

# Recycling and Environmental Waste Management in Constructions

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*Abstract:-* The article focuses on a recycling and on the issue of importance of environmental management in constructions. Construction Waste Management is a part of a growing movement toward a sustainable world. Recycling and reuse of materials have long been associated with wise construction practices. Recycling, reusing, and salvaging construction waste can save money. The role of the manager of construction systems is to direct to and guarantee reduced pollution and also to prevent the negative effects of the environmental pollution. Method shows great possibilities for increasing use of construction waste materials from lightweight concrete with aggregates containing expanded glass in order to benefit from better use of available capacity of existing construction waste

*Keywords:-* constructions, environment, waste, management, recycling

## 1 Introduction

Construction, one of the oldest activities of mankind, has an important effect on the social-economic development and at the same time sets an indelible seal on the surroundings and the environment. It influences the economical dynamics of society and also has an important effect on the environment and surroundings. That's why it is very important to implement the Environmental Management System in constructions. The activities connected with constructions have long-term effects on the change in appearance of a region, as well as on natural resources and Waste Management. The current environmental policy is based upon the concept of Sustainable Development. The latter has been gaining increasing importance both in the international community and the Member States of the European Union as a form of development bringing prosperity to future generations. It fosters the prevention and mitigation of pollution at source and emphasises sound use of natural resources as well as preservation of biodiversity. In the environmental sphere, Sustainable Development is understood as an interdependent relationship between the economy, infrastructure, settlement and the way of living, taking into consideration the bearing capacity of the

environment and natural resources. [1]. It is inevitable that Sustainable Development becomes one of the values of constructions because constructions has one of the principal effects on infrastructure, settling and lifestyle taking into consideration the bearing capacity of the environment and natural resources.

The Institute of macroeconomic analysis and development states in the results of the research in the framework of *The Strategy for the Economic Development of Slovenia* project titled *Slovenia in the European Union: The environment as a development factor* that the basic challenge of the *Strategy for the economic development of Slovenia* [2]. until 2006 is development which increases the welfare of at least the present generations. Therefore Slovenia beside material and well proprietary controlled sources of welfare increasingly incorporates non-material, public and collective sources of welfare in its conventional development policy. But we are well aware of the fact that the economic rules of use for all the various types of welfare are not the same. But in the rare cases when the rules are the same they are not very successful and not very well put into effect[2].

## 2 Problem formulation

## 2.1 Legal aspects of managing with environment

The primary starting point of the Environmental Management System for organizations is the passed and renovated Protection of the Environment law (OJ RS No 41/2004), which is also the key direction for the formation of the environmental policy in Slovenia. In connection with the environmental legislation EU membership poses a great challenge and obligation for Slovenia, as it provides the right to co-determination and co-formulation of European environmental policies. As a member of the European integration process, Slovenia aspires to achieve a high level of environmental protection with regard to the principles of environment protection and preservation. Slovenia's priority tasks in this sphere also include the development of new legislation and consistent implementation of the current legislation, the encouragement of sustainable use of natural resources, the integration of environmental contents into sector policies, the development of new environmental technologies, the promotion of sustainable production and consumption, the proliferation of "green funds", the heightening of the awareness and strengthening of the dialogue with all stakeholders, as well as cooperation with the public sphere in the decision-making processes [1]. Evidence that legal aspects of environmental protection are becoming an important business factor is also the course Environmental law for postgraduate students of the Institute of public administration on the Faculty of law Ljubljana.

The contents of the course are:

- Part I: (Ethical) origin of current environmental law
- Part II: Current environmental law
- Part III: Fields of environmental law
- Part IV: Environmental law regarding sources of Pollution. [3].

The Ministry of the Environment and Spatial Planning of the Republic of Slovenia on its website (<http://www.gov.si/mop/>) enables the accessibility of environmental laws and regulations on the basis of The Environment Protection Act. There are also given international agreements and regulations on spatial planning. The extensiveness and diversity indicate the importance of Environmental Management in current operations of companies. It also displays the need for a multi and inter-expert approach, which should not be coincidental. Therefore this approach is becoming an important task of the highest management of a company. Apart from the implementation of legal

frameworks companies demonstrate their environmental orientation also with other methods, e.g. with environmental declarations, eco label, EMAS (Eco-management and audit scheme) and with the imparted certificate Systems of Environmental Management ISO 14001:2004 [11]. It has to be taken into consideration that the decision for the extent of Environmental Management is left to the management of a company. Giving effect to requirements and elements of the certificates only indicates the ability of a company to put into effect enterprise novelties but it doesn't give a realistic picture about actual environmental effects and the actual Environmental Management.

## 2.1 Management and ethics

Ethics are principles of conduct used to govern the decision making and behaviour of an individual or group of individuals. Because management is concerned with making decisions within an organization, the ethics of the individual or group of individuals making these decisions have significant implications for the organization's stakeholders, its employees, customers, shareholders, suppliers, government, and the public at large [20].

Special are ethics principles important in environmental management system. Organizations of all kinds are increasingly concerned with achieving and demonstrating sound environmental performance by controlling the impacts of their activities, products and services on the environment, consistent with their environmental policy and objectives.. They do so in the context of increasingly stringent legislation, the development of economic policies and other measures that foster environmental protection, and increased concern expressed by interested parties about environmental matters and sustainable development. [21] [22]. Ethics principles covering environmental management are intended to provide organizations with the elements of the following philosophical approaches: justice, individual rights and utilitarianism. The principle of justice involves making decisions based on truth, a lack of bias, and consistency. The principle of individual rights involves making decisions based on protecting human dignity. Finally, the principle of utilitarianism involves making decisions directed toward promoting the greatest good for the greatest number of people [20].

The role of ethics in management decisions is difficult, partly because it is such an emotionally charged issue and partly because of the many and varied ethical problems faced by managers.

Codes of ethics should be formal, written, and communicated to all employees. Although codes of ethics differ in content from one industry to another and from one company to another, a general list of topics covered includes:

- Fundamental honesty and adherence to the law,
- Product safety and quality,
- Health and safety in the workplace,
- Conflicts of interest,
- Employment practices,
- Fairness in selling/marketing practices,
- Financial reporting,
- Supplier relationships,
- Pricing, billing, and contracting,
- Trading in securities/using inside information,
- Payments to obtain business/Foreign Corrupt Practices Act,
- Acquiring and using information about others,
- Security,
- Political activities,
- Protection of the environment,
- Intellectual property/proprietary information [20].

During the past 20 years, environmental protection has become an important social and economic issue. This concern has reflected itself in many designed to improve the environment. A significant number of those laws directly affect business. [20].

### 2.3 Environmental management in Construction

Construction Waste Management is a part of a growing movement toward a sustainable world. Sustainability or “green” management techniques are designed to protect the environment, save resources, and conserve energy. The use of construction waste management techniques which rely on salvage, recycle and reuse of materials have proven to have economic benefits for the construction industry. Economic development coupled with ecological health was first termed ‘sustainability’ in the late 1970s. The terms ‘sustainability’ and ‘sustainable development’ were used by the United Nations’ World Commission on Environment and Development in its report “Our Common Future” in 1987. Since that time, the ideas have worked down from a world-wide platform to practical applications in the local economy. The state of Washington declared its policy to promote construction waste management planning in design and building through changes in the Revised Codes of Washington in June of 2002. [13].

Legal matters including Environmental Management are the basis for managing a company. Companies are very diverse – in matters of objectives and activities and also in matters of order and resources being used. This diversity makes it difficult to examine, generalize and establish patterns [4]. When managing and planning the objectives of a company irrespective of its type and activity it is important to consider the normative frameworks. Therefore the management of a company - as the activity of its managers, who plan, organize, direct and supervise the activities of the organization - has to give consideration to the managing and handling of the environment and to the objectives connected with them. So it is inevitable to set objectives and achievement indicators. In evaluating the development of a certain phenomenon it is of crucial importance to be aware of an envisaged trend and intensity of the development. Therefore each indicator is accompanied by a goal.

Each company [8] should set its own measurable and attainable objectives in accordance with and appropriate for its activities. It is also necessary to define the period and time frame of the reporting. The report should include environmental indicators and be reasonably prepared in accordance with Article 106 and 107 of the Environment Protection Act (OJ RS No 41/2004) [7]. In construction is several type of construction waste. And it is important to find typically indicators. Figure 1 presents type of construction waste.

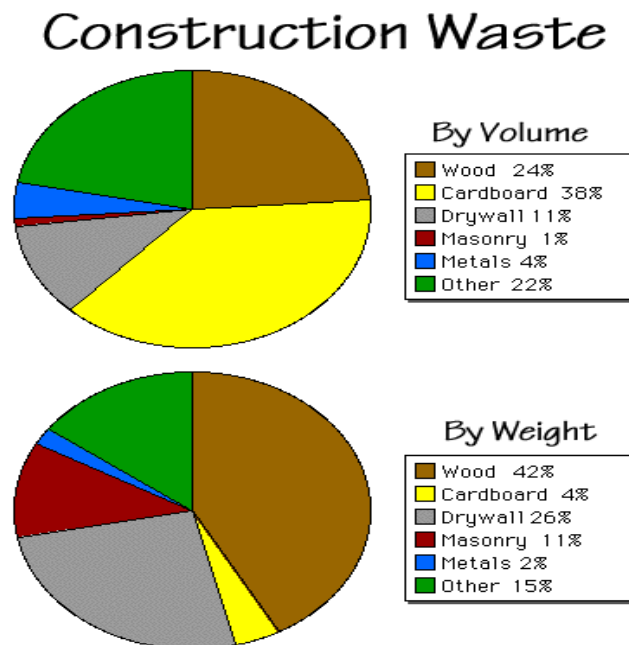


Figure 1: Type of construction waste [12].

Here are some important generalizations about residential construction waste.

- By weight or volume, wood, drywall and cardboard make up between 60 and 80 percent of jobsite waste.
- Vinyl and metals are generated in small quantities, but have good recycling value.
- Cardboard waste is increasing on most jobsites as more components, such as windows, appliances, cabinets and siding, are shipped to builders over long distances.
- Most wood waste is "clean" -- unpainted, untreated and recyclable. This usually includes dimensional lumber, plywood, OSB and particle board without laminates.
- Brick, block and asphalt shingle waste are insignificant in volume, but can be important in terms of weight.
- For most builders, the largest share of waste that could be considered hazardous is generated from painting, sealing, staining and caulking.
- Drive-by contamination (waste placed in a container by a party other than the builder or subcontractor) can be as much as 30 percent of the total volume hauled from a site [12].

As constructions is an activity which to a high degree includes mainly a part of the data from the Article 107 of the Environment Protection Act (OJ RS No 41/2004) and also the assessment frameworks used by the European Environmental Agency it is reasonable to determine the environmental indicators in accordance with the legislation of the Republic of Slovenia and with European guidelines. The "Environmental Indicators" report for a specific area is prepared and published at least every 4 years by the Ministry of the Environment of the Republic of Slovenia as well as by the community, the commune, or other bigger autonomous local community with a reasonable use of the Article 107 of this law. The content of the "Environmental Indicators" report originates from this law. It is prepared by the Ministry of the Environment and spatial planning and includes data particularly about:

1. natural phenomena, state of the environment, environmental pollution,
2. biodiversity and natural values,
3. endangered, protected and secured areas according to this law and the regulations of the protection and use of natural sources,
4. long-term trends and changes of the environment,
5. the evaluations of the state of the environment and its parts and the endangerment of them,
6. the influence of individual sectors on the state of the environment, especially of agriculture, fishery, forestry, energetic, traffic, industry, tourism and the use of natural sources; including the evaluation of the implementation of the protection of the environment demands into development policies of individual sectors,
7. influences of environmental pollution on the health of the population,
8. the implementation of the Protection of the Environment National Programme and operative programmes,
9. the implementation of programmes and provisions for the improvement of the quality of degraded environments,
10. the sources and spending of means intended for the implementation of environmental policies,
11. implementation of public services for protection and conservation of the environment and water treatment,
12. education, informing and collaboration of the public in the field of environmental protection,
13. important international events connected with environmental protection and
14. other data significant for environmental protection.

In the application for the Licence for Construction

Waste Disposal among the conditions from the Waste Management regulations it also has to be evident:

- types and quantities of construction waste for which recycling is being assured,
- the expected way of using the building material, gained from recycling of construction waste,
- the reason for the disposal of construction waste, if it is disposed directly, without processing,
- the way and place of the disposal of the remains of construction waste,
- directions of the environmental protection operative programme in the field of management

of construction waste in connection with expected ways and quantities of processing.

Rules amending the Rules on the management of construction waste (OJ RS No, 3/03) 50/04) [9], [10] add the article 13a with obligations of the investor who intends to gain an applicable licence, which states that as a constituent part of the accomplished work project he should enclose a Construction Waste Management Plan to the competent administration agency.

### 3 Problem Solution

#### 3.1 Strategies for recycling building materials

From these statements arise the role and the importance of Environmental Management and Waste Management as waste being one of the by-products of constructions. There needs to be a change in the Waste Management approach philosophy – from managing to economizing waste[6]. This approach means a change in the philosophy of the management of a company, which proves that environmental policy is a part of business policy. So the elements of Environmental Management are included in all elements of business processes, activities and products of this company as in planning, producing and the life cycle of individual products. Top management shall ensure that the environmental policy:

- is appropriate to the purpose of the organization,
- includes a commitment to comply with requirements and continually improve the effectiveness of the environmental management system,
- provides a framework for establishing and reviewing environmental objectives,
- is communicated and understood within the organization, and
- is reviewed for continuing suitability [23].

The organization's strategic planning and the policy provide a framework for setting of objectives. With management review only control the activities which leading to improvement of the organization's performance. The objectives should be capable of being measured in order to facilitate an effective and efficient review by management. When establishing these objectives, management should also consider:

- current and future needs of the organization and the markets served,
- relevant findings from management reviews,
- current product and process performance,
- levels of satisfaction of interested parties,

- self-assessment results,
- benchmarking, competitor analysis, opportunities for improvement, and
- resources needed to meet the objectives [23].

For this purpose there are various tools and regulations in the organisational and technical-technological field and in the field of controlling human resources and the treatment in line with employee's abilities. The consequences of this (tools and regulations) are economy effects which develop into Sustainable Development effects[5]. Especially in the case of environmental protection and Environmental Management it is important that we are very cooperative, creative and aim-oriented[9].

Recycling and reuse of materials have long been associated with wise construction practices. Experienced contractors are now reaping the economic advantages of Construction Waste Management. Communities are also seeing the side benefits as listed below.

#### A. Trim Costs.

Recycling, reusing, and salvaging construction waste can save money. Many of the contractors that have embraced Construction Waste Management have made changes to their operations and practices to take advantage of reduced waste disposal costs and revenues derived from recycle, reuse and salvage materials. Utilizing reuse and salvage methods on site reduce the need for new materials, reduces materials that end up in the landfill, creates a cleaner and safer project site, and improves community relations.

#### B. Establish a Market Advantage.

A company's experience in waste prevention and recycling is a valuable marketing tool for bidding on projects in response to customer interest in Construction Waste Management. Efforts to prevent waste, to recycle, and to use recycled-content materials on a project can help the project team earn points towards qualifying for LEED and other local and national programs.

#### C. Create Environmental Benefits.

Environmental benefits also result from recycling and waste prevention programs. In the long run, preventing waste reduces dependence on natural resources such as trees, oil, and minerals plus creates less pollution by reducing manufacturing and transportation related emissions. Reduction of the energy and water required to produce building supplies from virgin materials contributes to reduced greenhouse gasses related to the manufacturing and transportation of those materials.

Figure 2 presents an approach to environmental requirements. management system integrated with other management

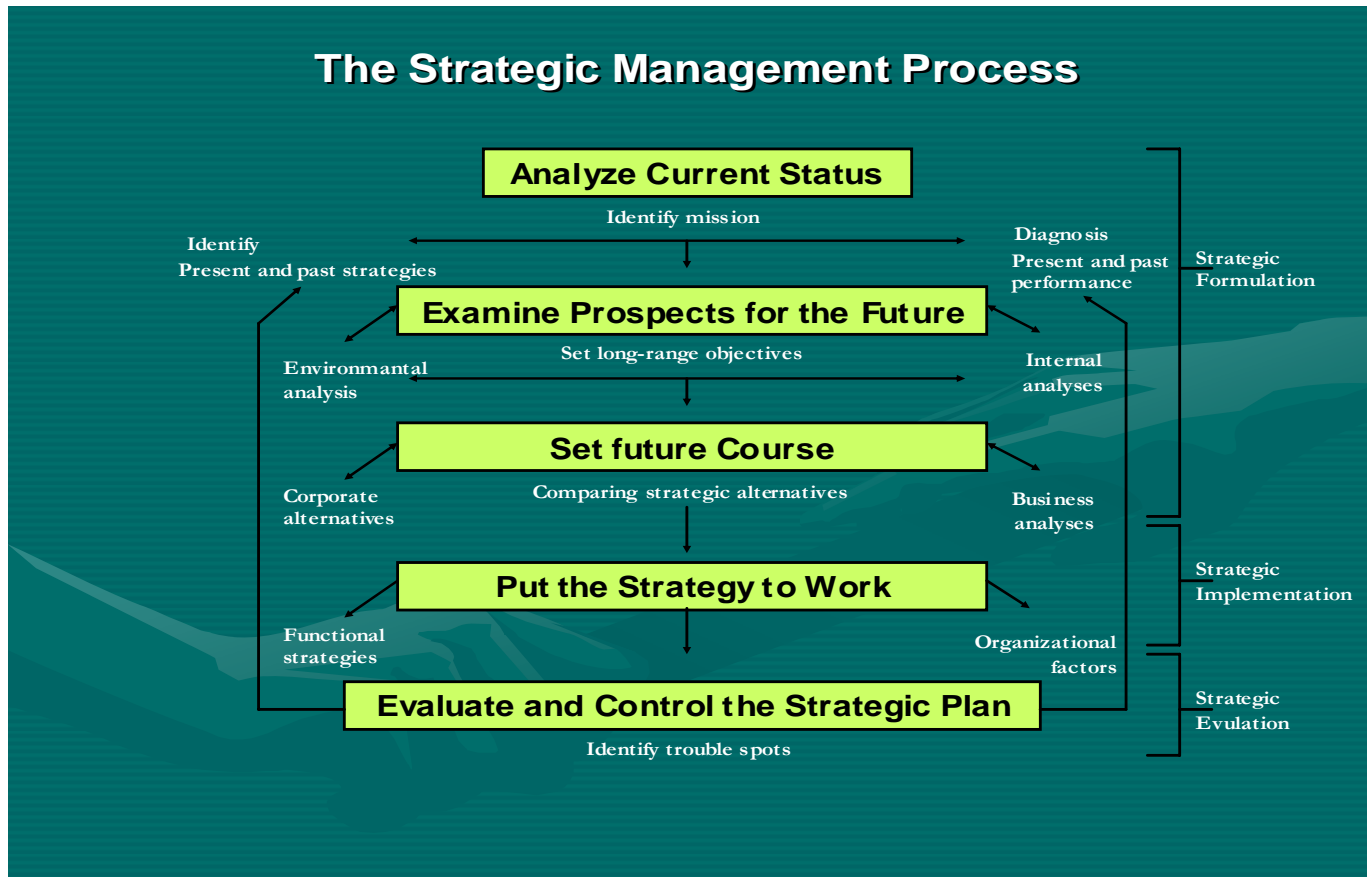


Figure2: The Strategic Management Process [20]

#### D. Help the Economy.

Recycling and reuse of construction waste can also help the economy through the creation of jobs related to salvaging and recycling of construction waste. New products create jobs through the manufacture of recycled content materials.

#### E. Assist Charitable Organization

Organizations such as Habitat for Humanity can use surplus building materials. Pick-up of materials at the project site can sometimes be arranged [14].

Strategies for recycling building materials:

- Set a goal
- Select a contractor with proven recycling experience
- Use a Construction Waste Management Specification
- Monitor the waste reduction program [13]

### 3.2 Research of recycling of waste

Europe is entering a new energy landscape. Our import dependency is 50% today, and certain to rise. Our hydrocarbon reserves are running down. Energy is becoming more expensive. Our infrastructure needs improving; EUR 1000 billion is needed over the next 20 years to meet expected energy demand and replace ageing infrastructure. And global warming has already made the world 0.6°C hotter. These challenges are common to all of Europe. They require a European response. At the end of 2005, European Heads of State and Government reunited at Hampton Court (United Kingdom) call for a true European Energy Policy [15]. In Europe buildings use between 5 to 15 per cent energy in so crucial contribute to greenhouse emissions. [15] Study of heat protection and efficient use of energy in buildings brings new recognition in area of planning, performance and using of objects in

their life cycle. It has theoretical and practical meaning. Efficient use of energy in buildings affects a lot of factors, including but not limited to sustainable development aspect in planning, environmental management aspect in business construction processes, care for natural resources and their efficient use, achieving technical specifications of construction products and reducing construction waste with method of sustainable production and raw materials. Use of recycling construction materials in civil construction and efficient use of energy in buildings present one of the very important method for efficient sustainable use of materials and energy. Up until now, issues of modelling and improvement of heat protection and efficient use of energy in buildings have not been adequately addressed as it is required by sustainable development approach. Ecological concerns provided the need for intensive research of recycling of waste. Why is such kind of study important? Because of environmental protection:

- by minimizing waste,
- saving of fossil fuels due to recycling,
- to improving recycling process,
- optimized use of available resources,
- improved intellectual capital,
- optimized, effective and efficient processes,
- enhanced organizational performance, credibility and sustainability
- reduced costs.

The care for reputation, that the enterprise profit with the environment protection and permanent development, places the reprocessing and recycling to the base of the organizational goals [16]. The process of recycling begin by product design and development. Some of these benefits may include: lower costs, stimulation of innovation, new business opportunities, and improved product quality [17]. Because of stimulation of innovation, new business opportunities and lower costs, the process of recycling into product design and development is so important. Figure 1 presents construction waste material: concrete from lightweight aggregates, which is typical construction waste. In our case we studied the possibilities for the recycling. If you look at the recycling facts, you will see that since 1990, the United States has improved dramatically in their recycling activities. Recycling facts report that fifteen years ago, the U.S. recycled roughly fifteen percent of our waste materials, which today has doubled to thirty percent! The following recycling facts are both interesting and fun bits of information to increase your knowledge on the art of

recycling [18]. There are many uses for the recycled material in products that we use every day. Some of the more common ones are paper towels, aluminum, and newspaper. The reason are increasingly better technical possibilities for waste processing which reduce the burden on the environment and are very economic. Another reason refers to the use of natural sources. An additional stimulation for searching new possibilities of waste disposal is the waste disposal levy. If we want to change the proportion between waste being disposed and waste being processed in favour of the later, there will be a lot of challenges for us in the future [19]. In constructions waste disposal represents one of the main issues of Environmental Management and has an important influence on the environment, especially hazardous waste. Waste Management includes the collection, movement, processing, and disposal of waste, and also the monitoring of these activities.

### 3.3 Waste management review

Review shall include assessing opportunities for improvement and the need for changes to the environmental management system, including the environmental policy and environmental objectives [24]. Records from management reviews shall be maintained. Inputs to evaluate efficiency as well as effectiveness of the environmental management system should consider the customer and other interested parties and should include:

- status and results of environmental objectives and improvement activities,
- status of management review actions items,
- results of audits and self-assessment of the organization,
- feedback on the satisfaction of interested parties, perhaps even to the point of their participation,
- market-related factors such as technology, research and development, and competitor performance,
- results from benchmarking activities,
- performance of suppliers,
- new opportunities fro improvement,
- control of process and product nonconformities,
- marketplace evaluation and strategies,
- status of strategic partnership activities,
- financial effects for environmental related activities, and
- other factors which may impact the organization, such as financial, social or safety conditions, and relevant statutory and regulatory changes.

By extending management review beyond verification of the environmental management system, the outputs of management review can be used by top management as inputs to improvement processes [24]. Selected output should be communicated to demonstrate to the

people in the organization how the management review process leads to new objectives that will benefit the organization. Figure 3 presents an approach to environmental management - waste management.

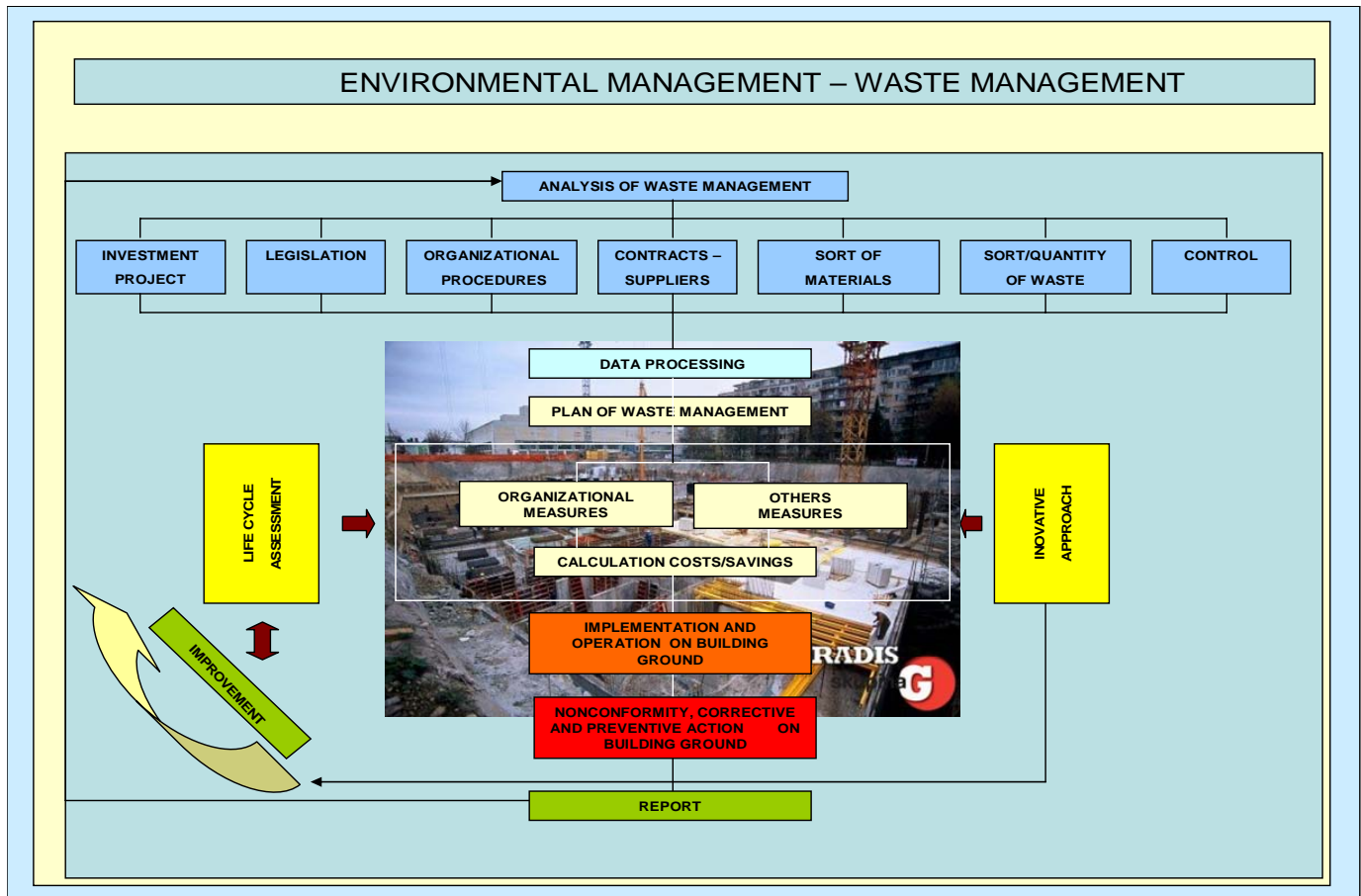


Figure 3: Environmental management – waste management

### 3.4 Life-cycle assessment (LCA)

Life-cycle assessment (LCA) is a process of evaluating the effects that a product has on the environment over the entire period of its life thereby increasing resource-use efficiency and decreasing liabilities. It can be used to study the environmental impact of either a product or the function the product is designed to perform. LCA is commonly referred to as a "cradle-to-grave" analysis. As LCA is a continuous process, companies can begin an LCA at any point in the product/function cycle. LCA can be used for the development of business strategy purchasing decisions, for product and process design and improvement, for setting eco-labelling criteria and to communicate about environmental aspects of products [25]. Key elements are:

- Identifies and quantifies the environmental loads involved; e.g. the energy and raw materials consumed, the emissions and wastes generated;
- Evaluates the potential environmental impacts of these loads;
- Assesses the options available for reducing these environmental impacts.

Figure 4 presents LCA of a product or function.



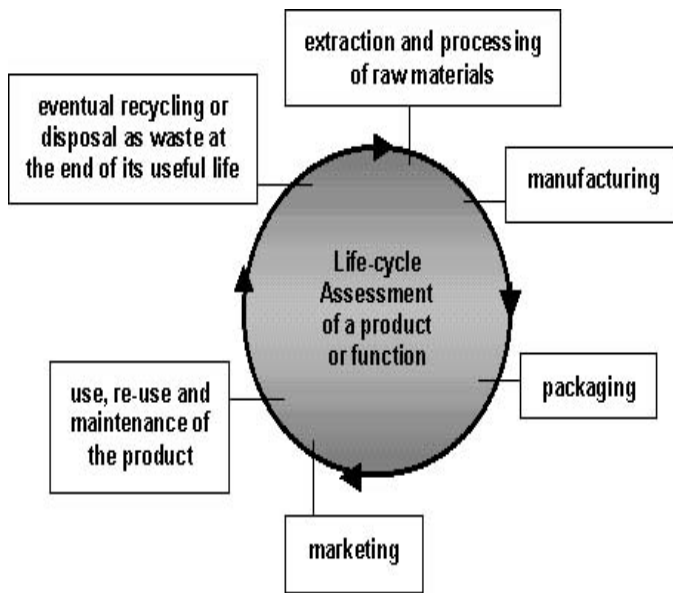


Figure 4:LCA of a product or function [25].

Life Cycle Analysis is essentially a method of considering the entire environmental impact, energy and resource usage of a material or product. It is often known as a 'cradle-to-grave' analysis and can encompass the entire lifetime from extraction to end-of-life disposal. Life cycle analysis can be an extremely effective way of linking many different aspects of the environmental impacts of materials usage. The scope of a life cycle analysis can be adjusted to suit a particular case[26]. Figure 5 schematically shows how the disparate areas under the heading of 'environmental materials' can be linked via a life cycle analysis approach.

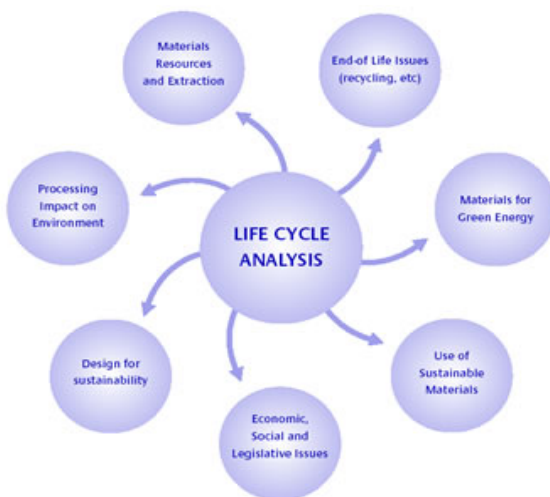


Figure 5:Life Cycle Analysis [26].

### 3.5 Recycling and Environmental Waste Management in Constructions

Taking action on waste is essential, since we are consuming natural resources at an unsustainable rate and contributing unnecessarily to climate change. Each year we generate about 100 million tonnes of waste from households, commerce and industry combined. Most of this currently ends up in landfill, where biodegradable waste generates methane, a powerful greenhouse gas. And much valuable energy is used up in making new products which are later disposed of, so also contributing to climate change [27].

The Government's *Waste Strategy for England 2007* identifies the good potential to increase resource efficiency in construction and reduce waste. The construction industry is a major source of waste in England, using the highest tonnage of solid material resources in any sector, over 400 million tonnes. The construction, demolition & excavation (CD&E) sector generates more waste in England than any other sector, and is the largest generator of hazardous waste, around 1.7 million tonnes. By comparison, the sector accounts for 9–10% of GDP. Objectives of the waste strategy for the construction sector include:

- provide the drivers for the sector to improve its economic efficiency by creating less waste from design to demolition
- treat waste as a resource, re-using and recycling more and asking contractors for greater use of recovered material
- improve the economics of the re-use and recycling sector by increasing demand and securing investment in the treatment of waste [27].

### 4 Conclusion

The role of the manager of construction systems is to direct to and guarantee reduced pollution and also to prevent the negative effects of the environmental pollution. An important part of the cycle of reclaiming materials is the reuse of those materials. Buying recycled-content building materials supports efficient use of our natural resources without compromising building standards. A well developed Construction Waste Management Plan combines good communication with attention to details. Effective implementation will foster employee pride and elevate the corporate image. This will ensure success, maximize the benefits, and provide a marketing edge

[14]. The conviction of the importance of creative cooperation and positive motivation for sound treatment with the environment classifies constructions organisations as environmentally friendly organisations with the aim of a safer and more qualitative life.

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