional and hierarchical areas is therefore crucial for efficient and effective implementation of environmental protection. The typical area of responsibility of the persons responsible for environmental protection extends mainly to the description and documentation of rules and structures in the end-of-pipe area.

Eco-controlling and environmental indicators

The following is a description of the scope of eco-controlling, which in the recent past has been announced in the economic context mostly by terms such as "Life Cycle Assessments" or "Environmental Indicators", including those of logistics companies. A general and simplified economic presentation of eco-controlling is followed by an explanation of environmental indicators.

Concept and Approaches of Eco-Controlling

In order to achieve the objectives of strategic environmental management that have already been addressed, it is essential to provide the necessary data and information and suitable instruments to develop, implement and communicate the environmental strategy. The strategic formulation of objectives is the prerequisite for eco-controlling, which should ensure the collection, processing and evaluation of environmentally relevant data. Eco-controlling is an "operational instrument that provides a basis for future-oriented, operative and strategic management decisions through ecologically oriented, cross-functional and cross-company information acquisition as well as quantitative and/or qualitative information evaluation".

The following approaches can be distinguished with regard to the systematisation of different eco-controlling systems:

- Financially oriented approaches

- Ecologically oriented approaches

- Ecologically and economically integrated approaches

These in turn can be divided into operational and strategic approaches in terms of their orientation. Operational approaches aim at the short- to medium-term realisation of success potentials, while strategic orientation concentrates on the long-term identification and development of success potentials.

The financially oriented approaches are more likely to be found at the operational level and focus on the monetary impacts of ecologically implemented measures.

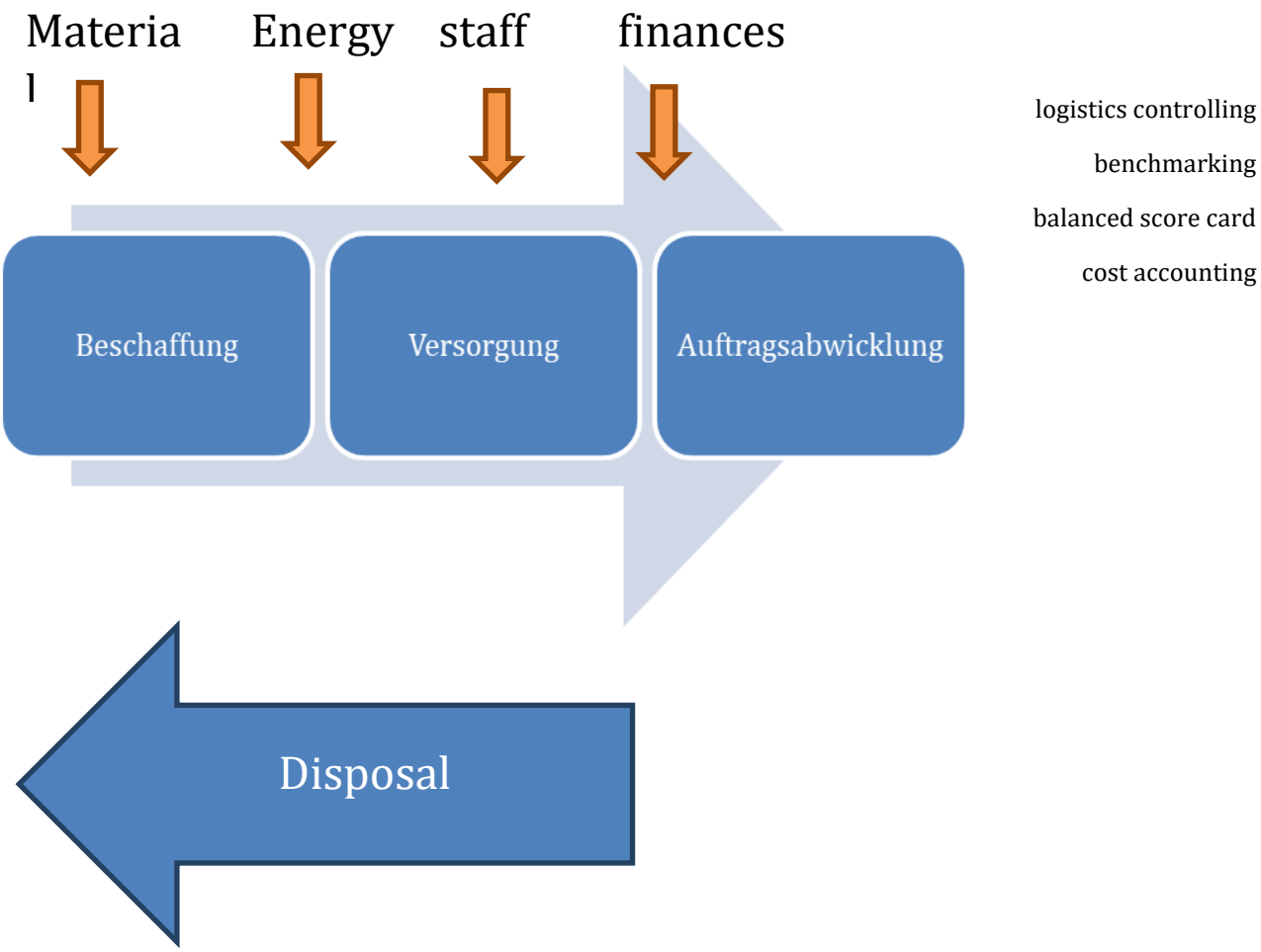
A detailed evaluation of the financial success of the company is to take place according to the criteria and specifications of classical accounting and controlling. The approaches prevailing in practical application are the ecologically-oriented approaches, which measure and attempt to control the operational impacts on the natural environment. Although the design is widespread at both operational and strategic levels, insufficient integration into existing management methods is considered problematic. This can lead to eco-controlling being managed as a parallel system, it can easily be neglected in economically difficult times and conflict situations can arise in the company due to the lack of consideration of economic aspects.

This grievance is taken into account in the integrated ecological-economic approaches, through an equal consideration of environmentally conscious and economic interests. In addition to integrating ecological aspects into the existing controlling system, this system is to be consistently further developed so that a system is created that takes into account economic and ecological goals and their interdependencies.

Selected instruments of eco-controlling and key figures

In order to implement an environmental strategy that encompasses all areas of the company, appropriate information, analysis and management tools from eco-

controlling are required. The corporate target system is of decisive importance for a sustainable, ecologically oriented corporate policy, as it determines the type and dimension of corporate actions. Therefore, instruments for recording and analysis are necessary in order to determine the objectives. These instruments, if available, provide the relevant information and allow statements to be made regarding the environmental situation of the company. A central task of (eco-) controlling is therefore the collection or procurement of external data, which relate predominantly to the results and trends of competitors ("best practice") or legislators, to systematise them and process them in a decision-oriented manner. In addition to instruments for measuring input-output flows (e.g. life cycle assessments), there are instruments for evaluation (e.g. cost-benefit analysis) and decision preparation (e.g. environmental indicators).



In order to record and evaluate environmental measures, it is necessary to extend the existing company or logistics controlling system to include eco-controlling instruments and corresponding indicators.

The presented instruments are conceivable for a configuration of environmentally oriented logistics companies. The arrows represent possible material- and energy-related input and output streams. The strategic decision-making of logistics companies can be made ecologically sustainable if the controlling instruments are extended to include appropriate eco-controlling instruments and key figures.

There are various approaches to this in the business literature, such as the Balanced Scorcard (BSC).

Target costing is an instrument of eco-controlling that attempts to transfer environmentally friendly innovation potentials to existing market offerings and prices by means of target environmental cost accounting. The goal is to be able to influence and control the market through ecological innovation.

3.4.3. Green Target Costing

Through green target costing, customer requirements and willingness to pay for ecological product properties are already understood in the development of new products and taken into account at an early stage in the planning of product costs. The following three steps, shown in Figure 15, are necessary to green the Target Costing.

1. to identify essential ecological customer requirements and the existing willingness to pay for green product features.

2. translation of the ecological customer requirements into design requirements of the product components, taking into account the environmental impacts over the entire life cycle.

3. ecologically oriented interpretation of the target cost diagram ("cost kneading"): use of cost potentials to increase the ecological performance of the product,

reduction of ecological costs in case of cost overruns (examination of ecological over-engineering) The application of a green target costing requires knowledge of the green product properties perceived by the customers. In order to achieve a realistic distribution of environmental target costs, users and experts must be trained in dealing with green issues. The information basis of the green target costing must be available through the Life Cycle Assessment instrument.

The life cycle assessment, on the other hand, is characterised by a material and energy balance, which records and evaluates all input and output-related material and energy flows of a company in the form of tables or accounts. The life cycle assessment primarily has an internal function, but is also increasingly being used by logistics service providers as a means of communication for dialogue between companies and their environment.

In addition to the instruments described here, other approaches such as environmental cost accounting have recently been developed within the framework of eco-controlling. However, literature and practice have shown that many instruments have not been integrated into existing management systems, contrary to the demands made in the scientific literature. It can therefore be assumed that the large number of existing instruments is only used by a relatively small circle of addressees.

Another instrument commonly used in business practice for measuring environmental performance is the recording of key figures that represent quantitative facts in concentrated form. Industry-specific key figures thus support the company in the static and dynamic evaluation of the functionality and responsiveness of the EMS set up. Furthermore, environmental performance indicators are useful in the evaluation of the company environmental balance sheets and thus in the identification of environmentally relevant processes and procedures on the basis of qualitative and quantitative data. In conjunction with environmental protection, environmental indicators are used for weak point analysis, corporate management and behavioural orientation. In addition to life cycle assessments, environmental indicators can also be used effectively for external communication and, if standardized, can be used externally for company comparisons or internally for a

benchmark between company locations, departments or processes. Process and department-related indicators can be regarded as short-term when it comes to determining and presenting input- and output-related environmental impacts, while location and company indicators tend to serve as general and long-term performance indicators for the environmental management system.

In the logistics and above all in the transport sector there are key figures such as the average fuel consumption of a truck per 100 kilometres, which play a role in classic logistics controlling as well as in eco controlling. Fuel consumption can thus be allocated to vehicle cost accounting or to the environmental management system as an indicator. Consequently, an environmental performance indicator does not have to be collected specifically for environmental management, provided that it contains information on the relationship between business and the natural environment.

Environmental indicators can be divided into relative (ratios) and absolute indicators. Although absolute (eco-) indicators are more meaningful when viewed individually, as they illustrate the actual extent of environmental impacts, the relative indicator is of greater importance for a comparison and the activities in the environmental management system. Furthermore, environmental indicators can be differentiated according to quantity or cost. In a warehouse, for example, electricity consumption can be measured in kWh. This can also be done on a cost basis by specifying the electricity consumption in €. These absolute quantities can be represented as ratios, i.e. relative. The electricity consumption is thus apportioned to the output of the warehouse - in terms of quantity, the electricity consumption results in kWh per shipment handled and cost-related in € per shipment.

However, the cost-related key figures are to be applied with reservations, as misinterpretations may occur. The costs are made up of the ratio of volume to price, whereby only the volume component can be influenced in environmental management. External influences of the price component cannot be represented in environmental indicators and thus, for example, the actual increase in electricity costs cannot necessarily be attributed to an increase in electricity consumption.

Unfortunately, it is not possible to present environmental indicators in logistics companies in more detail, as information on the specific instruments used by the company in the context of the initial conditions and requirements is required. It can be stated that the need for metrics for the ecological compatibility of internal and external actions (value-added chains) is certainly present. As various cross-company processes are organised by logistics companies in the SCM, the inclusion of environmental indicators in logistics controlling offers the possibility of checking products and services with regard to their ecological sustainability.

Possible key figures in green logistics input:

Use of renewable energy [kWh] / total energy use [kWh]

Recycling material [t] / Total material input [t]

Share of reused water [l] / Quantity of water used [l]

Reusable packaging [t] / packaging quantity [t]

Possible key figures in green logistics throughput:

Mass of finished products [t] / mass of all materials used [t]

Mass of finished products [t] / Energy used [kWh]

Net turnover [€] / mass of all materials used [t]

Mass of finished products [t] / Quantity of water used [l]

Possible indicators in the green logistics output:

Total direct and indirect greenhouse gas emissions [t] / product unit [pcs.]

Waste quantity [t] / product units [pcs.]

Recyclable product units [pcs] / All product units [pcs]

Wastewater quantity [l] /product unit [pcs.]

Quantity of hazardous waste [t] / total amount of waste [t]

Possible key figures in the green logistics outcome:

Turnover with ecological products [€] / Total turnover with all products [€]

Environmental protection and environmental damage costs [€] / Total operating costs [€]

Savings through reduced resource consumption, avoidance of environmental damage and waste recycling per year [€].

Number and amount of fines related to environmental infringements

Corporate Carbon Footprint

Transporters and forwarding companies are currently faced with a fast and highly competitive business environment. The easy access to transport platforms, which allow a quick comparison of fees and prices, leads to an increased price pressure. In addition, intralogistics solutions often require large investments such as automated or semi-automated high-bay warehouses.

Current challenges include last-mile solutions in urban logistics, the pressure to reduce CO2 emissions, same-day delivery and the provision of data to assess environmental performance, and the optimization of time-distance relationships in every transport process (in-house, delivery, intercontinental).

Public transport systems are playing an increasingly important role in reducing greenhouse gas emissions from transport. An intelligent and appropriate link between the various modes of transport, freight transport and public transport will be necessary in the future.

A carbon footprint is the total amount of carbon dioxide (CO2) and other greenhouse gas emissions (e.g. methane, nitrous oxide, etc.) directly related to a product. A carbon footprint covers the entire supply chain as well as the use and recycling or disposal of the product.

Greenhouse gas emissions arise from power generation in power plants, fossil fuel combustion, transport movements and other industrial or agricultural processes.

The Carbon Footprint (CF) shows the total amount of greenhouse gases (CO2e) caused by an organization (Corporate Carbon Footprint; CCF) or a product (Product Carbon Footprint; PCF). Carbon Footprinting therefore stands for the balancing of GHG emissions for a specific reference object.

The Greenhouse Gas Protocol (GHG Protocol) and ISO 14064-1:2006, which is aimed at companies wishing to balance their greenhouse gas emissions on a voluntary basis, provide important guidance for the preparation of a CF. Several well-known organisations, such as the World Business Council for Sustainable Development (WBCSD), the World Resources Institute (WRI), the United Nations Framework Convention on Climate Change (UNFCCC), the Intergovernmental Panel on Climate Change (IPCC) and the International Accreditation Forum (IAF) were involved in the development of these standards.

There is great agreement between ISO 14064-1 and the GHG Protocol. Both assign GHG emissions to so-called scopes:

- Scope 1: Direct GHG emissions caused by plants or parts of plants belonging to the company (e.g. self-employed freight forwarder).

- Scope 2: Indirect emissions from electricity and heat supply if these occur outside the company (e.g. energy purchase).

- Scope 3: (voluntary) All other indirect emissions: Commuting and business travel, transport by subcontractors, waste.

The higher the scope, the more difficult it often is to collect the greenhouse gas emissions correctly and completely or to check the accuracy of the survey by third parties.

Questions:

1) **Which standard defines the framework of an environmental management system?**
a) ISO 14001
b) ISO 9001
c) ISO 13400
d) ISO 29900
Answer: a

2) **What is the reason for implementing an ISO 14001 system?**
a) Instrument for the simultaneous pursuit of economic and ecological interests
b) Marketing reasons
c) Reasons for cost savings
d) Reduction of personnel costs
Answer: a

3) **What is the reason for implementing an ISO 14001 system?**
a) Marketing reasons
b) Reasons for cost savings
c) Reduction of costs per truck
d) Promotion of environmental protection
Answer: d

4) **What is the reason for implementing an ISO 14001 system?**
a) Reasons for cost savings
b) Increase in sales
c) Basis for external verification
d) Increasing the quality of logistics services
Answer: c

5) **What does the PDCA cycle aim at?**
a) Planning the logistics service
b) Control of logistics performance
c) Continuous improvement process
d) Implementation of suggestions for improvement
Answer: c

6) **What is ÖKO Controlling?**
a) Acquisition of environmentally relevant information
b) Acquisition of cost-relevant information
c) Entry of customer-relevant information
d) None of the answers is correct
Answer: a

7) Which approach is important for eco-controlling?
a) Financially oriented approach
b) Customer-oriented approach
c) Quality-oriented approach
d) none of the answers is correct
Answer: a

8) Which approach is important for eco-controlling?
a) Customer-oriented approach
b) Quality-oriented approach
c) none of the answers is correct
d) Ecologically oriented approach
Answer: d

9) Which approach is important for eco-controlling?
a) Customer-oriented approach
b) Quality-oriented approach
c) none of the answers is correct
d) Ecologically and economically integrated approach
Answer: d

10) Which instrument is used to measure input-output currents?
a) Cost accounting
b) Balance
c) Life cycle assessment
d) Eco cost accounting
Answer: c

11) Which instrument is used to assess environmental measures?
a) Cost accounting
b) Balance
c) Cost benefit analysis
d) Eco cost accounting
Answer: c

12) Which instrument is used to prepare decisions on environmental measures?
a) Cost accounting
b) Balance
c) Environmental indicators
d) Eco cost accounting
Answer: c

13) Which of the answers is an instrument of Okö controlling?
a) Target costing
b) Balance

c) Financial plan
d) None of the answers is correct

Answer: a

14)What is a typical environmental performance indicator?

a) Diesel consumption per 100 kilometres
b) Personnel costs in the warehouse
c) Personnel costs in the vehicle fleet
d) Kilometres driven per truck

Answer: a

15)What is a typical environmental performance indicator?

a) Personnel costs in the warehouse
b) Personnel costs in the vehicle fleet
c) Power consumption in the warehouse
d) Kilometres driven per truck

Answer: c

16) What is a typical environmental performance indicator?

a) Personnel costs in the warehouse
b) Personnel costs in the vehicle fleet
c) Total kilometres driven
d) Tonnes of packaging material

Answer: d

17) What is a typical environmental performance indicator?

a) Personnel costs in scheduling
b) Power consumption in trucks with cooling
c) Personnel costs in the vehicle fleet
d) Kilometres driven per truck

Answer: b

18) What is a typical environmental performance indicator?

a) Personnel costs in the warehouse
b) Personnel costs in the vehicle fleet
c) Disposed oil in the workshop
d) Kilometres driven per truck

Answer: c

19) What is the Carbon Footprint?

a) Total amount of pollutants caused by a product
b) Total amount of costs caused by a product
c) Total amount of personnel costs caused by a product
d) Total amount of greenhouse gases emitted by a product

Answer: d

20) What is Scope 1 in the GHG Protocol?

a) Causation of direct greenhouse gases caused by the company
b) Causation of indirect greenhouse gases caused by the company
c) Causation of direct and indirect greenhouse gases caused by the company
d) None of the answers is correct

Answer: a

21) What is Scope 2 in the GHG Protocol?

a) Causation of direct greenhouse gases caused by the company
b) Causation of indirect greenhouse gases caused by the company
c) Causation of direct and indirect greenhouse gases caused by the company
d) None of the answers is correct

Answer: b

22) What is Scope 3 in the GHG Protocol?

a) Causation of direct greenhouse gases caused by the company
b) Causation of indirect greenhouse gases caused by the company
c) Causation of all other indirect greenhouse gases that are caused
d) None of the answers is correct

Answer: c

23) Key figure in green logistics is input:

a) Use of regenerative energy [kWh] / total energy input [kWh] X Use of renewable energy [kWh] / total energy input [kWh] X Use of renewable energy [kWh] / total energy input [kWh
b) mass of finished products [t] / mass of all materials used [t]
c) Mass of finished products [t] / Energy used [kWh]
d) Net sales [€] / mass of all materials used [t]

Answer: a

24) Key figure in green logistics is output:

a) Mass of finished products [t] / Energy used [kWh]
b) Net sales [€] / mass of all materials used [t]
c) Mass of finished products [t] / Quantity of water used [l]
d) Total direct and indirect greenhouse gas emissions [t] / unit of product [pcs]

Answer: d

25) Key figure in green logistics is the outcome:

a) Recyclable product units [pcs] / All product units [pcs]
b) Wastewater quantity [l] /product unit [pcs.]
c) Quantity of hazardous waste [t] / total waste generated [t]
d) Turnover with ecological products [€] / Total turnover with all products [€]

Answer: d

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Authors:

Stanislav AVSEC

David RIHTARSIC

3.5. Waste Management

3.5.1. Introduction

Waste is an issue that affects us all. Waste greatly contributes to environmental pollution and the production of greenhouse gas emissions. The amount of waste generated is increasing, as evidenced by the fact that by 2050, waste generation will outpace population growth more than double. Besides that, the nature of waste itself is changing (European Commission, 2010; Kaza et al, 2018). Annually, the world produces 2.01 billion tonnes of municipal waste. The world still produces a lot of plastic waste. For example, in 2016 it was generated 242 million tonnes of plastic waste, which represents 12 percent of all municipal solid waste.

On average, a person generates 0.74 kilogram of waste per day (ranging from 0.11 to 4.54 kilograms). The amount of global waste is estimated to increase to 3.40 billion tonnes by 2050. Looking at the regions (Figure 17), we see that the East Asia and Pacific Region are the regions that generate most of the world's waste (23 %). On the other side, the Middle East and North Africa region are the regions that generates the least of the world's waste (6 %). Waste generation and collection differs across income levels. 32% of total waste is generated in high-income countries, besides that, high-income countries generate more dry waste that could be recycled (plastic, paper, cardboard, metal, glass). Middle- and low-income countries generate 56 % food and green waste. In low-income countries, there is only 16 % of the waste that could be recycled.

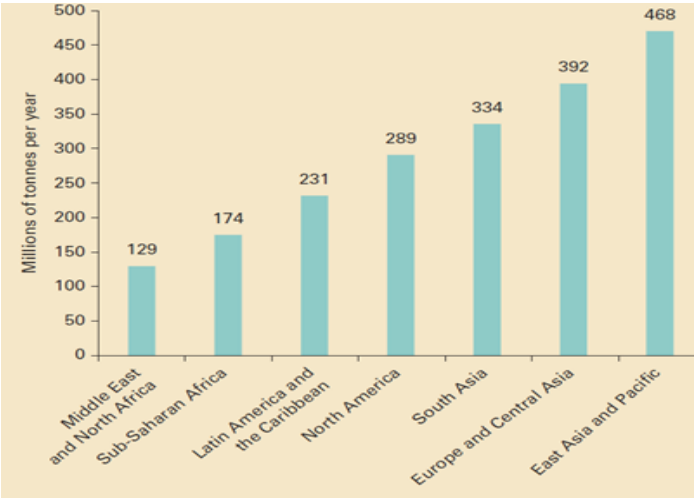

Figure 17: Waste generation by Region (Kaza et al, 2018).

Food and green waste are the largest waste category at an international level and represent 44% of global waste. Dry recyclables, such as plastic, paper and cardboard, metal and glass, represent 38 % of global waste (Figure 18). Higher-income countries generate more paper and plastic waste than in lower-income countries.

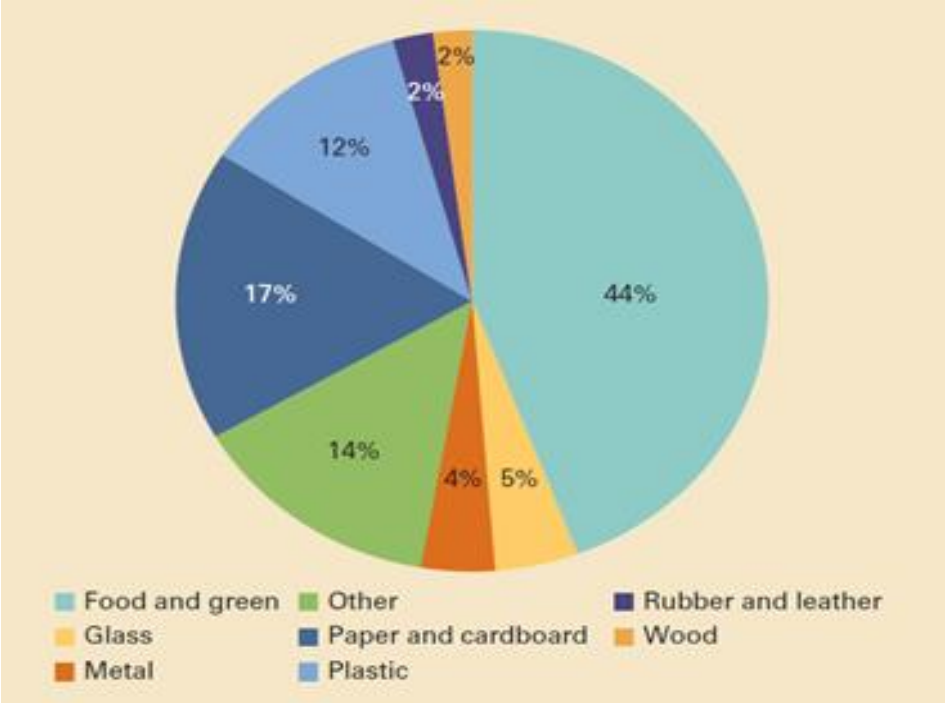

Figure 18: Waste composition on global level.

In 2016, solid waste management generated 1.6 billion tonnes of carbon dioxide-equivalent greenhouse gas emissions. Without improvements, emissions generated from solid waste are anticipated to increase to 2.6 billion tonnes of carbon dioxide by 2050 (Kaza et al, 2018). Figure 19 shows an increase of waste generation by Region until 2050.

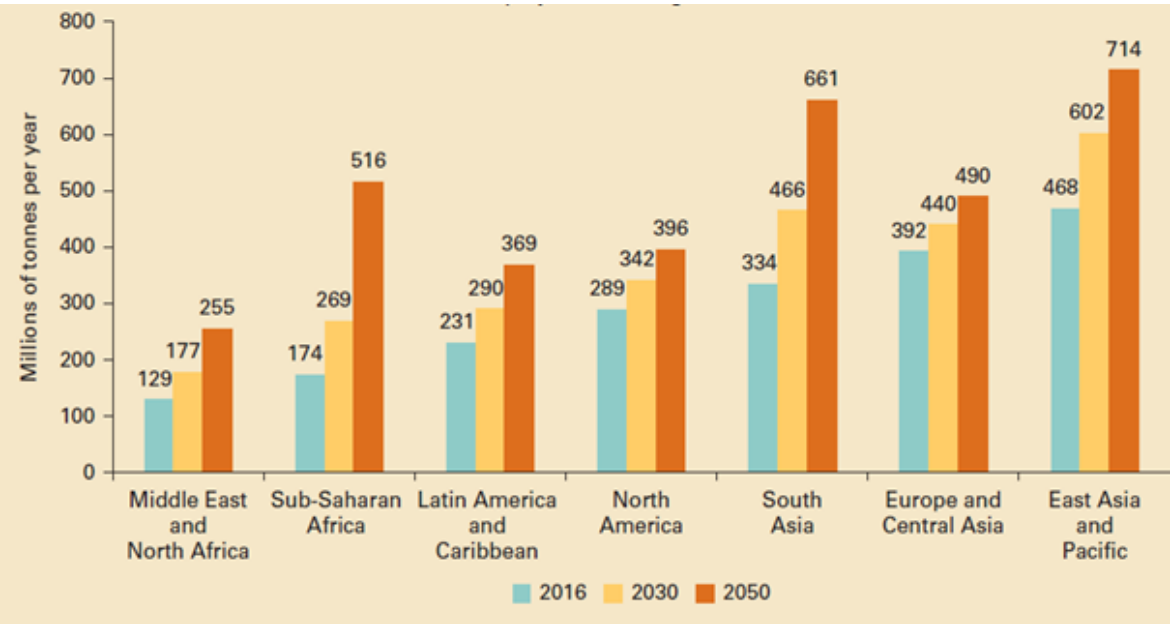

Figure 19: Waste Generation by Region until 2050 (Kaza et al, 2018).

In Europe, 16 tonnes of material per person per year is currently used, and 6 tonnes of this material become waste. Waste management improve in the EU, but the European economy still loses the big amount of potential 'secondary raw materials', such as metals, wood, glass, paper, plastics present waste streams. Total waste production in EU was 2.5 billion tons in 2010. From this amount of waste, only 36 % of waste was recycled, the rest was landfilled or burned.

Each person in Europe is currently producing, on average, half of tonne of household waste. More than 80 % of such waste is landfilled and only 40 % of it is reused or recycled (Waste, 2019).

European Union Action Plan for a circular economy was adopted in December 2015. Later, in 2018 the EU accepted a set of measure that support the EU's vision of a circular economy and implementation of the Action Plan (Kaza et al, 2018). The aim is to reduce environmental impacts and thus achieve effective economic growth (Halkos and Petrou, 2016). One key to a circular economy is turning waste into a resource. The objectives in European legislation have been important drivers to improve waste management, limit the use of landfilling, stimulate innovation in recycling and create incentives to change consumer behaviour. Move to a more circular economy is achieved by re-manufacture, reuse, recycle, and to use waste as secondary raw materials. The circular economy makes it possible to eliminate waste and use resources in an efficient and sustainable way.

The long-term goal of EU waste management policies is to turn Europe into a recycling society and thus to reduce the environmental and health impacts of waste, improve Europe's resource efficiency, reduce greenhouse gas emissions by cutting emissions from landfills and indirectly by recycling materials, and avoid negative impacts of landscape deterioration, landfilling, local water and air pollution, and littering (European Commission, 2010).

Waste hierarchy is the basis of the EU's approach to waste management. It sets the following priority order at shaping waste policy:

1. prevention,
2. (preparing for) reuse,
3. recycling,
4. recovery and,
5. disposal (which includes landfilling and incineration without energy recovery).

The 7th Environment Action Programme sets the following priority objectives for waste policy in the EU:

1. Reduction the amount of waste generated;

2. Increasing recycling and re-use;
3. Limiting incineration to non-recyclable materials;
4. Phasing out landfilling to non-recyclable and non-recoverable waste;
5. Ensuring full implementation of the waste policy targets in all Member States.

Many programs have been implemented in the context of the development and implementation of EU waste policy, for example 7th Environment Action Programme, the Resource Efficiency Roadmap and the Raw Materials Initiative (Waste, 2019).

3.5.2. Waste generation

The natural product of urbanization, economic development, and population growth is waste generation. High-income countries generate 34 % (683 million tonnes), of the worlds' waste. Low-income countries generate only about 5 % (93 million tonnes) of global waste (Kaza et al, 2018).

The total waste generated by all economic activities and households in 2016, amounted to 2 533 million tonnes.

To some extent, the amount of waste is related to the population and the economic size of a country. Thus, smaller EU Member States report lower waste generation level and the larger EU Member States report higher waste generation level. Bulgaria and Romania are Member States that relatively generate the highest quantities of waste and Italy produce the lowest quantities.

911 million tonnes of waste excluding major mineral wastes were generated in 2016 in the EU. In 2016, the EU per person generation of waste amounted to 1 783 kilograms. This is 3.7 % or 63 kilograms more than in 2010. Majority of European countries generate between 1 and 2 tonnes of waste per person per year. Between 2010 and 2016, half of the EU countries reduced their per person waste generation, while the other half increased it.

Figure 20 presents the data for 2016, in the EU-28 by economic activities. For the mining and quarrying were recorded the highest absolute levels of waste generation (25.0 %), following by manufacturing (10.3 %), waste and water services (10.0 %) and households (8.5 %), services (4.6 %) and energy (3.4 %). Waste generation by water and waste services increased by 105.7 % between 2004 and 2016. Waste generated from construction increased only for 4 %, and waste generated by households remained quite stable. On the other side, a drop in agricultural, forestry and fishing waste generation was observed by 67,9 %, that from mining and quarrying by 31.8 %, that from manufacturing dropped by 29.9 % and by other sectors 11.0 % (Waste statistics, 2019).

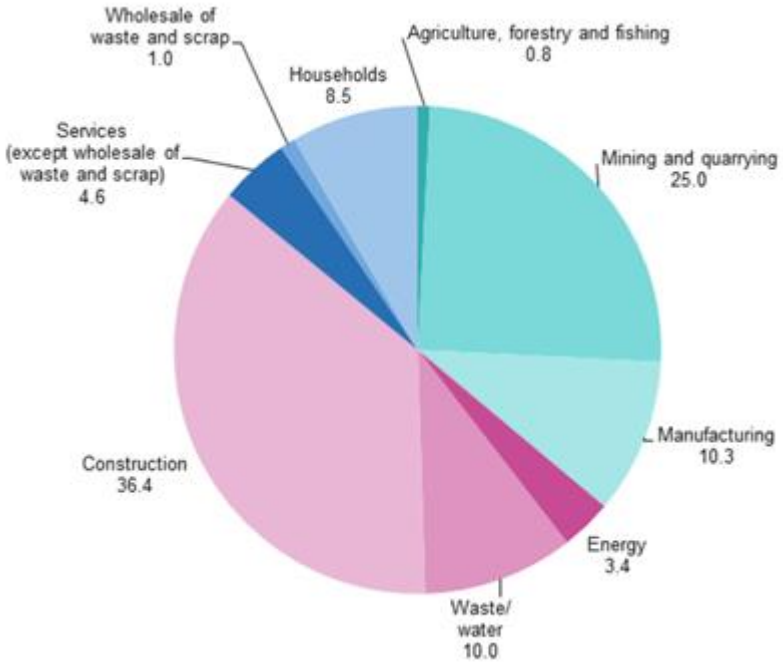

Figure 20: Waste generation by economic activities and households, EU-28, 2016 (Waste statistics, 2019)

Municipal waste. The amount of municipal waste in 2017 was vary considerably. For example, ranging from 272 kg per capita in Romania to 781kg per capita in Denmark. However, it is not yet uniform between countries about collecting and managing a municipal waste.

Between 1995 and 2017 the amount of municipal waste generated per capita, increased in at least 19 countries of 31 countries (Member states and EFTA). In Latvia (2.3 %), Malta (2.0 %) and Denmark (1.9 %) was recorded the highest average annual growth rates. On the other side, in Bulgaria (2.3 %), Slovenia (1.1 %) and Romania (1.0 %) was recorded the reduction of municipal waste generation. Generally, in EU-28 more waste is being generated, but success is seen in decreased landfilling of municipal waste. The amount of landfilled municipal waste in the EU-28 fell by 85 million tonnes (59 %) from 145 million tonnes or 302 kg per capita to 58 million tonnes or 114 kg per capita from 1995 to 2017. Besides that, the amount of recycled municipal waste has increased from 25 million tonnes (11 %) or 52 kg per capita to 74 million tonnes (30 %) or 144 kg per capita from 1995 to 2017. Composting organic material has grown for 5.2 % between 1995 and 2017. Incineration of municipal waste has increased from 1995 to 2017 for 36 million tonnes, which represent 111%. In 2017, accounted 68 million tonnes (Municipal waste statistics, 2019).

Food waste. Wasting food is a big issue in an ethical and economic context. Besides that, wasting food depletes the environment of limited natural resources. In the EU, 88 million tonnes of food waste are generated annually. Wasting food contributes to increase of greenhouse gas emissions, more specifically in EU accounts for % of total greenhouse gas emissions (European Commission, 2019). Households, following by food processing (19 %), food services (12 %), production (11 %), wholesale and retail (5 %), generate over 50 % of food waste.

Hazardous waste. Hazardous waste is a huge issue due to risk to human health and to the environment in the case that they are not disposed safely. In the EU in 2016, 100 million tonnes, which represents 4.0 % of total waste, were hazardous waste. The amount of hazardous waste increased from 2010 to 2016 for 4.6 %. Percentage of hazardous waste in total waste production was below 10 % in all of the EU Member States except for Estonia (39.9 % - because of energy production from oil shale) and Bulgaria (11.1 %), in 2016. Among the non-member countries, Serbia recorded the 35. 2 % of hazardous waste in total waste generation

(the highest percentage because intensive activity in mining and quarrying), Montenegro (19.4 %) and Norway (14.5 %) (Waste statistics, 2019).

Waste electrical and electronic equipment. In the EU represents one of the fastest growing waste, growing at 3-5 % per year. EU legislation promote collection and recycling of such equipment from February 2003. One third of such waste is currently separately collected and appropriately managed. The rest of the waste is collected and treated in various ways. Either is collected by unregistered companies and treated in the proper way or collected by unregistered companies and treated in the improper way or illegally exported or disposed to landfills or incinerate.

Waste treatment. 2,309 million tonnes of waste were treated in the EU in 2016. The data only covers the treatment of waste imported into the EU and excludes exported waste. The quantity of waste recycled, used for backfilling or incinerated with energy recovery increased from 2004 to 2016 by 28.6 % from 960 million tonnes to 1 235 million tonnes. The percentage of such recovery increased from 45.4 % to 53.5 % between 2004 and 2016 in total waste. The quantity of waste subject disposal decreased for 7.0 % between 2004 and 2016 from 1 154 million tonnes to 1 074 million tonnes. The percentage of disposal in total waste treatment decreased between 2004 and 2016 from 54.6 % to 46.5 %. 53.5 % of the waste was treated by recycling (37.5 %), backfilling (10.1 %) or energy recovery (5.6 %) in 2016. The rest amount of the waste 46.5 % was incinerated without energy recovery (1.0 %) and disposed by landfilling (45.5 %). High recycling rates has Italy, and Belgium, while Bulgaria, Romania, Greece, Sweden, and Finland favoured landfill (Waste statistics, 2019). In 2016, 76.4 million tonnes of hazardous waste were treated in the EU-28. More than a half (51.3 %) of the hazardous waste was landfilled. 6.0 % of all hazardous waste was incinerated without energy recovery, 7.3 % was treated in energy recovery, 35.3 % was recovered by recycling or backfilling (Waste statistics, 2019). The EU is trying to move away from disposal waste by landfilling and encourage recycling and incineration. The share of landfilled waste decreased from 28 % to 24 % between 2010 and 2016.

3.5.3. Waste regulations

Directive 2008/98/EC of the European Parliament and of the Council of 19 November 2008 on waste and repealing certain Directives

In order to establish measures to protect the environment and human health by preventing or minimizing adverse effects of waste generation and by reducing overall impacts of resource use and improving the efficiency of such use the European Parliament and the Council of EU adopted the Directive on waste (Directive 2008/98/ec of the European Parliament and of the Council of 19 November 2008 on waste and repealing certain Directives, 2008). Some of the more important provisions of the Directive, which broadly regulates the field of waste management, are presented below.

Member States shall ensure that the law making of waste legislation and policy is a fully transparent process, citizens and stakeholders can be involved in this process according to existing national rules about the consultation and involvement of the interested public (Directive 2008/98/ec Article 4, 2008).

Directive lays down waste hierarchy that shall be applied “as a priority order in legislation and policy in the field of waste prevention and management:

1. prevention;
2. preparing for re-use;
3. recycling;
4. other recovery, e.g. energy recovery; and
5. disposal” (Directive 2008/98/ec Article 4, 2008, p.10).

For the purposes of preventing the formation and re-use, recycling and other methods of waste recovery, Member States may take legislative and other measures to ensure that all natural or legal person who professionally develops, produces,

processes, sells or imports products (producer of the product) has extended producer responsibility. The Directive lays down some examples of such measures:

- “acceptance of returned products and of the waste that remains after those products have been used, as well as the subsequent management of the waste and financial responsibility for such activities;
- the obligation to provide publicly available information as to which extent the product is re-usable and recyclable;
- measures to encourage the designs of products that reduce their environmental impacts and the generation of waste;
- encouragement of the development, production and marketing of products that are suitable for multiple use, that are technically durable and that are, after having become waste, suitable for proper and safe recovery and environmentally acceptable disposal” (Directive 2008/98/ec Article 8, 2008, p.12).

The Directive states that if it is technically, environmentally and economically practicable waste should be collected separately and should not be mixed with other wastes or other materials with different properties. The Directive provided for a separate collection to be established by 2015 at least for paper, metals, plastics and glass (Directive 2008/98/ec Article 10-11, 2008).

Regarding reuse and recycling, the Directive provides for the Member States to take appropriate “measures to promote reuse and recycling in particular by encouraging the support and establishment of reuse and repair networks, the use of economic instruments, procurement criteria, quantitative objectives” (Directive 2008/98/ec Article 11, 2008, p.13).

Member States are obligated to safely dispose of waste by procedures that comply with the rules on the protection of human health and the environment (Directive 2008/98/ec Article 12, 2008). In addition, The Directive states down that Member States should ensure measures, which do not bring the risk to water, air,

soil, plants or animals, do not cause a nuisance through noise or odours and do not adversely affect the countryside or places of special interest (Directive 2008/98/ec Article 13, 2008).

The Directive provides the polluter-pays principle. The original waste producer or current or previous holders of waste cover the costs of waste management (Directive 2008/98/ec Article 14, 2008). Member States must ensure that original waste producer or other holder of the waste carries out the “treatment of waste:

- himself;
- has the treatment handled by a trader, an establishment or a company that carries out waste treatment operations;
- arranged by a public or private waste collector” (Directive 2008/98/ec Article 15, 2008, p.14).

During transfer of the waste from the original waste producer or holders of waste to the entity performing preliminary treatment the responsibility for carrying out a complete recovery or disposal operation shall not be discharged as a general rule (Directive 2008/98/ec Article 15, 2008).

The Directive specifically regulates hazardous waste. Member States must “ensure that hazardous waste is not mixed with other categories of hazardous waste or with other waste, substances or materials” (Directive 2008/98/ec Article 18, 2008, p.15). Any dilution of hazardous substances is prohibited. Mixing of hazardous waste is exceptionally allowed only under certain conditions:

- must be carried out by an establishment or undertaking which has obtained a permit;
- impact of the waste management on human health and the environment is not increased;

- operation conforms to best available techniques (Directive 2008/98/ec Article 18, 2008).

When collecting, transporting and temporary storing, hazardous waste must be appropriately packaged and labelled in accordance with the international and EU standards. During transport of hazardous waste within a Member State, it shall be accompanied by an identification document (Directive 2008/98/ec Article 19, 2008).

Member States must encourage separate collection of bio-waste with the purpose of composting and digestion and the use of environmentally safe materials produced from bio-waste (Directive 2008/98/ec Article 22, 2008).

Any establishment or company intending to carry out waste treatment must obtain a special permission in which it is stated:

- types and quantities of waste that can be processed;
- technical and any other requirements;
- safety and precautionary measures;
- method to be used for each type of process;
- monitoring and control operations;
- closure and after-care provisions.

Permissions may be granted for a fixed time period and can be renewed.

When a permit is issued covering incineration or co-incineration with energy recovery, energy recovery must take place at a high level of energy efficiency" (Directive 2008/98/ec Article 23, 2008, p.16).

For violation of the provisions of the Directive, Member States set their own sanctions. Sanctions should be effective, proportionate and dissuasive (Directive 2008/98/ec Article 36, 2008).

Regulation (EC) No 1013/2006 of the European Parliament and of the Council of 14 June 2006 on shipments of waste

In the field of waste management, European Parliament and the Council of EU adopted Regulation (EC) No 1013/2006 of the European Parliament and of the Council of 14 June 2006 on shipments of waste (2006). Regulation lays down very detailed rules about the procedures and arrangements for the shipment of waste according to "the destination and route of the shipment, the type of waste shipped and the type of treatment to be applied to the waste at its destination. The rules only apply to shipments of waste:

- between Member States;
- transit through third countries;
- imported into the EU from third countries;
- exported from the EU to third countries;
- in transit through the EU, on the way from and to third countries" (Regulation (EC) No 1013/2006 Article 1, 2006, p.5).

On the other hand, Member States "establish an appropriate system for the supervision of shipments of waste exclusively within their jurisdiction" (Regulation (EC) No 1013/2006 Article 33, 2006, p.22).

3.5.4. EU's approach to waste management

The 7th Environmental Action Programme entered into force in January 2014 and will guide European environment policy until 2020. The programme long term-vision is (Waste, 2019; European Commission, n.d.):

"In 2050, we live well, within the planet's ecological limits. Our prosperity and healthy environment stem from an innovative, circular economy where nothing is wasted and where natural resources are managed sustainably, and biodiversity is protected, valued and restored in ways that enhance our society's resilience. Our low-carbon

growth has long been decoupled from resource use, setting the pace for a safe and sustainable global society" (European Commission, n.d., p. 1).

The priorities are grouped into nine goals. Besides that, there are the guidelines for the EU on how to achieve these goals.

- to protect, conserve and enhance the Union's natural capital - from fertile soil and productive land and seas to fresh water and clean air,
- to turn the Union into a resource-efficient, green, and competitive low-carbon economy- special focus on turning waste into a resource, with more prevention, re-use and recycling, and phasing out wasteful and damaging practice like landfilling, and to safeguard the Union's citizens from environment-related pressures and risks to health and wellbeing - pollution remains above acceptable levels in many cities in Europe. The programme sets out a long-term vision of a non-toxic environment.
- better implementation of legislation – the importance of much greater access to information in improving public understanding of environmental issues was recognis.
- better information by improving the knowledge base – knowledge base should be made more accessible to citizens and policymakers,
- more and wiser investment for environment and climate policy, and
- full integration of environmental requirements and considerations into other policies (regional policy, agriculture, fisheries, energy and transport).
- to make the Union's cities more sustainable – Europe is densely populated and 80 % of its citizens are likely to live in or near a city by 2020. In cities there are problems with poor air quality, high levels of noise, greenhouse gas emissions, water scarcity, and waste, and
- to help the Union address international environmental and climate challenges more effectively ‘’ (European Commission, n.d., p. 2).

Circular Economy Package. It includes new proposals in waste legislation to increase recycling of municipal and packaging waste and decrease landfilling by disposal of municipal waste.

1. **Production.**

    - **Product design.** We must strive to produce products that are more durable, easier to repair, upgrade or remanufacture. Valuable materials and components can be recycled. Eco-design Directive is the Commission's directive, which goal is to improve the efficiency and environmental performance of energy-related products.

    - **Production processes.** An important role in production processes play raw materials and renewable materials. EU and non-EU countries have to pay attention to the environmental and social impacts of their production. Promoting innovative industrial processes, such as reuse of gaseous effluents, remanufacturing, is very important.

2. **Consumption.** Circular economy can be supported or hindered by consumers. The Commission is working to give customers more trust in green claims. It is testing the Product Environmental Footprint for measuring environmental performance. For example, Ecolabel is an EU label for products that have a reduced environmental impact throughout their lifecycle. Lifecycle of the product can be also extended by reuse and repair. The development of the circular economy it can be supported by using innovative forms of consumption.

3. **Waste management.** It defines how the EU waste hierarchy is put into practice. The Commission tends to increase recycling of municipal and packaging waste and to reduce landfill.

4. **From waste to resources: boosting the market for secondary raw materials and water reuse.** Recycled materials can be put back into the economy and represent new raw material. In EU, this represent a small proportion of used materials EU.

European Strategy for Plastics in a Circular Economy. Entered into force in January 2018 and deals with transformation of plastic products design, use, produce, and recycle. Plastic waste presents a huge issue around the world, so this action is a priority in the Circular Economy Action Plan (European Strategy for Plastics, 2018). China is the first largest global producer of plastics, following by EU, and about 60 thousand enterprises are involved in the plastics sector with more than one and a half million workers. EU countries generate 25.8 million tonnes of plastic waste annually, with a recycling rate of 30 %. EU has endeavoured to improve the processing of plastic waste and reduce the use of e.g. plastic bags. The goal of European Strategy for Plastics in a Circular Economy is to extend the lifecycle of plastic products by reuse and repair them and increasing recycling and promoting the use of more sustainable materials. Commission's goals are:

- to make plastic packaging reusable or recyclable in the European market;
- to increase the amount of recycled plastic waste from 30% to 50%;
- to grow the market for recycled or innovative plastic products;
- to reduce CO2 emissions and dependence on fossil energy thanks to advances in recycling and reuse;
- to combat the spread of microplastics in water and reducing plastic left in the environment;
- to reduce the number of disposable plastic bags used annually to 90 per person in 2019 and 40 in 2026 (The European strategy for plastic in a circular economy, 2018).

The Roadmap to a Resource Efficient Europe. Entered into force in September 2011. It seeks to transform Europe's economy into a sustainable one by 2050. Recognises the importance of waste as a secondary raw material. It prioritises re-use and recycling and points to the creation of incentives for waste prevention and recycling. The Roadmap includes the reduction of waste generation.

Waste Prevention Programmes (WPPs). Waste prevention strategies available to Member States fall into three broad categories: information, promotion and regulation (European Commission, 2012). Preventing waste being produced is the most important thing and should be on the first place as waste prevention represents the most efficient and sustainable use of resources.

Informational strategies, aimed to change behaviour and make informed decisions, include:

- Awareness campaigns
- Information on waste prevention techniques
- Training programmes for competent authorities
- Ecolabelling.

Promotional strategies, incentivising behavioural change and providing financial and logistical support for beneficial initiatives, include:

- Support for voluntary agreements
- Promotion of reuse and repair
- Promotion of environmental management systems
- Clean consumption incentives
- Promotion of research and development.

Regulatory strategies, enforcing limits on waste generation, expanding environmental obligations and imposing environmental criteria on public contracts, include:

- Planning measures
- Taxes and incentives, such as pay as you throw schemes
- Extended Producer Responsibility policies
- Green Public Procurement policies
- Eco-design requirements'' (European Commission, 2012, pp. 10-11).

Raw materials initiative. ''In 2008, the Commission adopted the raw materials initiative which set out a strategy for tackling the issue of access to raw materials in the EU. This strategy has 3 pillars which aim to ensure:

- Fair and sustainable supply of raw materials from global markets.
- Sustainable supply of raw materials within EU.
- Resource efficiency and supply of ˝secondary raw materials˝ through recycling'' (Policy and strategy for raw materials, n.d.).

3.5.5. Reverse logistics for waste management

Through the challenging targets set by 'producer responsibility' legislation in a range of waste-stream-specific European Directives, the responsibility is on fabricators to produce less waste products by efficient management of resources and include in theirs supply chain also specific waste as source material. Principally the goal is to pursue the product lifetime and try to get the product back into companies supply chain when the customers decided to throw away. To achieve that kind of monitoring system of product lifetime we have to establish centralized and decentralized supply chain mechanisms to be able to coordinate reverse process. With a variety of centralized and decentralized supply chain mechanisms being employed to service retailers, there is potential scope for coordinating reverse processes. With that approach we can reduce waste and more efficiently spent our resources on material needed (Cherrett et al, 2015).

Rogers and Tibben-Lembke (1999) already defined the ‘Reverse Logistics’ as ‘the process of planning, implementing, and controlling the efficient, cost-effective flow of raw materials, in-process inventory, finished goods, and related information from the point of consumption to the point of origin, for the purpose of recapturing value or proper disposal’. Meaning that this process is different than ‘Waste Management’ where the main goal is profitable collection, sorting and processing of discarded products which cannot be reused. Some process such as collecting waste, consolidation for further use and transportation are well-established nowadays in Waste Management especially in urban places and can be adopted in Reverse Logistics process. (Cherrett et al, 2015).

While a path of recovered products is directed towards a reuse market, the the products will eventually end at the landfill sites as a waste (Figure 21) after various treatment processes. However, the increased emphasis on producer responsibility and the policy focus on waste minim-ization and recovery as a result of the EU Waste Framework Directive (2008/98/EC) have led to the distribution and return networks being modified.

If we would be able to establish good data monitoring of a product lifetime and apply it in process of reverse logistics the used products may not be necessarily returned to original factory but to a different point where specific material can be recovered and used as supply material. To achieve this kind of process we have to address the issues of sustainability of such resources and integration within the overall supply chain. The sufficient flow off returning materials to the origin factory and carefully treated wasted products is the essence of reverse logistics since this cycle most importantly affect the negative transport impacts (Cherrett et al, 2015).

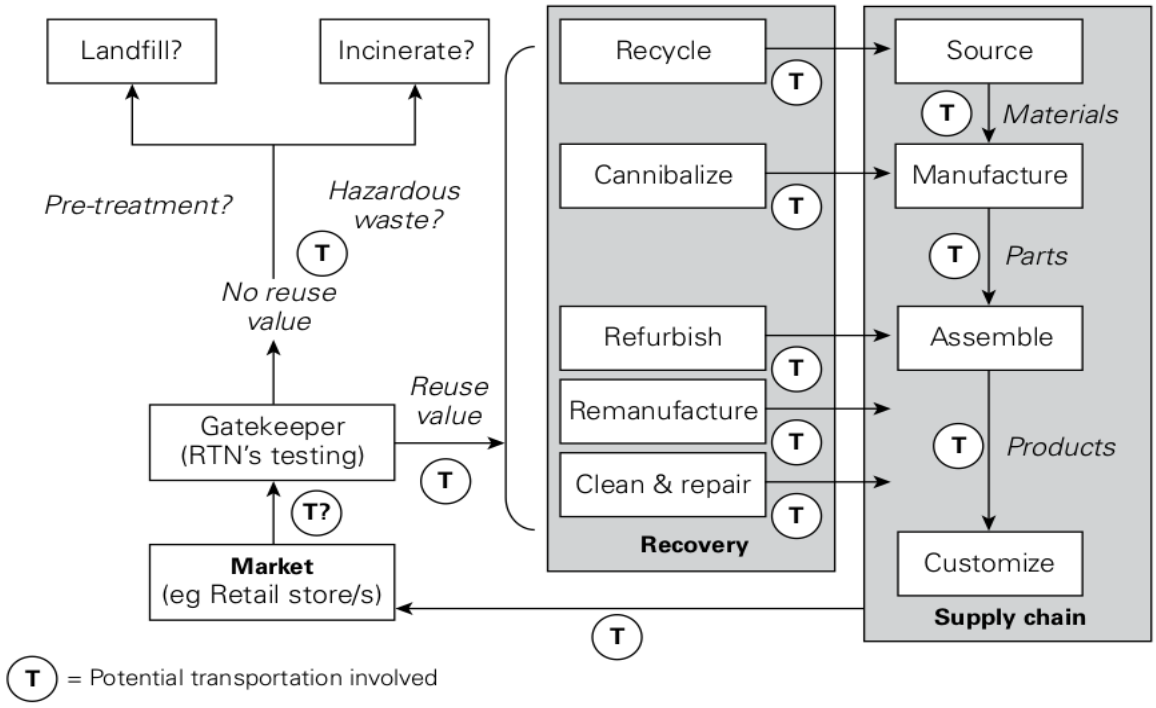

Figure 21: Recovery process incorporated in the supply chain (Cherrett et al, 2015).

In the retail sector we can point out two different processes that's a dressing the returns management (Halldórsson and Skjøtt-Larsen, 2007):

1. The first process includes **collection, inspection, disposition and redistribution** of scrapped products. This process can be organized as centralized task where one organization take care for all the management. However, these tasks can be driven by multiple organizations and collaborate in decentralized reverse supply chain. In this case individual sales outlets act as their own 'gatekeepers', reviewing returned product and deciding should the item be reused or disposed.

2. The second process is **gatekeeping** where individual store He's doing all the inspection and testing. in this case local skill, we will be needed in product inspection. Since this is not an easy process and if the process is not carefully managed and coordinated this can lead to increased waste generation.

Since the wastes are one of the biggest problems regarding the produced amount and transport involved in waste management in we have to establish waste

tank-back systems. In order to do that one option is that we established more facilities for various waste treatments/process for extracting as much supplying material as it is possible. Management of such facilities must be in constant connection with domestic and commercial waste collections. The local collection authority should encourage these types of combined centres and offer SMEs an opportunity to recycle more material.

The other option to reduce the waste impact is to reduce the transport footprint. In that aspect we can use existing delivery mechanisms that serves retail sector to take back damaged or discarded product and associate them into waste management in local centres. Since the transportation is a huge part of the costs in supply chain management this integration of take-back approach could also gain the financial savings. But we have to point out some difficulties that transport companies will meet in such system. One is that transport companies have to have appropriate Waste Carrier Licence to be allowed by Environment Agency for waste transportation. The other problem is that transport vehicles that supplies retailers with goods and consumable products are equipped differently to transport vehicles focusing on waste transport. Although such a system would be more cost-efficient it is very difficult to implement it (Halldórsson and Skjøtt-Larsen, 2007).

We can consider several issues to estimate the opportunity full using existing delivery transportation also for take-back process:

1. ***Do the delivery vehicles have spare capacity in delivery rounds?***

   In this case the single-drop delivery rounds have more potential to be involved in take-back process since vehicles are loaded at one place and fully unloaded at the final destination. The take-back process can be planned for the return journey. However multi-drop delivery rounds are more problematic. Not only that this process is more time consuming as it is necessary to collect, consolidate and store returns at each stop, but it is difficult to ensure that

products would not share the same storage space with recyclate/returns material.

2. ***Is the frequency of the vehicles service frequent enough?***

Considering the cost of storage, the goods one of the retails' management strategy is to keep the storage space as small as possible. In that situation the demand for frequent delivery of goods and waste-collection service is highly desirable. Although if some retailers have the opportunity to enlarge the storage space this is certainly not the case for all of them - especially those businesses that operate in historic city centres. The opportunity of available backloading strategies highly depend on demand of supply chain needs.

3. ***What kind of material is suitable for backloading process?***

The collected material is highly depended on the end-processor and must meet its specifications. Although the mixed collection of waste is desirable, but it is highly unlikely to expect that the end-processor will be able to manage such a variety of waste. Since waste sorting and recycling process can be very complicated and sophisticated is more common to expect that the backloading process will manage only 'clean', uncontaminated material such as: paper, cardboard and specific type of plastic.

4. ***Considering the equipment needed...***

In practice we cannot expect that mix waste will be suitable for backloading. Retailers should consider if the sorting is an option for them since this process requires an extra space and special equipment such as: bucketsm bins, sacks, compacting and baling machines, lifting mechanisms and waste-collection vehicles… Furthermore, an existing equipment used in vehicles for goods delivery defines the nature of items that can be returned.

5. ***Considering the waste/recyclate material final destination point.***

Usually the waste/recyclate material is gathered in regional gathering centres where the waste is properly sorted and, in some cases, recycled to some degree. However, the situation can be more complex if the same vehicles are used for the delivery and back-loading. In this case scheduling such a delivery process is not an easy task and even can be more complicated if backloading has to be done at several endpoints. Moreover, the reprocessing facilities are usually not equipped for accepting delivery vehicles.

6. ***How often and regular the backloading process can be?***

To have effective scheduling off delivery and backloading processes there should be a regular and stable workflow. If the sale and/or manufacturing process off retailer is highly dependent on some or several variables it might be difficult to coordinate backloading process as part of the delivery structure.In practice the back-loading process can be incorporated into supply chain management strategies of small to medium-sized businesses in regards of minimizing the overall costs. This type of businesses has several advantages: they do not produce significant volumes of waste end they are usually specialized in one particular task thus do not produce a variety of different types of waste what simplifies the sorting process.

3.5.6. Green Supply Chain Management

Green supply chain management (GrSCM), a term and a concept that is defined to have its roots in both environmental management and supply chain management and is mainly driven by the escalating degradation of the environment (Ahi & Searcy, 2012; Srivastava, 2007). It is a composition of the commonly known concept of supply chain management (SCM) and the component “green”, which together is mainly about logistics and environmental thinking. GrSCM also has close

connections to sustainability and integration of economic, environmental and social systems in organisations (Brindley & Oxborrow, 2014; Ahi & Searcy, 2012).

According to Morrissey and Browne (2004), some effective tools can be used in economic and environmental aspect to gain profit with optimisation of waste management by using a GrSCM. They suggest three categories each with different analytical tools of waste management:

1. ***Cost-Beneficial Analysis:***

   The cost-benefit analysis (CBA) measures all impacts in monetary terms, whereas environmental impacts must be estimated into money and include the cost of avoiding a negative effect, which for example can be done by pollution control (Morrissey & Browne, 2004).

2. ***Life Cycle Assessment:***

   The life cycle assessment (LCA) model considers all potential environmental impacts during the lifetime of a product – from raw material to final disposal. Production processes are reviewed in order to get an overview of the complete product system (Morrissey & Browne, 2004).

3. ***Multi-Criteria Decision Analysis:***

   The multi-criteria decision analysis (MCDA) identifies several criteria and alternatives simultaneously (Morrissey & Browne, 2004). Instead of only considering a single dimension objective function as in the cost-beneficial model, the MCDA approach is to analyse several individually and often conflicting criteria in parallel, which leads to a more robust analysis.

Furthermore, Morrissey and Browne (2004) point out that different types of organisations must use different strategies, and a for-profit organisation is most likely to differ in strategy from a non-profit organisation. Therefore, it is stated that these

analytical tools by themselves are not a sustainable approach, this since there are flaws that need to be further studied for each to be used by themselves.

In general, GrSCM can be divided in two parts: supply chain management (SCM) and environmental thinking. The first part, SCM, very well established in the most companies and is about the decision making in the areas of ***production, inventory, location, transportation and information*** (Hugos, 2018). The sum of these decisions will determine the effectiveness of the supply chain and how the company will perform compared to its competitors. The logistics behind every step above could be addressed to waste management rather than the whole value chain of a product or service as it is described by Hugos (2018). Because waste management is strongly connected to SCM and GrSCM (Paulraj, Chen, & Blome, 2017; Ahi & Searcy, 2012; Srivastava, 2007). The steps above from a waste management perspective could be perceived as follows:

1. The ***production*** is where the waste originates.
2. The ***inventory*** is how much waste that could be stored at each location in the supply chain and where it is a balance between cost of waste gathering and waste storage facilities.
3. ***Location*** is where and how many of these storage facilities that should exist, it must also be cost-efficient and facilitating for the employees.
4. ***Transportation*** is how waste should be moved between the nodes in the supply chain, once again it must be cost and time efficient.
5. Gathering of the ***information*** from each step in the supply chain is as important as it is to know how to improve the supply chain and how to be able to make the right decision in future planning.

The second part, the environmental thinking is as mentioned before driven by the environmental degradation of the planet, global warming and climate change among other phenomena (Srivastava, 2007). Organisations can achieve many benefits by focusing on environmental initiatives, and the component “green” has

been developed to incorporate not only environment, but also economic and social aspects (Ahi & Searcy, 2012). More sophisticated approach benefits to the company to be more sustainable in the long run.

To analyse GrSCM and to connect it with waste management, three suitable analytical tools (cost-benefit analysis, life cycle assessment and multi-criteria decision analysis) can help broaden the perspective and to adopt the sustainable approach (Bansal & DesJardine, 2015; Ahi & Searcy, 2012; Morrissey & Browne, 2004).

COST BENEFIT ANALYSES

Cost-benefit analysis (CBA) is an analytical tool that compares the benefits to the costs of a specific decision done by a business regardless of the subject matter. By applying the same strategy on waste management, it is possible to analyse the problem in further depth. CBA consists of multiple stages, and these multiple stages are necessary for a CBA to be successful (Björklund and Fors, 2018):

1. **Definition of project:** The link between the analysed project and waste management is explained. In the terms of objectives, it has to be addressed: what welfare and time which are considered. In this step private costs, social costs, and benefits are examined related to the general term of welfare. The private costs mentioned are often connected to operation and management or capital investment while the social costs often are linked to externalities that occur from the proposed project. The benefits mentioned are directly related to the incomes provided by performed services and all these together become a significant part of the overall welfare connected to the project.
2. **Identification of physical impacts:** All impacts must be defined with a physical value, which later is used for monetary calculations within the projects. Also the carbon emission must not be overlooked and since most of the countries have taxes on carbon emissions can be easily transformed into money value. By representing these values regarding carbon savings, it is

possible to do a proper analysis whether the carbon emissions are decreasing or not which can lead to conclusions regarding climate change effects with the project. This is not only applicable to carbon saving but to all possible externalities and physical impacts that can arise with a suggested project.

3. **Valuation of physical impacts:** Björklund and Fors (2018) concludes from several studies that the main environmental and physical impacts that should be given a monetary value are emissions of different kinds and origins when it comes to waste management. It is important to notice that there is more than one possible approach to the CBA, for example, the European Commission has developed a pathway methodology usable when impacts are to be valued in monetary terms. This pathway methodology could be adapted to fit other studies to ease up the general use of the CBA method.
4. **Cost and benefit flow discounting:** The cost and benefit flows are discounted and compared to each other. Present values regarding time value of money are needed for both flows to more easily compare them. Therefore, the monetised valuations of the costs and benefits are discounted and transformed into present values.
5. **Sensitivity analysis:** This step is done to determine how the different values from the earlier steps are impacting the comparison of the projects. When all the mentioned and explained steps are taken in mind, the CBA can show both quantitative and qualitative results regarding the existing and the proposed projects within the waste management sector (Björklund and Fors, 2018).

LIFE CYCLE ASSESSMENT

Life cycle assessment (LCA) is a method used that addressing environmental impacts of a specific product with concerns for environmental sustainability. LCA tool is one of the most frequently used to optimise a process containing waste management. In more detail this tool is used to assess strategies, methods, models and different technologies regarding waste management since include unique

properties and possibilities of comparisons and calculations of environmental impacts and waste management optimisation processes (Björklund and Fors, 2018). LCA can be compared to “reverse logistics” based on EU directives (sub-chapter 3.5.4) an is also relevant to SCM, which is partly about continuous flows of materials, funds, information across multiple areas and the process from raw material to the end user; which makes organisations increase their consideration of the life cycle assessment (Ahi & Searcy, 2012).

According to Hellweg and Canals (2014) the LCA can be split into four phases:

1. **Goal and scope definition:** This is the major outline of the LCA method, and consist of: 1) material extraction, 2) manufacturing, 3) usage of the manufactured product or service and finally 4) the disposal of the manufactured product or service. This step is important to visualise LCA process from the beginning of the cycle to the end. The material must be extracted either through natural resources or through recycling of old products that can be reused. Manufacturing is the second part and this since the products must be created and produced somehow no matter the specific type of product. The third part is the usage of the manufactured product, and finally, the fourth part of the first step in the normalised LCA model is the disposal of the manufactured product (Hellweg & Canals, 2014).
2. **Inventory analysis:** It gathers inputs (resources) and outputs (emissions) from each process and functional unit within the specific product or service life cycle and compiles them across the complete system to achieve an overall accumulation of information. Subsequently, an initial analysis must be done regarding the environmental impacts and trades from the service or product (Hellweg & Canals, 2014).
3. **Life cycle impact assessment:** This is a calculation, interpretation and indication of how the environmental impacts and trades from both products and services affect the natural environment. The resources and emissions can

be sorted into groups based on specific impact categories and by converting the information to comparable impact units. The results from this phase can help us understand and evaluate the environmental impacts caused by included production phases.

4. **Interpretation:** All information is gathered and compiled in order to properly interpret the actual answers that LCA gives. It is also needed to do this step since it connects to the first phase of the method – the goal and scope definition. All these phases can be connected to waste management and how to consider environmental and cost perspectives.

MULTI-CRITERIA DECISION ANALYSIS

In waste management, as a very complex and diverse process the multi-criteria decision analysis (MCDA) is one of the most sophisticated since considers many different aspects, which can be monetary, environmental or others. The nature of criteria represented in waste manager are very different, some are individual, others are conflicting with each other and hase to be analysed with multidimensional perspectives to achieve an as robust decision making as possible. The process can be seen in Figure 22.

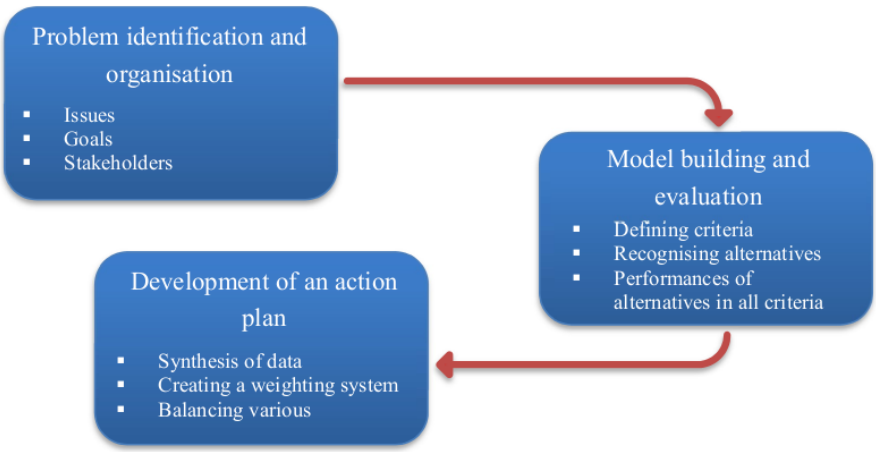

Figure 22: Multi-Criteria Decision Analysis strategy model (Soltani et al, 2015)

In Figure 22, the whole multi criteria decision analysis methodology can be seen from start to end:

1. **Problem identification and organisation:** By this stage is possible to take aspects of known issues, common goals, and different stakeholder interests in mind while performing the analysis (Soltani et al., 2015).
2. **Model building and evaluation:** Next step is to build a model for the specific decision-making process and then evaluate the said model. This modelling refers to defining criteria and by identifying and recognising different alternatives to proceed in the making of the decision and to finally evaluate the performance of all the possible options in each criterion that is being brought to surface within the model (Soltani et al., 2015).
3. **Development of an action plan:** The final step of the general MCDA methodology is to develop an actual action plan for how to make the already built model to work and to solve the problems identified in step one. This to be developed action plan should be a part of creating a weighting system within the model and the specific decision-making together with a careful balancing of all aspects that could be of interest for the decision (Soltani et al, 2015).

MCDA also works for the decision makers concerning learning about the actual problems identified and how to take proper action against each one of these identified problems. Many actors can also be involved in the process, such as a municipality, a government, a company or even its customers. The steps in the method are to identify the problem, defining the different criteria and finally create an action plan with a balance of all the previous viewpoints (Soltani et al, 2015).

3.5.7. Best practices

Some good examples of turning waste reduction, waste prevention and promoting public awareness of the topic into the business abroad EU Members States are presented by European Commission (European Commission 2016):

National Industrial Symbiosis Programme (UK)

The National Industrial Symbiosis Programme has created a network where cooperating together micro, small and medium-sized businesses one producing waste and other can use it. With that program they achieved remarkable results. Only in England they divert 47 million tons of industrial waste from landfill, reduced carbon emissions by 42 million tons, saved over 60 million tons of virgin material, etc.

Vienna waste prevention programme (Austria)

Vienna City decided that they will spend public money for helping small businesses establish services for reuse and repair of goods. The citizens can now buy and sell products through an online flea market. With that program they Repair around 400 tons of products and with that prevent cca. 1000 tons of waste each year.

Stub-Pub (France)

Due to very invasive advertising activity in France the average household received around 15 kg of junk mail in one year resulting into almost a million tons of waste. The French Ministry of Energy and Environment launched a StopPub operation Produced a post box sticker with one can label that he or she do not wish to receive advertising publication. This simple sticker lead to a significant reduction of junk mail and quickly spread to EU countries.

Eco-point initiative (Italy)

The echo Point initiative in Italy is targeting on reducing unnecessary packaging of dry food in supermarkets. Dry food can be both in bulk and do not need an extra packaging. With such an offer shoppers can save around 10% Compared to the price of the package Goods moreover this approach significantly reducing waste produced by grocery stores. With this approach Italy and Switzerland save estimated 1 million packages per year.

Menu Dose Certa (Portugal)

Right Serving Menu (Menu Does Certa) Project Is aiming to reduce food waste. They supporting the restaurants with “know how” to design desirable, right size and appropriate nutritional value meals with minimal food waste. The aim is to reduce the restaurant's food waste by a 48.5 kg per year.

Kringloop Re-use Centres (Belgium)

In today's increasingly consumer-driven society, it is very important to highlight a Kringloop Re-use Centres in Belgium. They focus on extending the product’s lifetime by repairing discarded kitchenware, bicycles, appliances, clothes, furniture and books. With repairing activity, they safe 50000 tons of such items in year 2008 and even increased theirs work by a 10% in 2007.

Questions:

1) **High-income countries generate more waste than low-income countries.**
   a) True
   b) False

Answer: a

2) **Low-income countries generate more waste that could be recycled.**
   a) True
   b) False

Answer: b

3) **In higher-income countries there is more paper and plastic waste than in lower-income countries.**
   a) True
   b) False

Answer: a

4) **Which region generates more waste?**
   a) South Asia.
   b) Middle East and North Africa.
   c) Europe.
   d) East Asia and Pacific.

Answer: d

5) **The largest waste category is:**
   a) plastic.
   b) paper.
   c) food.
   d) metal.

Answer: c

6) **From waste to resources is one of the suggestions of Circular Economy Package. What does that mean?**
   a) Recycling of materials.
   b) Recycling the materials and re-use it as new raw materials in the economy.
   c) Reduction of waste generation.
   d) Limit incineration to non-recyclable materials.

Answer: b

7) **What is Ecodesign?**
   a) Standards for environment-friendly and energy-efficient production techniques.
   b) It identifies products that have a reduced environmental impact throughout their lifecycle.
   c) It describes products that are made from renewable materials.
   d) It identifies more durable or easier to repair or remanufacture products.

Answer: a

8) The Roadmap to a Resource Efficient Europe gives the most attention to:

a) Re-use and recycling of materials.
b) Landfilling of waste.
c) Improve waste management.
d) Ecolabelling.

Answer: a

9) Choose the right order of stages of waste management hierarchy?

a) Re-use, recycling, recovery, prevention, disposal.
b) Recycling, re-use, prevention, recovery, disposal.
c) Prevention, re-use, recycling, recovery, disposal.
d) Disposal, recovery, recycling, re-use, prevention.

Answer: c

10) EU approaches to waste management are increasingly leaning towards circular economy. What is circular economy?

a) A circular economy means the disposal of already used materials.
b) A circular economy means reusing of materials.
c) A circular economy means managing the environment and energy properly.
d) A circular economy means the valuing products, materials, and resources is maintained in the economy for as long as possible, and the generation of waste minimized.

Answer: d

11) The *Directive 2008/98/EC of the European Parliament and of the Council of 19 November 2008 on waste and repealing certain* provided a separate collection to be established by 2015 at least for paper, metals, plastics and glass.

a) True
b) False

Answer: a

12) According to the *Directive 2008/98/EC of the European Parliament and of the Council of 19 November 2008 on waste and repealing certain* the original waste producer is the only one that have to cover the costs of waste management.

a) True
b) False

Answer: b

13) Which of the following things The *Directive 2008/98/EC of the European Parliament and of the Council of 19 November 2008 on waste and repealing certain* does not describe:

a) the polluter-pays principle

b) regulation of hazardous waste
c) detailed sanctions for the provisions of the Directive
d) the components of a special permission for companies intending to carry out waste treatment

Answer: c

14) What does *Directive 2008/98/EC of the European Parliament and of the Council of 19 November 2008 on waste and repealing certain* define regarding to the regulation of hazardous waste? More than one answer is possible.

a) Any dilution of hazardous substances is prohibited.
b) Mixing of hazardous waste is not allowed under any circumstances.
c) When collecting, transporting and temporary storing, hazardous waste must be appropriately packaged and labelled in accordance with the international and EU standards.
d) During transport of hazardous waste within a Member State, it shall be accompanied by an identification document.

Answer: a, c, d

15) What is the scope of reverse logistics for waste management?

a) To reduce collective transport impact.
b) Make products for which there is no longer any reuse potential.
c) To reduce collective transport impact and maximize reuse value from the recyclate generated.
d) To increase emphasis on producer responsibility.

Answer: c

16) All the products after various reverse logistics processes return to their point of origin.

a) True
b) False

Answer: b

17) Which of the mechanism described below is one of the two main mechanisms of return management that is identified within the retail sector:

a) Obtaining Waste Carrier Licence.
b) One organization has responsibility for the collection, inspection, disposition and redistribution of return items.
c) The waste is directed towards the landfill sites or incineration plants.
d) The retailers try to maximize the financial return for the material carried.

Answer: b

18) Which of the questions listed below is NOT a key issue that would have to be considered with regards to using existing delivery fleets for take-back of waste?

a) Which materials may be collected?
b) Where does the waste/recyclate have to be delivered to?
c) How stable/regular is the demand for waste and return goods collection?
d) Will individual sales outlets act as “gatekeepers”, checking returned products?

Answer: d

19) The word “green” in GrSCM - Green Supply Chain Management is mainly about environmental thinking.

a) True
b) False

Answer: a

20) Which of the activities listed below is not one of the suggested three categories of effective tools in economic and environmental aspect to gain profit with optimisation of waste management and have different analytical tools of waste management?

a) Cost-Beneficial Analysis
b) Innovative take-back system Analysis
c) Life cycle Assessment
d) Multi-Criteria Decision Analysis

Answer: b

21) Which of the descriptions below is the most appropriate for SCM – Supply Chain Management?

a) Decision making in the area of production, inventory, location, transportation and information.
b) Focusing on environmental initiatives, economic and social aspects.
c) Reducing waste output and better management of respective logistic operations.
d) Focusing on spending public money on the green services and products.

Answer: a

22) Choose the right order of proper stages of the Cost-benefit Analysis (CBA) to be successful:

a) Scope definitions, identification of physical impact, valuation of physical impact, cost and benefit flow discounting.
b) Scope definitions, sensitivity analysis, identification and valuation of physical impact, cost and benefit flow discounting.
c) Definition of the project, identification of physical impact, valuation of physical impact, cost and benefit flow discounting, sensitivity analysis.
d) Definition of the project, model building and evaluation, cost and benefit flow discounting, sensitivity analysis.

Answer: c

23) Which of the phase of the Life cycle assessment (LCA) is NOT properly described?

a) Goal and scope definition: consist of 1) material extraction, 2) manufacturing, 3) usage of the manufactured product or service and finally 4) the disposal of the manufactured product or service.
b) Inventory analysis: It gathers inputs (resources) and outputs (emissions) from each process and functional unit within the specific product or service life cycle and compiles them across the complete system to achieve an overall accumulation of information.
c) Life cycle impact assessment: This is a calculation, interpretation and indication of how the environmental impacts and trades from both products and services affect the natural environment.
d) Interpretation: The different meanings of the previous phases are discussed. This phase's outcomes are related to the opinion of the manager and different stakeholder interests.

Answer: d

24) Multi-Criteria Decision Analysis (MCDA) methodology can be divided into three areas /aspects of analysis: Problem identification and organisation, Model building and evaluation, Development of an action plan. Which of the actions listed below is a part of the area Model building and evaluation?

a) Defining known issues
b) Recognising alternatives
c) Synthesis of data
d) Creating a weighting system

Answer: b

25) Eco-points in Italy are supporting restaurants in creating menus that generates less food waste.

a) True
b) False

Answer: b

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Authors:
Gamze YÜCEL ISILDAR
Deniz ISILDAR
Donald Romaric Yehouenou TESSI

4. Benefits of Green Logistics

Emergence of the green logistic can be connected to the increase in awareness and attitudes of individuals, governments and companies because of increasing environmental pollution, carbon emissions and worsening of environmental conditions. The aims of green logistics for both business and industry not only to reduce production cost, created value added, energy save but also kept environment clean and conserve natural resources too. As stated by Xia Yingying den Hans (2011) “The environment has been a concern. It is treated as a factor of the cost. Some companies have already taken external costs of logistics associated especially with the environmental issues such as climate change, pollution and noise into account. Green logistics is therefore defined as efforts to exam ways of reducing these externalities and achieving a more sustainable balance between environmental, economic and social objectives.”

Implementation of green logistics, through its components, presents many advantages and benefits. Indeed, it pursues the long-term goal of resource saving and environment protection which covers both economic interest and environmental benefits (Zhang Zheng and Wang Yu, 2015). It is in relation to many current climate friendly implementations take place in green economies such as green production, green marketing, green consumption, etc. (Xia Yingying den Hans, 2011).

Along this line, in this chapter, first, environmental benefits of green logistics will be examined and then social and economic benefits (in terms of companies) will be discussed. Actually, it is not possible to distinguish between economic, social and ecological benefits of green logistics. All benefits directly or indirectly affect each other. The unification of the economic benefits, social benefits and environmental

benefits is essential. It is what the goals of sustainable development. For this reason, in the final section of the chapter, the contributions of green logistics to sustainable development will be examined in order to reveal the relations and to sum up the benefits in the common denominator.

4.1. Environment benefits

Green logistics help to have a better method of processing of natural resources. It leads to reasonable natural resource utilization and less energy usage. It is found to provide ample benefits: reducing long term risks associated to resource depletion, pollution and waste management, minimizing reliance on scarce environmental resources, while minimizing waste, increasing revenues and profits through significant operational efficiency gains and reduced costs as well as resource efficiency through reduction of material consumption, compliance with regulatory requirements and finally, long-term global viability and sustainability. (Fennema, 2014).

In the packaging sector, materials used, and ways of packaging has been changing. Indeed, materials are more environmentally friendly, reusable and ecologically cost less (better life cycle performance of packaging material). Those better packaging methods help to reduce activities cost an also the ecological footprint of the companies on our earth.

Adoption of new means made in green transportation and the change of habits of managers in shipping's methods have the advantages of reduction of harm to the environment: use of electrical vehicles, reduction of fuel consumption, and change in the transportation hours that reduces noise pollution. In fact, the development of electric vehicles is a plus for reduction of air pollution, emission of CO_2 and to cut down the noise pollution.

In brief, all those benefits are all valid reasons that influence companies' operators' decisions. The environmental benefits can help companies gain carbon

credits which can then be sold to organizations worldwide (Tata Strategic Management Group, 2014).

Table 2 shows the CO2 savings via several components of green logistics (McKinnon and Piecyk, 2012).

Table 2: Estimated CO_2 savings (%)

Carbon-saving measure	Potential CO_2 saving by 2020 (%)
Ecodriving training	5
Speed reduction	2
Switch to biofuel	15–20
New vehicle technology	10
Modal shift	3–5
Optimized vehicle size	7–10
Increased vehicle fill	5–10
Smarter city logistics	2–4

Green logistics benefits can be quantified at the level of companies' business and environmental sector. Benefits from implantation of green logistic can be tangible such as cost reductions of certain activities or more intangible like better reputation or image. The application of the green logistic presents an important and beneficial asset for the companies. Indeed, its advantages are recognized in commercial theme, competitive theme, economic theme related to operational costs.

4.2. Business Benefits for companies

As the environmental problems are becoming critical concerns all around the world, companies feel themselves under pressure to develop environmentally responsible operations. Green logistics is becoming an important priority for many companies in order to respond to the increasingly environmentally sensitivity of customers. Since conventional logistics cannot meet the requirements of current societies and negative impacts on the environment, adoption of green logistics by companies is not only due to the benefits for the environment but also for real potential advantages for sustainability and cost savings (decreased consumption of water, electricity, resources used in production and transportation, increased

recyclable materials, use of reusable packaging and can be reintegrated into the production cycle.)

The development of green logistics at the enterprise level has multiple benefits like increase enterprise performance efficiency and the quality of the services, better indicator for financial performance, attractiveness for new investors (make a difference with competing companies thanks to the quality and durability of products; attract new market by communicating about the greening of its company).

4.2.1. Use of renewable energy, waste products quantity and reduction of cost

Logistics companies used thousands of gallons and types of oils, reflecting a costly price of the fuel. Reduction of waste products includes reduction of thousands of gallons of oils with the used of electric vehicles or better efficiency in transportation service; better life expectancy of all the materials in vehicles by using them not empty from a destination to another. Green transportation carries in logistics sector a good optimization of transport routes. Waste of time also is a problem in logistics activities, with its costs. Emerging of green technologies help to deal with those waste of time by implementing electric vehicles, a better system of shipping to reduce time and energy, increase of renewable source of energy in the distribution centre (energy-efficient warehouse), reuse of waste during the different process of the supply chain. Maritime transportation and usage of electric vehicles are an effective and efficient alternative to reach the goal of the protection of our environment. The company can benefit also by reducing shipping cost, time and get some advantages from the government.

The reduction in the total travelled distance provides environmental benefits, because of the reduction in fuel consumption. Reducing the distance travelled is a major factor in network optimization, emissions and the total supply chain cost might be reduced by this way (Sbihi et al. 2007; El-Berishy, 2017).

4.2.2. Competitiveness and tax reduction

The offer of green products and services oriented to the use of environmentally friendly resources and materials, reduction of emissions of CO2, carbon footprint and greenhouse gas emissions contribute to increase the reputation of companies. When companies go green, it helps them to attract more customers. In fact, with the increasing of people awareness about environmental issues, the public choice is towards companies that respect eco-production and eco-distribution rules and make a compatibility bridge between environmental protection and economic profit.

Governments are also involved in the greening of logistics activities with regulations. From then, the efforts make by enterprise to put into practice green logistics allow them some facilities in tax credits and other inciting advantages compare to their competitors.

By applying the green logistics concept and adding green attributes to their products, companies are getting a new label like “eco-label” to improve their relations with customer and public. It helps them to attract new markets, to ameliorate their image and reputation.

Additionally, the financial benefits of a green logistics chain have been proven. Its application in several large companies has achieved significant results in reducing the impact of their activities on the environment and improving efficiency in the execution of their activities.

As summarized from the literature survey (Table 3), some authors found out that many companies practicing green logistics as it has been described above, that there were various benefits of implementing green practices. Those authors were able to present evidence of green logistics benefits and categorize the most important following a ratio (expressed in rate, % of companies) (Table 3).

Table 3: Benefits for the greening of logistics and supply chain management (% of companies mentioning the benefits)

Benefits cited	Sources
Improve brand image (70%) Satisfy customer requirements (62%) Differentiate from competitors (57%) Reduce logistics costs (57%) Establish a competitive advantage (47%) Optimize logistics flow (40%) Expand to new markets (38%) Optimize manufacturing (35%) Reduce manufacturing costs (32%)	Bearing Point (2008) (Benefits of the green supply chain)
Reduce overall business costs (56%) Enhance corporate social responsibility (54%) Improve profits (48%) Reduce waste/improve disposal (43%); Improve visibility of green supply drivers (41%) Increase use of recyclables (37%) Improve fuel efficiency (35%) Reduce emissions 33%) Develop new products/Win new customers (26%) Reduce use of toxic materials (19% Improve employee satisfaction (9%).	Aberdeen Group (2008) (Best-in-class goals for sustainability initiatives)

4.3. Health and social benefits

Transportation sector through the shipping activities creates a numerous impact on the environment and human health with the production of hazardous waste. Most of the used means of transport functions with fossils fuels. Green transportation has a positive benefit for public health with the reduction of carbon or greenhouses gases particulate which impacts on human health and causes a lot of serious sicknesses. It helps to reduce the direct effects of the means of transport of the lifestyle of mankind.

As green logistics try to implement more green methods over all the stages of the supply chain of products management and logistics activities in general, the benefits in society are the following: better public health due to the depletion of pollution (from transportation, warehousing, packaging sector); better natural resources management and uses, reduction of injuries and death from accidents. It is described by Kumar and Malegeant (2006) as seen in Table 4.

Table 4: Contribution of Green Logistics to the creation of economic and social value.

Creation Value	
Economic	Social
Enhanced customer satisfaction	Reduction in environmental impact (such as; carbon dioxide emissions, noise levels)
Better relations with stakeholders	Rational use of natural resources
Green image	Development in harmony with culture and available resources
Higher distribution safety through optimized route planning and less truck downtime	Reduced social cost (such as; health problems in the communities)
Higher productivity through higher motivation of the employees	Access to clean water and clean Energy
Reduced liability risk	Creation of jobs
Reduced taxes	Enhanced quality of life
Improved financial performance	

Source: (Kumar and Malegeant, 2006)

4.4. Green logistics and sustainable development

Sustainable development has been defined in many ways, but the most frequently quoted definition is from “Our Common Future”, also known as the Brundtland Report: "Sustainable development is a development that meets the needs of the present without compromising the ability of future generations to meet their own needs (Kinoti, 2011). In this definition, needs and limitations are the key concepts. After the United Nations Conference on Environment and Development (UNCED) organized in Rio (1992), the resulting document of the summit was called the Agenda 21. Sustainable development has been carried out from Agenda 21, which also influenced companies’ business activities. As a key business performance activity, logisticians and supply chain managers in companies could no longer ignore the importance of sustainability in logistics. (Yingying Xia & Bo Wang. 2013; Hans, 2011). Green logistics definition is based on the ideas that can be related to

environmental and social sustainability and economic profits. As Alshuburi (2017) stated “many companies have special reasons for establishing the concept of sustainable development within the green logistics concept, as the result of pressure by customers and the desire to promote the company’s image and challenge the green competition in the market.”

The implementation of a sustainable development approach within a company is transverse insofar as it affects almost all the functions of the company (production, transport, etc.) and in the first place the supply chain, because it has a leading role to play, especially in the protection and preservation of the environment (Breka and Gaultier-Gaillard, 2013).

Implementation of green logistics offers logistics sector a pathway to facilitate the adoption of the ‘Sustainable Development Goals’ (SDG). In fact, the goals implicitly recognize the role that the logistics industry has to play in achieving the SDGs. So, logistics is more than just an environmentally sustainable sector, it facilitates a wider sustainable development (Willis Towers Watson, 2018).

As underlined by Alshubiri (2017), the link between green logistics and sustainable development is important, and the contribution to each other, success is obvious:

- Pagell and Wu (2009) emphasized that “sustainable development will continue in the companies, thanks to the administrative examination practices that lead to the good management of the supply chain, which is a combination of financial-economic and social activities, thereby achieving the goals of the green logistics concept.”
- Gold and Seuring (2011) indicated that “sustainable development is part of green logistics, which companies seek to take into account in terms of creativity at work and the differentiation of action in order to achieve competitiveness in the market and improve the quality of services provided to customers.”

- Stolka (2014) found that the “environmental component of green logistics is the most influential factor in sustainable development and that resources must be consistent with the goals of organizations.”
- Kumar (2015) explained that the “environmental component of green logistics provokes changes in the decision-making processes in companies, and these contribute to the development of the concept of sustainable development.”

In the Context of the Sustainable Development Goals (SDGs), the benefits of green transport, an important component of green logistics, are not exclusively accrued by freight operators or individual nations, but rather serve multiple public policy goals locally, across borders and throughout supply chains. Green logistics promote sustainable development by facilitating economic development, trade, improving access and linking communities and societies to end poverty, protect nature and ensure wellbeing. Table 4.4. indicates how green logistics supports the achievement of the SDGs directly or indirectly. Green freight supports and plays a role in the achievement of the SDGs, by calling to actions (Sehlleier et al. 2017).

Table 5: Green Freight and the 17 SDGs* (authors’ analysis)

Sustainable Development Goals	Relevance or Role of Green Logistics
(1) No poverty	Efficient trucking encourages trade and thus contribute poverty reduction and well-being.
(2) Zero hunger	-Improvements in transportation, cold chains, etc. will help to increase food availability. -Development of inland dry ports as logistics centres will be beneficial for collection and distribution of rural products.. -Supporting self-sufficiency reduces ‘food miles’.
(3) Good health and well-being	- Eco-driving and cautious driving preparing prompts more secure driving practices. -Better maintained vehicles are less likely to experience critical failures. - Telematics hardware improves both eco-friendly driving and street security. -All green cargo measures, especially those in a urban setting, diminish emanations of air contaminations and their related wellbeing impacts.
(4) Clean	- Reduction of spillage of fuel and other toxic substances by taking

water and sanitation	necessary precautions - Reducing air pollutant to minimize atmospheric deposition in water -Standardization and proper handling of hazardous goods reduces accidental discharge of toxic substances.
(5) Affordable and clean energy	-Burn less -Burn clean Developing infrastructure for with less carbon emissions, more climate friendly fuels
(6) Decent work and economic growth	- Greener and increasingly proficient cargo transport cuts down transport and coordination costs. -Efficient freight transport infrastructure and logistics support trade and market access at the national, regional and global levels and have positive impacts on economic growth and productivity throughout sectoral supply chains. -The freight transport sector is a significant employer and is dominated by small and medium-sized enterprises (SMEs).
(7) Industry, innovation and infrastructure	-Further advancement of railroad arranges inside and between nations advances mode moving and encourages exchange. -Emergence of dry ports and ports as an efficient intermodal interchange. - New infrastructure is required in many countries, but also existing improvements (e.g. roads, ports, terminals, etc.) should be maintained for sustainable efficiency, safety and for minimum impacts on nature.
(8) Sustainable cities and communities	-Efficiency gains in urban coordinations diminish the general travel of cargo vehicles in urban communities, lessening mileage on framework, improving street wellbeing for all clients, battling blockage, decreasing commotion contamination and adding to urban bearableness. - Green logistics upgrades may likewise redistribute some cargo transport to territories more averse to affect non-mechanized vehicle and open vehicle modes. - Optimizing urban logistics coordination will include making 'last mile' cargo transport progressively effective (for example through course arranging and planning). - Investments in cleaner vehicles or powers will decrease emanations per kilometre went inside urban communities – in this way lessening discharges of destructive air contaminations.
(9) Responsible competition and production	-As part of greening logistics, firms also look at green packaging alternatives, decreasing negative environmental impact of warehousing and minimizing waste via reverse logistics activities. -Training, technology, infrastructure and organizational improvements can help boost the efficiency of the transport of food from sources to processors, wholesalers and ultimately to consumers. -Supporting the safe transport of dangerous goods can help to ensure

	environmentally sound management of chemicals and other hazardous materials throughout their life cycle. -Vehicles contain hazardous materials; green freight programmes can address end-of-life disposal or recycling.
(10) Climate action	Comprehensive green cargo foundation ought to be arranged, structured and worked in light of atmosphere flexibility. - Climate change alleviation is a centre head of green cargo and coordination, and without tending to the cargo division, worldwide atmosphere objectives can't be sensibly met.
(11) Life below water	-Environment-friendly practices in shipping, port operations and shipyards help to protect aquatic life. -Ballast water management standards and treatment systems.
(12) Life on land	- New streets ought to be intended to limit the fracture of environments and supplemented with afforestation endeavors. - Eco-driving and protective driving abilities help to lessen roadkill. - Reducing air contamination from cargo transport likewise mitigates the part's effect ashore living spaces
(13) Partnerships for the goals	-Public-private partnerships and common platforms are needed to incentivize industry-wide change and can be integrated into green freight programs. -Technology and know-how transfer to developing economies in Asia is a key ingredient to the necessary low carbon transformation of freight transport.

Source: Sehlleier et al. (2017): Based on a brainstorming activity with participants of the Green Freight Day at the Better Air Quality in Asia Conference 2016.
*for the 4, 5 and SDBs goals, no significant green freight contribution has been identified by the authors.

The most important benefit of green logistics implementation in the logistics sector is to help the promotion of sustainable development goals and encourage sustainability in many sectors.

4.5. Benefits of components in green logistics

Benefits of green logistics could be sum up according to the each components as given by Zhang zheng and Wang yu (2015); Tata Strategic Management Group (2014):

4.5.1. Warehousing

- Reducing of physical footprint;
- Reducing of products damage, reducing of defective goods, damaged goods, and obsolete goods: less raw materials used and less pressure on natural resources;
- Reducing waste: by implementing reuse and recycle initiatives, water saving initiatives;
- Reduced energy and utilities consumption: by adopting sustainable and energy-saving alternatives, more environmentally friendly and less costly, and use energy-efficient equipment (save on cooling or heating of the warehouse, select an efficient source of light to decrease electrical costs);
- Higher space utilization, strengthen storage control, improve the commodity turnover rate;
- Layout optimization minimizes movement and increase firm's productivity in terms of reducing cost and increase profit; reduction of transportation cost.

4.5.2. Green Packaging

- Improved packaging material utilization/ reduced inventory;
- Use of minimal materials to reduce packaging cost;
- Lower waste disposal costs;
- Use recycle, reuse materials, minimize waste and use of material and time to unpack;
- Brand recognition (eco-responsible company image; supports from customers).

4.5.3. Green transportation

- Increase of enterprise's performance efficiency (Fuel cost saving);

- Satisfaction of social needs of drivers (time-saving, a decrease of congestion, the safety of the driver), a decrease of the number of accidents;
- Increase the security of workers, increase comfort level;
- Increase competitiveness (increase speed/ shorten transport time).

4.5.4. Standardisations

- Synchronized supply chain with better visibility and lower operational costs;
- Improved truck and material handling equipment utilization ;
- Development of pooling and hiring system.

4.5.5. Network Optimization

- Distribution & transportation efficiencies
- Reduced reverse logistics;
- Improved fleet management.

Multiple-Choice Questions:

1) Which of the following is NOT true for the direct benefits of green logistics?

a) Reduction of fuel consumption
b) Cut down the noise pollution
c) Reduction of water pollution
d) Reduction of air pollution

Answer: c

2) The purpose of green logistics is:

a) provide customer satisfaction
b) improve quality of environment
c) provide better image for companies
d) all of the above

Answer: d

3) Which of the following is NOT true for the economic benefits of green logistics?

a) Development in harmony with culture and available resources
b) Green image
c) Reduced taxes
d) Reduced liability risk

Answer: a

4) The concepts of the three pillars of sustainability are:

a) Economic, Social, and Environmental
b) Environmental, Economic and Legislation
c) Social, Legislation, and Economic
d) Social, Equitable and Economic

Answer: a

5) Why should people be concerned about sustainable transportation?

a) For the environment
b) To save money
c) For human health reasons
d) All of the above

Answer: d

6) What is the primary greenhouse gas emitted by burning the fuels we most commonly use in transportation?

a) Carbon monoxide
b) Carbon dioxide
c) Sulfur oxide
d) Methane

Answer: b

7) Which one of the benefits cited most by companies implementing green logistics?

a) Expand to new markets
b) Optimize manufacturing
c) Improve brand image
d) None of the above

Answer: a

8) Which component of green logistics has the highest environmental benefits?

a) Warehousing
b) Data management
c) Packaging
d) Transportation

Answer: d

True-False Questions

9) Green logistics is a way of achieving a more sustainable balance between environmental and social objectives.

□ True
□ False

Solution: False. (also economical objectives)

10) When companies go green, it helps them to attract more customers.

□ True
□ False

Solution: True.

11) By applying the green logistics concept and adding green attributes to their products, companies are getting a new label like "eco-label".

□ True
□ False

Solution: True.

12) Further development of highway networks within and between countries promotes mode shifting to green logistics.

□ True
□ False

Solution: False. (railway)

13) Vehicles contain hazardous materials; green freight programs can address end-of-life disposal or recycling.

□ True
□ False

Answer: True.

14) Green packaging improves fleet management.

- True
- False

Answer: False.

15) Reducing spillage of fuel and other hazardous substances from vehicles by better maintenance practices help to reach SDG no 7 (affordable and clean energy).

- True
- False

Answer: False.

16) All green freight measures, particularly those in an urban context, reduce emissions of air pollutants and their associated health impacts.

- True
- False

Answer: True.

17) Minimizing the distance traveled is a key step in network optimization because it reduces both emissions

- True
- False

Answer: True.

18) "Improve employee satisfaction" is the least cited benefit of green logistics by the companies.

- True
- False

Answer: True.

19) In fact, with the increasing cost of transportation in green logistics, the costumers' choice is towards conventional logistics.

- True
- False

Answer: False.

OTHER TYPE OF QUESTIONS

20) Which of the followings are benefits of green warehousing? (more than 1 answer is correct)

a) Reduced energy and utilities consumption
b) Reduced waste
c) Use of minimal materials for packaging

d) Satisfaction of social needs of drivers
e) Use energy-efficient equipment
Answer: a), b) and e).

21) Green Packaging helps to: (more than 1 answer is correct)
a) Increase the security of workers
b) Development of pooling and hiring system
c) Use of minimal materials to reduce packaging cost
d)Lower waste disposal costs
e) Brand recognition
Answer: c) and d) and e).

22) Green Transportation helps to: (more than 1 answer is correct)
a) Decrease in carbon footprint
b) Satisfaction of social needs of drivers
c) Development of pooling and hiring system
d) Increase competitiveness
e) Brand recognition
Answer: a) and b) and d).

23) Which of the following is true for the social benefits of green logistics? (more than 1 answer is correct)
a) Creation of jobs
b) Improved financial performance
c) Access to clean water and clean Energy
d) Development in harmony with culture and available resources
e) Good relations with stakeholders
f) Green image
Answer: a) and c) and d).

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Authors:

Altan DIZDAR

Ertuğrul DIZDAR

Çağan DIZDAR

5. Urban Logistics

5.1. Introduction

Urban logistics / City logistics mean to supply freight distribution in urban areas, developing plans raising its complete proficiency against traffic jam & emissions. Its aim is to supply assistance for a proper & efficient transfer of products in the cities & to create the best solutions to consumers' requests.

'Urban logistics' is also described as the transportation of the products, materials & waste within, into, from, out, within or through the urban place.

Thus, Urban Logistics provides the mobility of urban freight through the transportation of goods by or for commercial entities taking place in an urban area. It is one of the most important focus topics in the European Commission's Urban Mobility Package and also necessary for cities to operate successfully and to establish a good harmony with the urban traffic.

Here below, some types of transportations are shown:

Figure 23: Types of transportations

Ref: https://unsplash.com/search/photos/green-transport , https://unsplash.com/search/photos/green-transportation , https://unsplash.com/photos/4H_I-HRjkyA

Most of the people populate in cities, approximately 60 % out of 10 000 people are living in cities. They stay at the same place during their daily stayings & when they go out, they use the common foundations. Mobilities in the cities creates 40 percent of the carbon dioxide discharges of the transportation from the roads & 70 percent of other contaminants from transportation.

Therefore, urban places always encounter difficulties occurred from traffic & transportation. So, it must be solved, while making the mobility, how can we reduce the pollution, traffic jam & also accidents where they are a common problem all around the world.

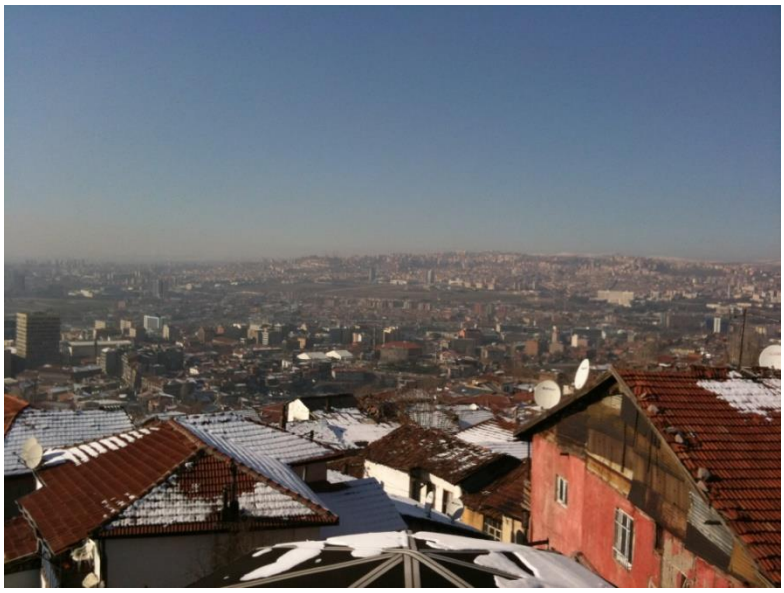


Figure 24: Effect of urban logistics on the air pollution of the city

5.2. Eu Policies & Directives

Directives belonging to urban transportation have been set by the European Union. The efficiency of the transportation method of the European Union, social & economical situations, changes in the climate & energy requirements are also related with the decisions taken by the authorities.

Cities are very important locations for the transfer of materials & knowledge, where cities are the main points for our way of life & also for the economy. In order to have comfort & safety at the cities, they are needed to be optimised for the transfer of materials & knowledge with the supplement of keeping the cities as charming locations for working & living. In city logistics, it must be satisfied that stores are kept with the required needs, instruments are working, transfers to houses are made without any obstacles, everything is supplied to everywhere & their trashes are taken away as well. As these deliveries must take place every time & to everywhere, if these logistics necessities are not done properly, this will lead to disruptions in the city logistics & it will cause to pollution. Improving the efficiency of the deliveries is very important for the growing economy. An increase in the city population when gathered with the other facts such as delivery to houses, getting the population ages older, making the e-commerce will cause a higher compactness & a higher requirement for the services & products & as a result, there will be significantly increased demand for urban logistics.

European Commission gave utmost importance for the reduction of the carbon dioxide in urban logistics & they sent a report on the reduction of carbon dioxide from the new trucks. The new trucks will be in use shortly. Around 2020's, European Commission will reduce gas emissions by 6 percent from the transportation fuels.

Overcrowding makes a bad influence on the race & on the economy of the cities; logistic movements will not be efficient & the costs will be increased. This will be a barrier for the enlargement & growth of the deliveries as the costs will be high. City logistics effects the environment in respect with green house emissions, pollution of noise, air quality & damage of the road. Costs of freight transportation increases in more densely populated areas in the cities. Meantime, buying on-line will be able to decrease the costs for the delivery to the people & increase the efficient delivery to the customers.

Regardless of the struggles of urban areas & countries, to lower these gas emissions demands a lot of works in the future. It is necessary to make a

development & innovations in the cost effective solutions for the urban transportations.

Figure 25: Typical traffic congestions in the cities

Ref: https://unsplash.com/photos/YCUBnYTicwk

Share in carbon dioxide transport emissions are defined as follow

Freight 40 percent	Passengers 60 percent
Inter-urban freight 23 percent	City travel 17 percent
City freight 6 percent	Inter city travel 33 percent
Inter continents freight 11 percent	Inter continents travel 10 percent

Figure 26: CO2 emissions from transport (Source: PRIMES and TREMOVE)

5.3. Main Problems in Urban Logistics

In urban freight transportation, it is seen that almost all of them are done by road & this brings some problems together. It is needed to set goals & set some rules while considering the problems of congestion, air pollution, noise, security & violations. Acceptance areas, urban logistic and policy measures must be developed to reduce these important & negative impacts of freight traffic. Some of the problems can be listed as follows:

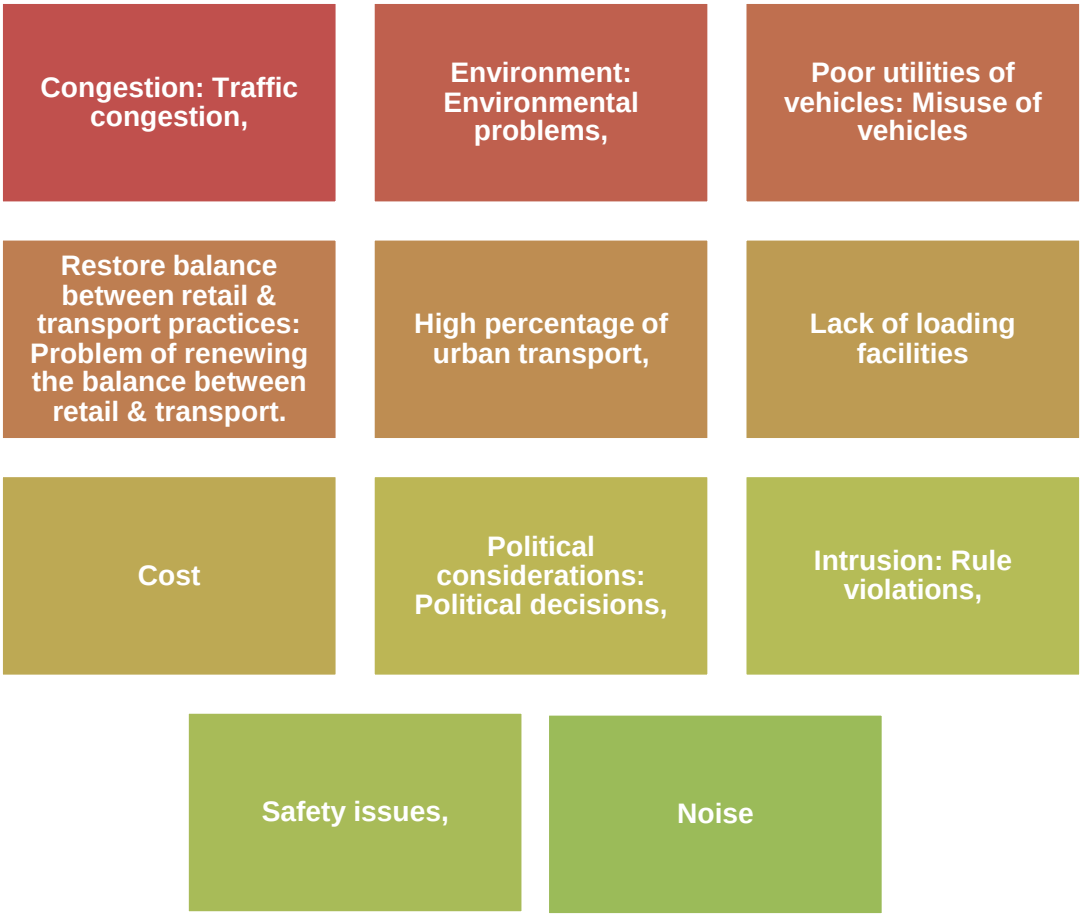
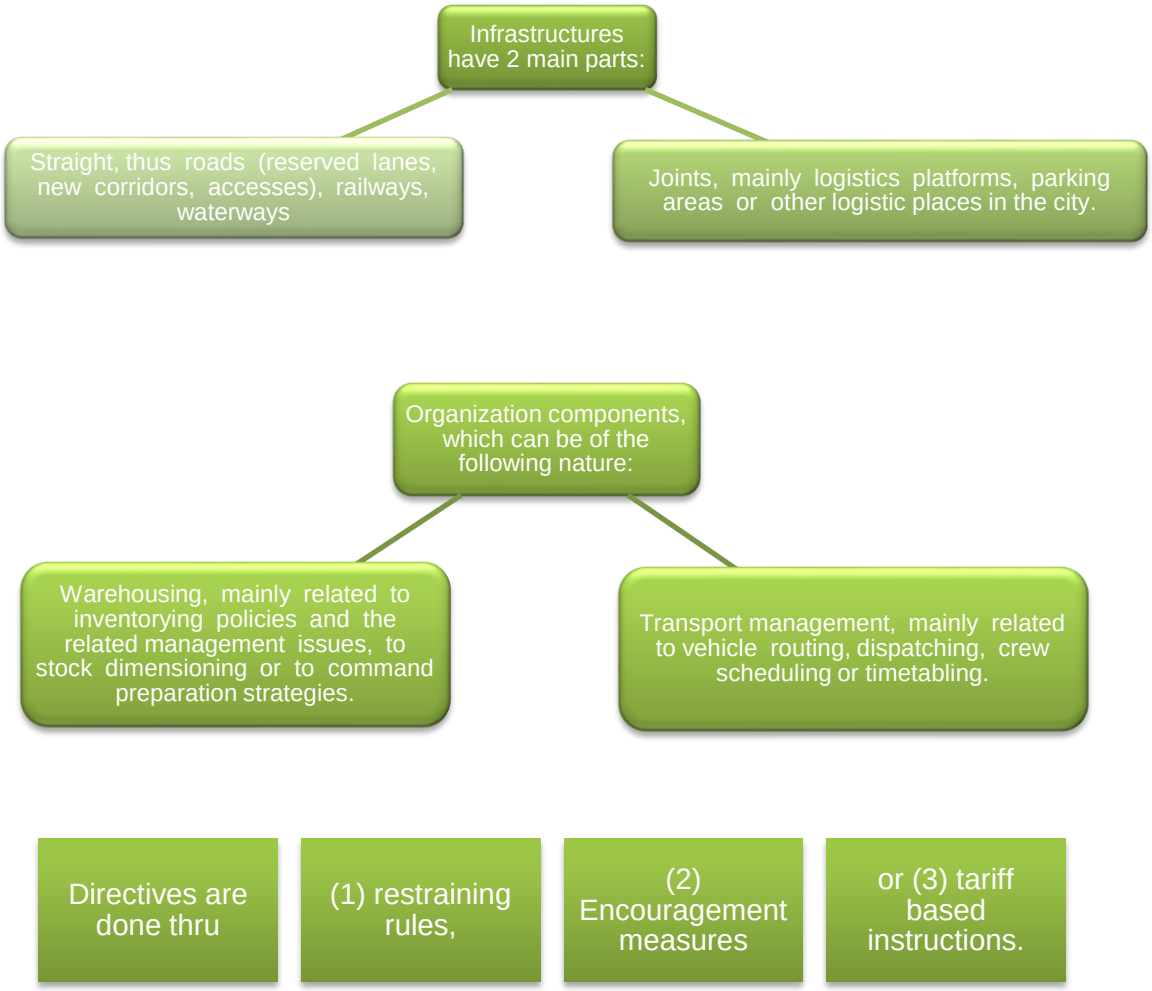


Figure 27: Problems of Urban Logistics

Simple developments like choosing a better method & means of transport, better loading types, optimizing the transport path & reaching to cargo places can be very cheap & decrease the cost of urban logistics.

Figure 28: Improperly loaded trucks

For the solution of urban logistics, Gonzalez-Feliu (2008, 2016a) analysed the important parts of the methods in urban logistics as follows:



Technologies are connected to ;

Vehicles, mainly to engine (new fuel engine norms, electrical motorization, gas technologies, etc.), to truck equipment (noise reduction technologies, loading-support technologies), to non-truck heavy vehicles (barges, cargo tramways) or to the development of soft mobility vehicles (cargo-bikes).

Other ICT-based technologies, like speed and acceleration limitators, information systems, etc.

Intelligent Transport Systems

Non-vehicle assistance-based technologies, mainly to electrically-assisted cars and to warehousing equipment.

Campaigns on valorisation & communication

Financing mechanisms, mainly subsidies, tarification for financing purposes, fault-paying schemes or Public-Private Partnerships (PPPs).

Figure 29: Green Transportation by bicycles

Ref: https://unsplash.com/photos/VZznLQjC1as

https://unsplash.com/search/photos/green-transport

https://unsplash.com/search/photos/green-transportation

Combination of these stated components will have a better result in the services of the urban logistics and will have also better solutions to the problems. And, for the definition of the influence on increasing the living quality & for its sustainability, methods must be used by making a comparison between them.

5.3.1. Public & Private Stakeholders' Aims & Benefits in Urban Logistics

If a comparison is made among the private & public organisations, public ones will perform the below items for their objectives & benefits in urban logistics:

- Reduce the effects of troubles caused by greenhouse gas & other atmospheric pollutant emissions & reduce the levels of noise;
- Reduce congestion problems in denser (central) urban areas;
- Revive the economic activities of urban areas, especially city centers (with retail stores and varying services);
- Main urban expansion that controls strategic city planning;
- Applying appropriate goods distribution services and creating social cohesion.

Private organisations will prefer the following:

In this context, even when both categories of stakeholders take care of sustainable development, their functioning aims will not be similar to their planned aims.

5.3.2. Definition of Sustainable Logistics

In general, sustainability is analysed in 3 areas, applying to many regions, it covers logistics & materials transports & they are shown as the following (Morana, 2014; Gonzalez-Feliuand Morana, 2014):

The economic sphere covers all the elements of economy and logistics performance, that is to say, whether the urban logistics system is economically viable and logistically efficient. In other words, an urban logistics solution or initiative must be economically sustainable to ensure continuity in the timeline, and the human factor is central to the management of any organization.

Environmental space means respect for the environment and the rational use of natural resources, traditionally regarded as a restriction in logistics. However, urban logistics has been defined mainly from an environmental perspective. Most of the studies on urban logistics are interested in this field, and many of them confuse green urban logistics with sustainable urban logistics.

The social sphere is less studied and the most complex. In fact, respect for society and the search for a more ethical world are difficult to investigate and measure. However, many public authorities see urban logistics as an opportunity to improve the quality of life, increase the accessibility of the urban population (eg to shopping areas or basic needs) or create and improve the employment of sensible populations.

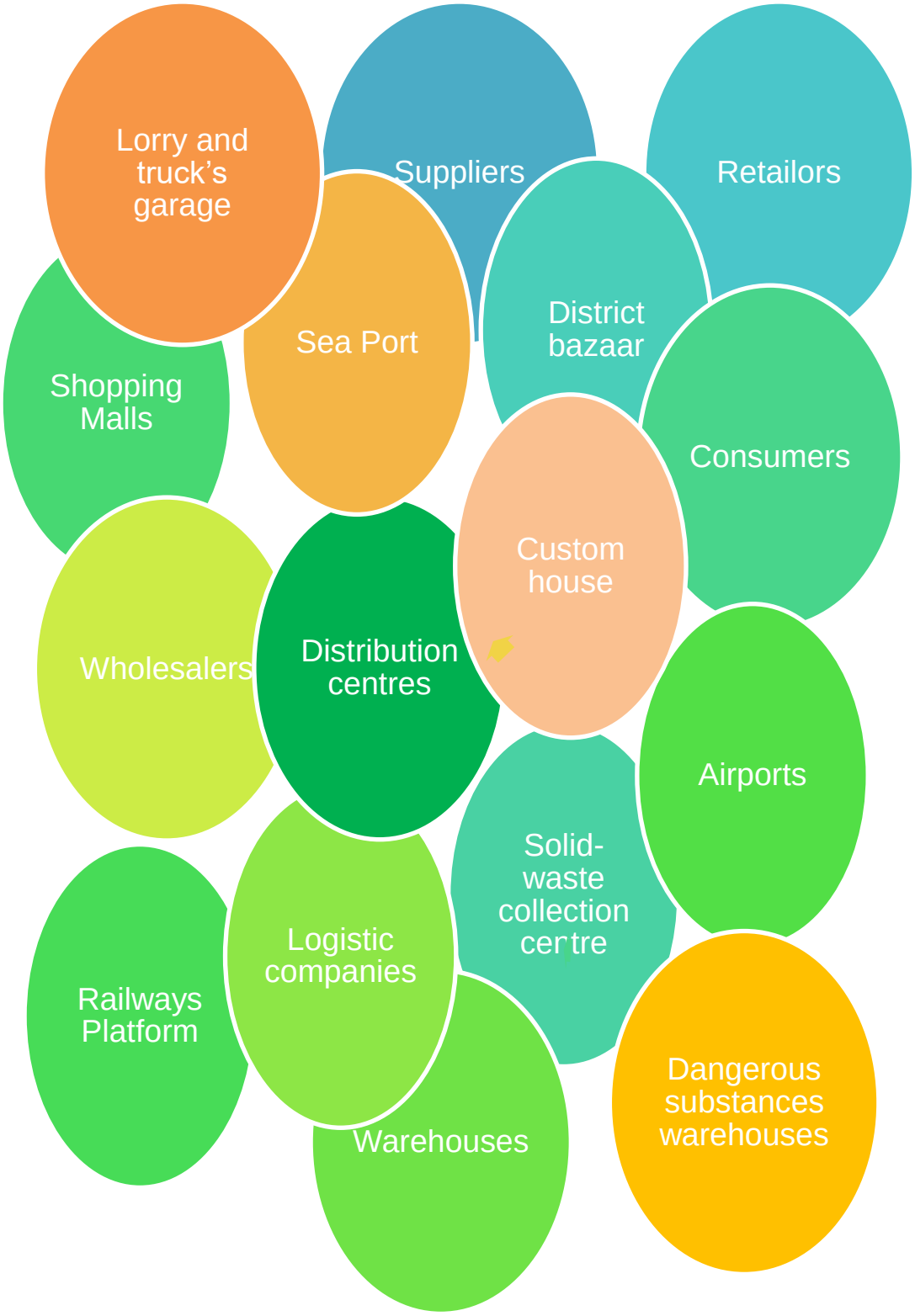
5.3.3. Precautions for Urban Logistics

Even though, the evaluation of goods services in urban areas is always thought as a complex problem, to have the same methodological ways will be a better way for a more suitable urban goods transport on the whole system.

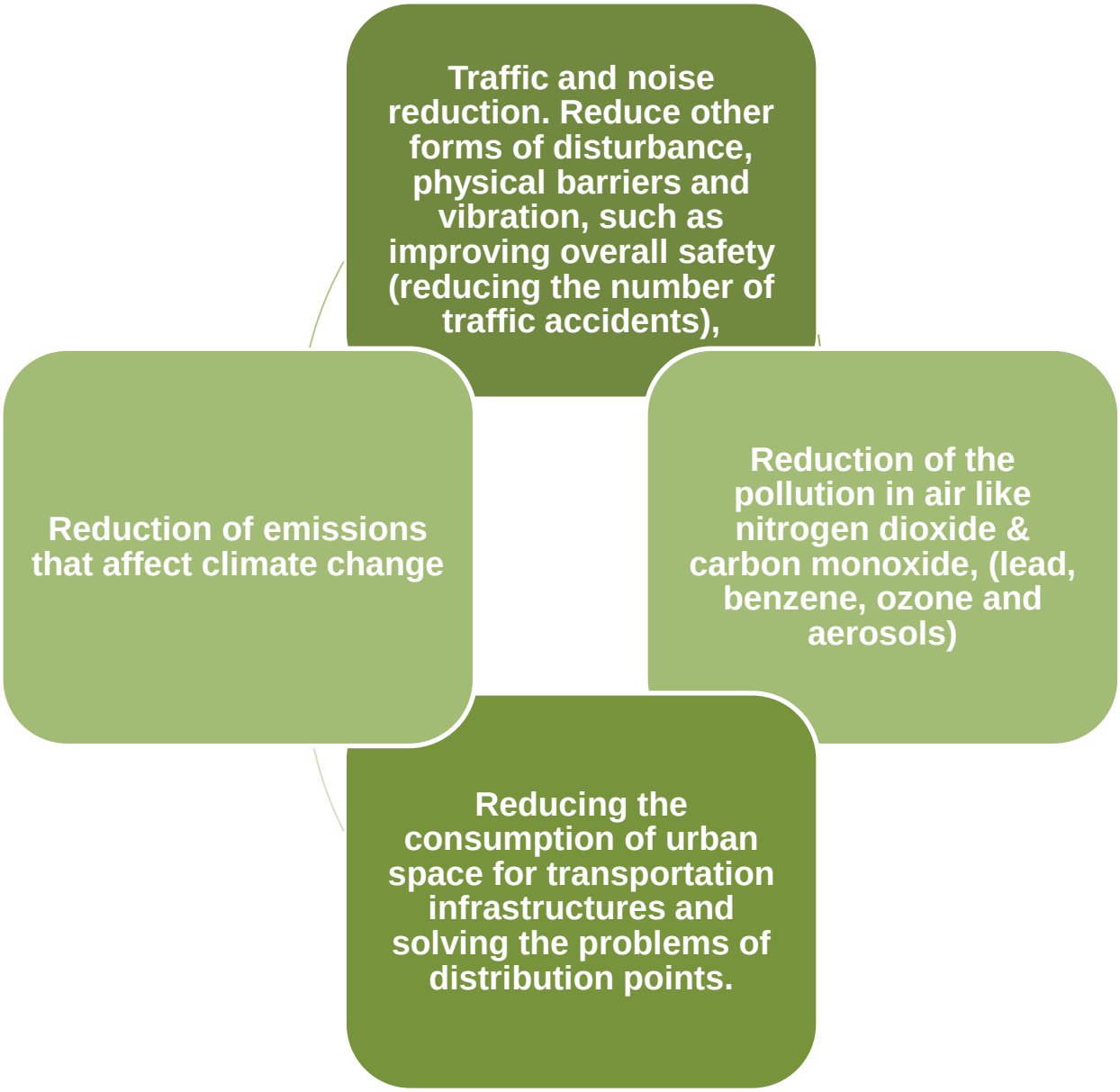
Here below, some of the precautions for green urban logistics are listed as follows:

optimization of workload depending on vehicle capacity, avoiding empty vehicles	optimization of routes and delivery times taking into account existing deliveries and maximizing response times	improvement of the situational awareness of traffic circulation in the city;
decreased pollution through optimized routing and parking optimization of freight vehicles;	increased fluency and timeliness of public transport in the city centre	reduction of traffic congestion in the city centre through offering traffic planners with more accurate tools;
improvement of road maintenance, especially in winter	ensure viability of urban logistics	more efficient traffic management due to more rapid detection of disturbances, and potential guidance of mitigation measures

5.3.4. Elements of Urban Logistics



5.4. Environmental Goals in Urban Logistics:



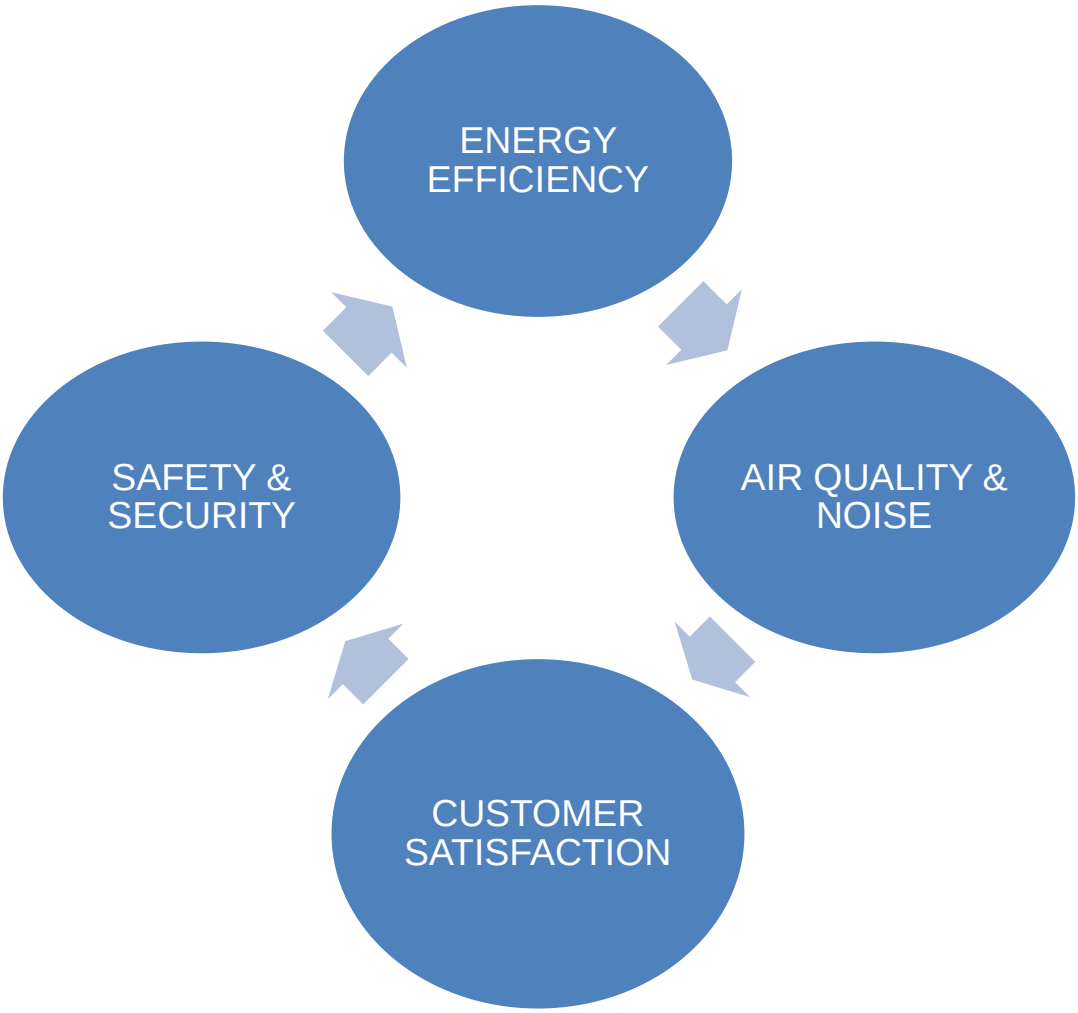
The main objective of the solution is to plan the cargo movements at the city or regional scale.

5.4.1. Logistic Villages

Storage, maintenance-repair, loading-unloading, weighing, load division-assembling, packaging, etc., which are the components of all modes of transport, including all companies of logistics and transportations and public / private institutions, it is tried to have fast, low-cost, safe, environment-friendly transfer areas and equipment between transportation services. And, all activities related to national and international transportations, logistics and distribution of goods are carried out by various operators.

When the product costs of logistics are reduced, logistics chain is optimised, urban competitiveness is increased, environmental problems are confronted (energy consumption, visual & air pollution, noise pollution, etc.), all of these can reduce the urban problems. The success of urban logistics is measured with respect to the speed, flexibility, land use, environmental factors, traffic, safety and cost of the whole system. At the same time, urban companies have specific objectives and different expectations related to urban logistics. So, all the parties taking part in urban logistics must work and reach to an agreement altogether.

It is foreseen to realize a complete consolidation of freight movements in cities' actions & flows that admit people to reach to the assets they require and the assets to reach to the people vice versa, while meantime supporting the development of sustainability. Developed freight flow aims to:



5.4.1.1. Energy Efficiency

Increase of energy efficiency can be supplied by the achievement of the improvement of the profitability of the complete city logistics system by the efficiency of the vehicles' energy.

Vehicle-side improvements are expected to result from increased efficiency of ICE (Internal Combustion Engine) vehicles, as well as improved activation of

alternative fuel vehicles and, in particular, electric vehicles for urban freight transport. The use of electrical vehicles will be successful by the spreading the infrastructure for charging & demonstrating fast charging places which are shared with public transportation vehicles. To increase the energy efficiency of the system is to find solutions for to reduce the number of kms per kg / goods, to increase the efficiency of deliveries, to reduce leisure trips, to reduce shopping trips & to increase the load factor of vehicles.

Figure 30: Using electrical cars in urban logistics

Ref: https://unsplash.com/photos/L1_XWJ_bRSM

5.4.1.2. Air Quality & Noise

To improve the quality of the city environment, air quality must be increased & noise must be reduced.

Figure 31: Effect of urban logistics on the city's air pollution

It must be expressed that the items corresponding to the air pollution differ from urbans to urbans & that corresponding part of transport to air pollution in urban places changes as well. Because of that, it is not easy to put forward a common rule for the air quality improvement. Efficient integration in the strategy of traffic & also integrations in local emissions can reduce the emissions from the freight fleets. This also depends on the amount of materials being transported & of the average # of km/goods transported.

The other important local emission is noise. Noise emissions directly impact the health of the citizens. It is important to do the delivery at nights in the logistic system. It lowers the noise of the transportation vehicles and auxiliaries and also lowers the noise related to the packaging & handling of the products & loading/unloading actions.

5.4.1.3. Customer Satisfaction

For the consumer's satisfaction, delivery must be in time and the system must be trustable.

Figure 32: Use of motorcycles for light goods in urban logistics

Ref: https://unsplash.com/photos/0eIUwjVoqCk

Transfers of products are considered successful whenever the cargo is transferred and at the final point, there is a person or place where it can be delivered. The success of deliveries nowadays is 95 percent. But it must be increased to 100 percent. E-commerce is nowadays very important trend & must be fully supported.

5.4.1.4. Safety & Security

In the logistics, security & safety must be increased, fatalities & injuries must be reduced & cargo lost or damage must be decreased.

There is an increasing concern about accidents & fatalities about the transportation vehicles & lacerable traffic users in the cities. At this stage, road safety is becoming very important. From the research community of EU, there are very important attempts, acquiring great political backing from the sector, showing all the problems, vehicles & actions of the drivers. In this way, fatalities & injuries will be reduced up to 90 percent in the following years.

Also, an efficient urban freight transport system must be securely done, and damages & stealing must be reduced. The aim must be to make a reduction of the damages & stealing & it can be expected that it would be decreased until 90 percent in the near future.

5.5. Developing Innovative Ways for the Vehicles in the Delivery Systems:

Developing innovative vehicles in urban freight activities in the urban logistics will supply success & comfort in the logistics sector. Trucks and vans are stressed from congestion and vehicles are stopped in crowded traffic jams, they drive unwanted kilometres to find a place to park and roads are closed by cars & vehicles which are parked to carry the products. Dual parking by the vehicles is usually done as a practical way out for faster distribution of the goods & this leads to problems in the traffic which completely influences the comfort in logistic transports & make a stress on the people in the other vehicles. When the complete organisation of the transportation is improved and when the congestion is decreased, it means the unwanted miles driven will be decreased and it will also decrease the unnecessary stops and the time wasted accordingly. Therefore, below topics must be followed to be successful in urban logistics:

Establish measurement ranks with respect to loading methods (volume, mass, etc.), making the complete control for the urban traffic access & the operation of the whole network.

Define future optimal urban freight vehicle sizes & architectures from multi-stakeholder perspective.

Make it easy for the access to distribution places: Supply the manoeuve to the vehicles & give assistance to the drivers.

Establish systems to exchange loads between vehicles (small & large) and also with other transportation types, integrated multifunctioned procedure, vehicles' structures, load rates to release a dissociating of the distribution operations between heaped transportations & last mile functionings.

Establish the logistics system in a standardized & modular way (coherent with regular containers) for a better load factor and interoperability among different transport systems and modes.

Work on developing innovative alternative vehicles, such as cargo bikes, should continue to be supported.

Semi-Automation, generation & provision to increase the support for the driver will be the 1st step to be performed.

Lowering noise related to handling, loading and unloading of the goods to enable night deliveries.

5.5.1. E-Commerce

In retailing, e-commerce is becoming very popular nowadays. It is a new type of making sales for retailers and internet serves to the consumer a good chance to choose what he needs. In this way, consumers have an easy way to access to the goods avoiding travelling to shops and this gives a good chance for the requirement of the goods to customers without going anywhere. The difficulty in e-commerce is that the distributions must be done by the commercial vehicles. Also, it is difficult to plan the times for delivery to each different customer. Returns are also problem, as much as 50 percent of purchases in clothing and textiles in some countries are returned back to shops. So, e-commerce has different problems & requirements than traditional retailing, but these problems can be solved in the coming years.

E-commerce logistic method that brings a solution to the problem of the transportation to the consumer, must be analysed with the service, cost, amount of space used & with the evaluation of the environmental clauses. Within the sector, for the successful organisation of the deliveries to the consumers must be established. A common station which will deliver the goods for all the shops in the city will be a good idea for the delivery of the goods. For the coming years, e-commerce will be very popular and finding solutions to the problems will make e-commerce a leader in logistics sector.

Questions:

1) **Urban logistics mean to;**
   a) supply freight distribution in urban areas,
   b) developing strategies that improve its overall efficiency against congestion and emissions,
   c) providing innovative solutions to customer requests,
   d) All of them

Answer: d

2) **Improve the urban environment by decreasing the air quality and increasing the noise.**
   a) True
   b) False

Answer: b

3) **Increase of energy efficiency can be supplied by the achievement of the improvement of the efficiency of the whole urban logistics system by the energy efficiency of vehicles.**
   a) True
   b) False

Answer: a

4) **Trucks & vans are stressed from congestion & vehicles are stopped in crowded traffic jams, they drive unwanted kilometres to find a place to park & roads are blocked by vehicles which are stopped to deliver goods.**
   a) True
   b) False

Answer: a

5) **Developing innovative vehicles in urban freight activities in the urban logistics will not supply success & comfort in the logistics sector.**
   a) True
   b) False

Answer: b

6) **Improvements on the vehicle side are expected to come from the increased efficiency of ICE (Internal Combustion Engine) vehicles but also from the developed activation of alternative fuels vehicles and especially from electric vehicles for urban freight.**
   a) True
   b) False

Answer: a

7) **Technologies, which can be related to vehicles are,**
   a) engine (new fuel engine norms, electric motorization, gas technologies, etc.),
   b) to truck equipment (noise reduction technologies, loading-support technologies),
   c) to non-truck heavy vehicles (barges, cargo tramways)
   d) All of them

Answer: d

8) **Which is not correct for the main objective of the solution for the cargo movements:**
   a) Separation of living areas and production areas within the city,
   b) Making the urban logistics from the centre of the city,
   c) Establishing a balance between transport types instead of road transport,
   d) Configuring their access separately from passenger transportation.

Answer: b

9) **Congestion is divided in 3 spheres (social + environmental + society) and is applied to many fields, including agriculture & goods exchange & in urban logistics.**
   a) True
   b) False

Answer: b

10) **Which one is correct?**
   a) The economic sphere includes all economics and logistics performance elements
   b) An urban logistics solution or initiative needs to be economically sustainable to ensure its continuity in the timeline
   c) The environmental sphere refers to the respect of the environment and the rational use of natural resources,
   d) All of them

Answer: d

11) **It must be expressed that the factors contributed to local air pollution does not differ from cities to cities, and that the relative contribution of transport to air pollution in cities does not change as well. That's why, it is possible to set a common target for the improvement of air quality.**
   a) True
   b) False

Answer: b

12) **Which one is not an element of urban logistics?**
   a) Warehouses
   b) Retailors
   c) Buildings

d) Lorry and truck's garages

Answer: c

13) Energy efficiency of the system is not related with:

a) The use of electric vehicles,
b) Finding solutions to increase the load factor of vehicles,
c) to increase empty trips and to increase the number of shopping trips,
d) to reduce the number of km driven per kg/goods delivered,

Answer: c

14) CO2 emissions directly impact the health of the people. It is important to do the delivery at nights in the logistic chain. It increases the noise of the cars and auxiliaries and also increases the noise related to the handling of the goods and loading and unloading services.

a) True
b) False

Answer: b

15) Customer satisfaction is important and increase customer satisfaction by delivering the goods on time and improve the trustability of the system.

a) True
b) False

Answer: a

16)Which one is not correct?

The success of urban logistics is measured with respect to;

a) the speed,
b) age of the population,
c) land use,
d) traffic, safety and cost of the whole system.

Answer: b

17)When the product costs of logistics are reduced, logistics chain is maximized, urban competitiveness is decreased, environmental problems are confronted (electricity consumption, visual & air quality, noise pollution, etc.), all of these can reduce the urban problems.

a) True
b) False

Answer: b

18)Which one is not correct for environmental goals in urban logistics:

a) Traffic and noise reduction, reduce other forms of disturbance, physical barriers and vibration, such as improving overall safety (reducing the number of traffic accidents),

b) Reduction of shopping malls & centres,
c) Reduction of emissions that affect climate change,
d) Reduction of local air pollution such as carbon monoxide, nitrogen dioxide

Answer: b

19) Which one of the choices is not correct?

In retailing, e-commerce is becoming very popular nowadays and;

a) It is a new channel of sales for retailers,
b) Internet gives the consumer a good chance to choose what he needs,
c) Shopper goes and gets from the shop what he has chosen from internet,
d) Consumers have an easy way to access to the products avoiding travelling to shops,

Answer: c

20) E-commerce has different problems & requirements than traditional retailing and these problems cannot be solved in the coming years and e-commerce will be ended in the near future.

a) True
b) False

Answer: b

21) To be successful in urban logistics, develop standardized and modular logistics units (compatible with regular containers) for a better load factor and interoperability among different transport systems and modes.

a) True
b) False

Answer: a

22) Successful freight flow aims for:

a) Energy efficiency
b) Air quality and Noise
c) Commercial company's satisfaction
d) Customer satisfaction

Answer: c

23) It is foreseen to achieve a full integration of freight flows in cities actions and activities that allow citizens to reach to the goods they require and the goods to reach to the citizens vice versa, while at the same time sustainable development must be supported.

a) True
b) False

Answer: a

24) Which one is not a component of the modes of a transport?

a) Making storage,

b) Maintenance-repair,
c) Waste Separation
d) Weighing

Answer: c

25) Which one of the following is not correct?

For green urban logistics following precautions must be taken;

a) Optimization of workload depending on vehicle capacity, avoiding empty vehicles,
b) Improvement of road maintenance, especially in winter
c) Reduction of traffic congestion in the city centre through offering traffic planners with more accurate tools
d) Cancellation of routes and delivery times taking into account existing deliveries and minimizing response times.

Answer: d

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https://unsplash.com/search/photos/green-transportation

6. Case Studies

CNL (Council for Sustainable Logistics)

The "Council for Sustainable Logistics" is made up of 18 of the largest Austrian companies from the fields of logistics, production and trade who cooperate with the aim of "taking joint steps in the field of sustainable logistics". A further definition of the objective is "to bring e-ground vehicles onto the road as cost-neutrally as possible". It is a unique initiative throughout Europe.

The project was founded in 2014 on the initiative of Max Schachinger (Schachinger Logistik), started 10/2014 and is to be completed by 9/2019. CNL operates at the University of Natural Resources and Applied Life Sciences Vienna, a networking agency for sustainability, climate and global change. Cooperations on research topics are discussed with other institutes of the University of Natural Resources and Applied Life Sciences.

Source: CNL (2018), in: www.http://councilnachhaltigelogistik.at/

The CNL's work focuses on research and implementation projects as well as cooperation with manufacturing companies.

The working groups were divided into three areas:

- Working focus on the e-Commercial Vehicle sector
- Development partnership between CNL and MAN Truck & Bus AG.

- This focus on e-Vehicles includes research and implementation projects as well as cooperation with manufacturers.

On 13 September 2018, the first nine 26-ton MAN eTGM electric trucks were handed over to nine member companies of the Austrian Council for Sustainable Logistics for practical testing at the MAN plant in Steyr. The test vehicles were designed to customer specifications in order to be able to test authentic situations. The vehicles operate in regular logistics operations. Hofer, Metro and Spar received electric trucks with 6 x 2 chassis, cooling box and loading platform, 6 x 2 chassis with swap body, the forwarding companies Gebrüder Weiss, Quehenberger Logistics and Schachinger Logistik tested the 6 x 2 chassis, the Stieglbrauerei received a 6 x 2 chassis for beverage transport, Magna Steyr tested a 4 x 2 truck tractor in the factory logistics. The electric motor has an output of 264 kW with a torque of max. 3,100 Nm. Lithium-ion batteries are located under the cab on the side of the frame. For example, twelve batteries are installed in the 26-ton solo chassis, which, in the best case scenario, enable a range of 200 km. The two-axle semitrailer tractor has a range of 130 km with eight battery packs. All vehicles are equipped with air suspension on the front and rear axles in order to be able to adjust the load situation accordingly. The kinetic energy of the vehicle in the thrust phases enables the conversion into electrical energy which is fed back to the vehicle (braking energy). The batteries can be charged with direct current 150kW or alternating current 22 or 44 kW.

A representative cross-section of the most common distribution transport tasks in urban logistics thus enables an optimal approach. Extensive knowledge from everyday life for continuous further development can be incorporated.

Focus on sustainable urban logistics

Logistics dialogues were conducted with the cities of Vienna, Graz and Salzburg. The objective defines a CO2-free city logistics by the year 2030 to achieve. In line with the strategic framework, suitable framework conditions are to be developed to promote the use of e-commercial vehicles and investments in the

associated infrastructure in the cities. This is to be achieved through non-monetary incentives (delivery windows, flowing traffic, stationary traffic).

Focus on sustainable warehouse logistics

From 2019 onwards, changes in warehouse logistics and distribution centres will be analysed and measures taken as part of the switch to electro-mobility. A development partnership will be entered into with Österreichische Post AG.

Gebrüder Weiss

Gebrüder Weiss is the oldest private freight forwarding company in Austria and is represented in 25 countries with 137 locations and around 4,500 employees. The Vorarlberg-based company from Lauterach offers the following under the umbrella of a holding company A comprehensive range of transport and logistics services, with a regional focus on Europe, Asia and the USA, through various subsidiaries and in addition to strategic partnerships.

In addition to the fundamental economic corporate factors, environmental compatibility and sustainability are also among the Group values of the mission statement. Since Gebrüder Weiss is of the opinion that an ecological orientation will be sustainability has a high value in the company and is therefore strongly taken into account at the strategic level.

Economic sustainability forms the basis for the implementation of ecological and also social measures in the company. Environmental protection goals are set by the company management and via the process management to the company locations.

There are also local environmental officers in the branches. Benchmarks between individual sites and processes are used to review ecological measures. Overall, cost-benefit analyses and the Balanced Scorecard are used as is deemed to be expedient. Gebrüder Weiss believes that the implementation of environmental protection measures and their degree of target achievement within the Group and includes environmental management in the scope of the Group's internal best

practice performance rankings, the "Challenger of the year". In addition, the the information of the company goals to the employees about the different Communication channels, including environmental objectives. On the part of management, it is endeavoured a high identification of the co-workers over the enterprise goals with the company. That this works at Gebrüder Weiss, shows the initiative of the staff of two branches, which rewards employees, if they come to work by bicycle, as this protects the environment.

Gebrüder Weiss' operational ecological measures include the Orange Combi Cargo in the area of modal shift, in which the together with Rail Cargo Austria, block trains for the REWE Group between Vienna and Bludenz. As a result, 60 truck journeys are shifted daily with corresponding CO2 emissions onto the railways. At the same time, this connection is used to also carries empties and returned goods. Gebrüder considers the following in this respect.

They know the reduction of CO2 emissions as the most important environmental protection measure. Followed by energy-efficient warehouses and buildings, the construction of customer-oriente procurement and distribution centres, the combination of collection and distribution separation of residual waste, as well as the use of reusable transport and reusable packaging and finally the ISO certification process.255 Further corporate goals within the framework of the CSR programme are energy savings and paper, by five percent each per year. These requirements were already met in the first year after introduction. In addition, all operating sites are energy detectives" for reduction potentials.

FOUR Logistica sostenibile

Four Logistica sostenibile is a strategic partnership between four transport companies (FC Consulting and Lacchi from Roma; Niinivirta from Milan and Rutilli from Mantova).

The main aim of the company is to offer logistic services to companies and clients while taking into consideration economic, social and environmental

sustainability. The company carries out logistic services reducing environmental and acoustic pollution.

The company has developed an open innovation model based on technology, operational and strategic activities, using internal and external resources and always involving suppliers, employees, customers and communities in the process.

Four manages sustainable logistics with 100% green vehicles, namely 8 electric trucks, 10 warehouses and 21 split points. It owns three main HUBS in Milan, Mantua and Rome, servicing 14 split points spread across Italy and satisfying the logistic needs of the fashion sector on a daily basis.

Transportation services preserve environmental well-being, economic progress and social justice by combining an environmental fleet and highly skilled human resources.

In order to reach the above the company has access to limited traffic access areas, has reduced fleet maintenance; reduced number of deliveries and has maximized vehicle loading capacity. Its fleet is powered by 100% renewable energy.

The company transfers social and environmental standards to suppliers and partners in order to generate social and environmental change

The warehouses are greener as they are equipped with photovoltaic systems and waste separation facilities and safer thanks to the on-going, specialized training of personnel and the adoption of precautionary measures. Recyclable or reusable packaging is used, and the company is starting with reverse logistics associated with re-use and recycling models.

FOUR also contributes to city and district logistics sustainability by participating in project and continuous research in the field of sustainable logistics solutions, through partnerships with research institutions, universities and public entities.

The company’s ultimate goals for environmental protection are:

- No CO2 emissions
- No PM10 emissions
- Reduced noise pollution

Ecologistico2

Ecologistico2 is a web tool, developped by ECR Italia which simulates environmental impacts of logistics and supports companies in identifying possible actions and strategies to improve the sustainability of logistic processes along the supply chain.

Ecologistico2 is a tool which has been developed to create awareness and culture in companies on environmental sustainability. The tool is developed in partnership with GreenRouter, to understand the variables which impact on CO2 emissions from company logistics.

Ecologistico supports companies in:

- Calculating CO2 emissions produced by the transportation and warehousing activities;
- Simulating the effects of the changes of some variables which determine environmental impact on logistics;
- Creating a report on the simulations done compliant to the UNI EN16258 norm and the CLECAL guidelines.
- Consulting innovative case studies and technical datasheets of the main solutions and technologies to reduce emissions of the supply chain
- Understanding which levers allow to reduce emissions in the company's logistics

The following benefits can be reached by companies with Ecologistico2:

- Pro-active management of CO2 logistics.
- Understand the environmental impact of a distribution network defined by the company;

- Understand the logistic variables which influence gas emissions;
- Reduce the company's ecological footprint, by identifying the most efficient actions in transportation and warehousing.
- Suggest new solutions and technologies to improve environmental sustainability of logistics;
- Create a company plan to reduce emissions. This also allows to participate in the Lean and Green award managed by the Freight Leaders Council.

CargoX

CargoX (CargoX, 2019) is the independent supplier of blockchain-based Smart Bill of Lading solutions that provide an extremely fast, safe, reliable, and cost-effective way to process Bills of Lading anywhere in the world. CargoX has developed a decentralised platform based on the network and has a pipeline of future products for the supply chain industry.

CargoX aims to transport the global shipping industry by securing Bill of Lading documents using blockchain technology. They provide a way for importers and exporters to exchange these documents digitally, securely, and with no possibility of fraud in a neutral environment – extremely quickly and much more affordable that currently.

Bills of Lading are the most important document in the global logistics industry. Bill of Lading is a mandatory document issued at the port of departure for every container boarding an ocean cargo ship. Every year, millions of paper Bill of Lading documents are issued. Unfortunately, paper Bill of Lading documents themselves must be shipped all over the world, which is the root cause of many of the challenges plaguing the supply chain industry:

(1) Slow – these paper documents need to be sent from the exporter to importer, and have an average travel time of more than a week while swapping hands between 2-3 courier delivery service,

(2) Lost- the process to resolve a damaged, lost, stolen Bill of Lading document is a complete bureaucratic nightmare and takes over 20 days to re-issue a replacement Bill of Lading,

(3) Cost – issuing and transporting one paper Bill of Lading document costs up to $180.

CargoX's Smart Bill of Lading solution based on the public Ethereum blockchain completely replaces old-school paper Bill of Lading documents and drives extremely fast, safe, reliable and cost-effective processing of Bills of Lading – anywhere in the world. CargoX's Smart Bill of Lading was publicly demonstrated at the 8th International Logistic Congress on 12 April 2018.

CargoX Smart Bill of Lading is the world's first and the only working open blockchain based Bill of Lading solution available today.

The blockchain-based Bill of Lading developed by CargoX preserves all of the legacy features of paper Bills of Lading and takes them a step further with the benefits offered by the decentralised platform, including security, cost reduction, and fast delivery.

Benefits of Smart Bill of Lading solution:

(a) Security – blockchain has no central storage that can be attacked by hackers,

(b) Fast delivery – Smart Bills of Lading are issued instantly and are immediately available to the exporter – just like sending an email.

(c) Cost reduction – Smart Bill of Lading solution saves shippers and consignees up to 100 % of their courier and postal costs.

(d) Paperless – the blockchain-based Smart Bill of Lading does everything that a paper one does, but is completely eco-friendly, with less printing, etc.

(e) Tracking and storing – every transaction is traceable. The sequence of events is clearly defined and forever written on the blockchain.

The CargoX main development office is located in Ljubljana, Slovenia, but they have a supervisory and strategic office in Hong Kong.

Pošta Slovenije

The specificity of the Pošta Slovenije fleet vehicle is in adapting the fleet vehicle to the services that Pošta Slovenije performs and the territory on which these services are performed (regulated roads, urban centres, agglomerations, hard access roads and unregulated areas). Therefore, for providing services in shipments' delivery (packet, letter, etc.), in comparison with other users of these vehicles, they are more burdened with numerous stops and spin-offs in shorter routes. These vehicles are mainly used for delivery of door-to-door. When purchasing vehicles, Pošta Slovenije takes into account the terrain where these vehicles will be used, and therefore important driving characteristics of these vehicles, vehicles dimensions, wheelbase, turning radius, front and rear overhangs, drive, etc.

When choosing vehicles, Pošta Slovenije pays a lot of attention to fuel consumption, releases of polluting emissions to the environment, and, the economic viability of using a particular vehicle in a given territory or for a specific provision of services. Efforts to use alternative energy sources for the propulsion of vehicles for providing services in the Pošta Slovenije are aimed at increasing the share of such vehicles within the entire fleet vehicle.

Pošta Slovenije fleet vehicles consume over four million litres of petroleum products; four-wheel vehicles use most of which, more than 85%. Into the atmosphere is released about 3 kg of carbon dioxide with each kilogram of fuel. Thus, in the field of efficient environmental performance in the Pošta Slovenije, a strategy was adopted on the ecological efficiency of transport, which shows the potential for a long-term reduction in annual greenhouse gas emissions and fleet vehicle costs by 2030.

An important turning point in the field of environmental protection was 2010 when first light electrically powered vehicles were introduced into the fleet vehicle of

Pošta Slovenije. The year before, electric bicycle replenished fleet vehicle. Since the introduction in 2009, the number of electric bikes is increasing.

As a company with a large fleet vehicle, they pay attention to training drivers on ecologically driven driving. In this way, they raise the level of awareness for environmental protection of our responsibility to the environment, both within the company and outside the company. They ensure that new transport vehicles driven by fossil fuels meet the highest environmental standards.

They also made calculations for the return of the fleet vehicle replacement investment in 2010, based on the anticipation of the annual increase in ecological vehicles and the reduction of classic vehicles in the Pošta Slovenije fleet vehicle. Calculations for 15 years showed that the fleet's operating cost (fuel, amortisation, and maintenance) would first increase (in the first 5-year period), then stabilise, and at the end of this period reduce.

They introduce the use of Piaggio Porter Electric's lightweight delivery vehicle (Figure 3.19) in some cities (Piran, Portorož, Ljubljana), where the delivery by conventional vehicles is disabled or legally prohibited. This electric car is small and therefore suitable for delivery in city centres, where narrow streets are also hindered.

Figure 33: Piaggio Porter Electric vehicle (Pošta Slovenije, 2018).

The ecological fleet vehicle of Pošta Slovenije currently has 5 light electrically powered vehicles, 60 delivery cars with liquefied petroleum gas, 60 electrically

powered motors bikes and 20 electrically powered scooters. Pošta Slovenije constantly endeavours to obtain the highest quality information on the possibilities of using more environmentally friendly vehicles. They often carry out tests of different types of vehicles that they could use in the future for their activities.

Figure 34: Pošta Slovenije's fleet vehicle (Pošta Slovenije, 2018).

GREEN LOGISTICS INITIATIVES

A particular case of effort to carry out logistics processes more committed to the environment is for example the one that has led the company Fedex. Its commitment is to connect different parts of the world in a more responsible manner and for this it has committed itself to reducing the emission of aircraft by 30 percent by the year 2020; Likewise, in terms of energy efficiency in vehicles, it is expected to

increase by 20%, increasing the use of alternative sources and the acquisition of renewable energy credits at the local level.

Among private initiatives, companies such as Linde have started using diesel trucks that are greener and emit 83% less particles than currently required by the European directive. This reduces emissions by 39%. Also, in Madrid, the European project for the distribution of goods under an electric system begins. It is a pilot project involving the City Council of the capital and companies such as Seur, the Madrid EMT and Renault.

Another example of logistics sustainability is that carried out by LIDL with its logistics platform in Murcia, which has already been recognized with the “Green building council Spain certificate, which proves that its design and construction meets environmental sustainability requirements. The German platform has 40,000 square meters and has involved an investment of around 35 million euros.

Research projects are also being promoted, such as the one that attempts to create biodegradable plastics for the interior part of the transport trucks. The investigations are carried out by six SMEs, including two Spanish and four European and the manufacturer Renault Trucks within the framework of the European project Naturtruck. The biodegradable material used is derived from corn starch and is provided by the European consortium of biodegradable material.

Other companies such as Mahou or San Miguel have generated alliances to reduce their emissions. For this they have designed a plan that tries to minimize emissions up to 1300 tons per year. There is a REDD + plan (Reduction of Emissions Derived from Deforestation and Forest Degradation) that attempts to conserve and sustainably manage CO_2 in the Amazon. Mahou and San Miguel try in this way to minimize their impact on the environment with this initiative to prevent the deforestation of thousands of hectares of virgin forest.

Among other great advances, last year a simulator was developed in Spain, whose purpose is to measure the emissions of land transport. This invention was developed in the Higher Technical School of Industrial Engineers of the Polytechnic

University of Madrid and has already been applied to Spain in various scenarios. According to the study born from this initiative, it has been possible to identify which are the main causes that influence emissions. Looking ahead, it is known that the relationship between diesel and gasoline vehicles and the age of the park are the most determining factors in the emissions of nitrogen oxides. For its part, in the emission of CO_2, the speed of circulation on motorways and the displacement of vehicles used for the transport of goods are the two factors that most include and in which it should affect each of the next years.

EKOL Logistics Company

Ekol, an integrated logistics company founded in 1990, provides international freight, warehousing, domestic distribution, foreign trade, customs, and supply chain management services in 15 countrieswith the utilization of its 2 Ro-Rovessels, 48 block trains per week and 5,500 vehicles and multinational team of more than 7500 staff member. Ekol Turkey's delivery centers are equipped with cutting-edge technology and eco-friendly fleets, and allow Ekol to render all types of internationally integrated services which the new economy calls for. The said services incorporate state-of-the-art intermodal and transportation equipment, and take advantage of a large warehouse with a capacity of 570,000 square meters and extensive cross-dock facilities.

Intermodal

Every day, Ekol provides services in all corners of the globe, aspiring to use natural resources optimally and creating a more sustainable business model, while employing the Intermodal transportation model it introduced in 2008. By doing so, the company saves 365,000 trees each month.

In a single Intermodal trip, Ekol achieves the following savings without having to cover a 2,429-km long road;

- 823 liters of fuel

- 2221 kg of CO2
- 5,8 kg of NOX
- 0,08 kg of particles.

Ekol reduces the mileage on road with its intermodal solution created by combining railroad, land and maritime transportation and minimizes the carbon dioxide, hydrocarbon, particle and nitrogen emission. With this environmentalist approach, Ekol Logistics aims to leave a better world for the next generations.

Ekol Logistics is pleased to be the first ever logistics company in Turkey to get involved in the WWF Green Office Program. As part of the program, it formulates and implements improvements in savings in the areas of Waste Management and Electricity and Paper Usage. The work is focused on increasing awareness among personnel.

Indeed, the Green Office Program entails awareness training for employees at Ekol facilities. Training sessions cover such topics as “WWF, Green Office, system/ecosystem, ecological footprint, water footprint, and climate change.”

Waste Management

Ekol perceives and recognizes that improperly disposed waste remains in the wild for countless years – continuing to harm the environment in the process. Accordingly, Ekol Logistics took the initiative in Waste Management as part of the WWF Green Office Program with the goal of properly disposing of all types of waste created during its processes. Ekol Logistics aims to reduce the amount of trash by collecting waste separately and decreasing the utilization of raw materials, energy, and other natural resources through proper sorting. Sorted waste can be disposed of or recycled properly by licensed companies contracted by Ekol.

Collecting Food Waste: We aspire to feed our animal friends by taking food waste from the cafeterias to nearby animal shelters.

Sorting Food Waste: We aim to support recycling by sorting the recyclable waste from the cafeterias.

Scrap Waste Recycling Campaign

We sorted scrap waste created in the facilities in 2011 and gave them to advanced recycling companies. We supported the adoption campaign of the World Wildlife Fund Turkey (WWF Turkey) with the revenues generated from this operation.

Paper Consumption

Ekol also initiated a paper saving and recycling project to protect forests, the lungs of the Earth, under the headings it identified as part of the WWF Green Office Program.

Ekol has developed solutions to decrease paper consumption by determining the amount of paper usage per department. Each ton of recycled paper prevents the cutting down of 17 trees, which provide for the oxygen requirements of 144 people. By using recycled paper, Ekol also brings about huge savings in water and energy use in paper production.

Electricity Consumption

Ekol knows that even a single person can make a great difference in electricity consumption by being careful. As such, it is working to create a mass movement and take a step up from individual efforts by providing employee training. The company is also building a roadmap of improvements based on the measurement results obtained by using different measuring tools for each office.

In our country, 20 percent of electricity is consumed for lighting purposes. A 20-percent move to energy-efficient lighting systems provides savings equal to the electricity produced by the Keban Hydroelectric Power Plant in one year. Thus, Ekol uses energy-efficient lamps in its facilities.

Launched in 2011, the Virtual Server Project achieves 20 percent savings in our electricity consumption each year.

WWF – Earth Hour Campaign

Ekol Logistics is the ambassador for the Earth Hour Campaign by the WWF, one of the world's most prominent environmental proponents. Accordingly, it supports the Earth Hour Campaign to bring attention to global climate change.

Ekol Memorial Forests

Ekol Logistics concluded the years 2012, 2013, 2014, and 2015 with significant social responsibility projects in line with its green logistics operations. The company believes that a new forest in Turkey is the best New Year's gift.

Ekol Supports the TEMA Nature Training Program

Having made donations to TEMA for the preservation of forests on behalf of our clients, Ekol also contributed to TEMA Nature Education Program in 2016.

Donations were raised to support children's natural science education during a special NTV show broadcast live by the Turkish Foundation for Combating Soil Erosion, for Reforestation and the Protection of Natural Habitats (TEMA) to celebrate its 25th anniversary. As a part of this special live broadcast, Ekol pledged to meet the education expenses of 2,500 children. (26)

ARKAS Logistics

ARKAS, which provides services in logistics, ship fleet, shipowner and port operations, was established in 1989 and provides sea, air, land and railway combined transports, open cargo and project transports, forwarding and warehousing services. ARKAS employs 850 employees and serves with 706 wagons, 1250 containers suitable for rail transportation, 450 trucks, numerous loading and unloading vehicles and equipment, as well as large container storage areas. The company, which prioritizes environmental concerns, is implementing green logistics practices.

Green logistics activities are as follows:

- Health-safety-environment department has been established at company ports.
- A wastewater treatment plant was established within the company and all kinds of domestic and industrial wastes are treated according to the standards determined by the regulations and discharged to the receiving environment. Wastes are handled to have minimum impacts on the environment by recycling or disposal. Hazardous wastes are also given to licensed firms and disposed according to regulations.
- Bilge waters are collected by PETDER (Petroleum Industry Association) for the purpose of disposing in a way that will not harm the environment and human health.
- Natural resource consumption values (rates) are measured by the Company regularly and studies are carried out to minimize these values.
- With the use of electric winches, the energy costs of the company are reduced by a quarter and the energy is used more efficiently.
- The company ships are operated with “economic speed”, thus saving 20 tons of fuel per day per ship.

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