Module 3

Topics: - Environmental management standards, ISO 14000, Life cycle Analysis-scope and goal, Bio-mimicking, Environmental Impact Assessment –procedures of EIA in India.

- **Environmental management system (EMS)**

  Refers to the management of an organization's environmental programs in a :-

  - comprehensive
  - systematic
  - planned
  - documented manner.

- It is implemented in an organization to make products and operations eco-friendly. Through EMS, the organization will try to implement mechanisms to reduce their environmental degradation.
- It includes
  - organizational structure,
  - planning and resources for developing,
  - Implementing and maintaining policy for environmental protection.
- Aim :- To control and reduce the environmental impact of operations and products designed by an organization/business unit.
- Basic EMS framework follows a PDCA cycle (also called Deming Shewhart Model)

- Plan :- establish an environmental policy ; set up targets based on organization's environmental policy, legal aspects etc
- Do :- implement actions to execute plans through training & operational controls
- Check :-monitoring ,measuring and recording the actual performance
- Act :- Includes management review and corrective measures for continuous improvement

Benefits of EMS

- comply with legislation and avoid the risk of costly fines and damage to your business reputation
- Improve resource efficiency and reduce unnecessary expenditure, as environment-related costs are increasing faster.
- set achievable improvement targets
- communicate your company's environmental credentials to employees, customers, suppliers and shareholders
- Control processes so that impact on the environment is minimized.

ISO 14000 series

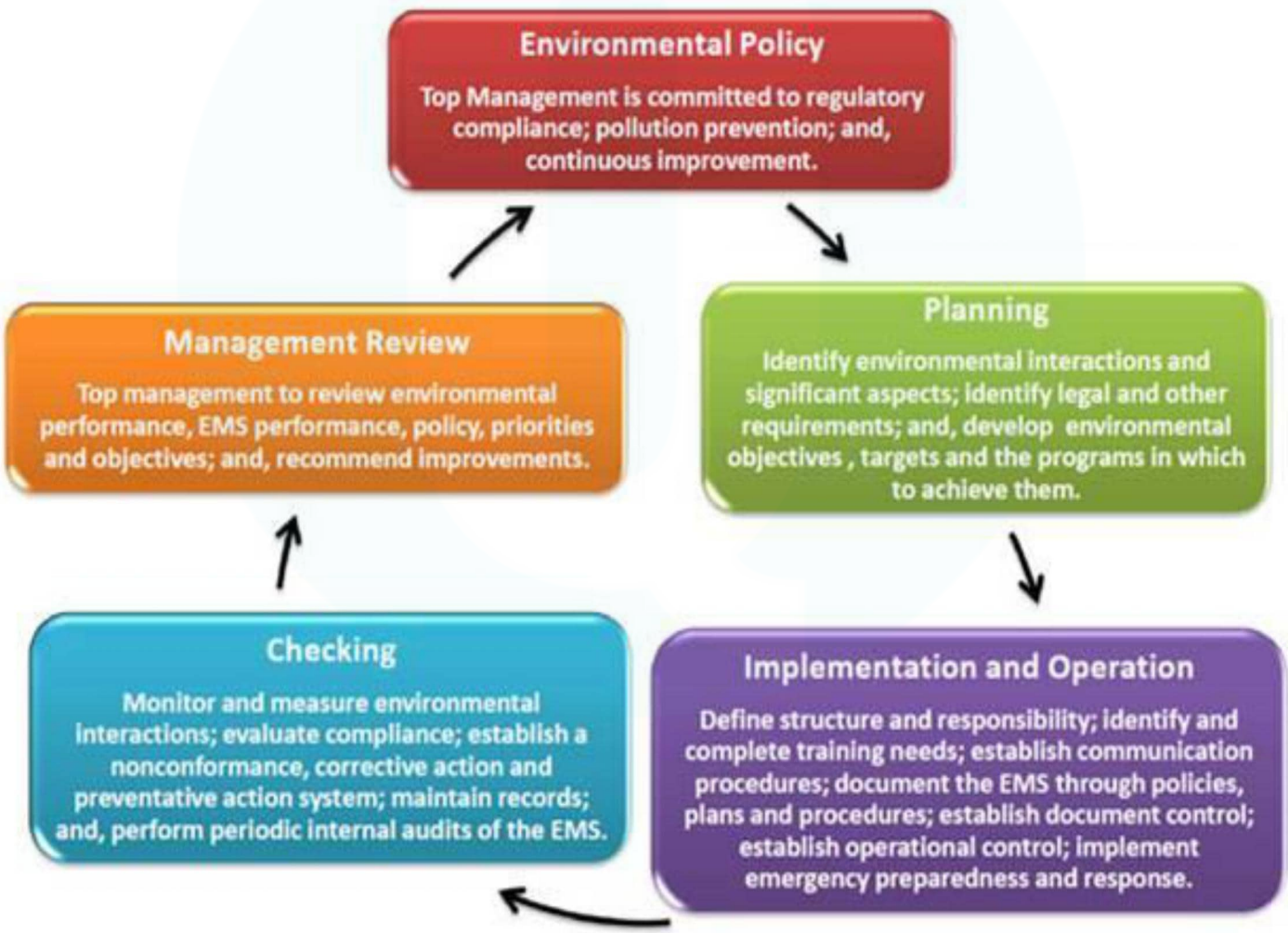
- International voluntary standard describing specific requirements for EMS.
- Published by ISO (International Standards organization)
- Certification for EMS
- EMS can be made efficient and benefits can be achieved

3 basic principles :
- Prevention of environmental pollution.
- Agreeing with environmental regulations.
- Continuous improvement of environmental performance.

Range of ISO	Subject
ISO 14000-14009	EMS
ISO 14010-14019	Environmental auditing
ISO 14020-14029	Environmental labeling

ISO 14030-14039	Environmental performance evaluation
ISO 14040-14049	Life cycle assessment
ISO 14050-14059	Terms & definitions
ISO 14060	Environmental aspects in product design

To obtain ISO 14000 certification, the PDCA cycle of EMS should ensure the following

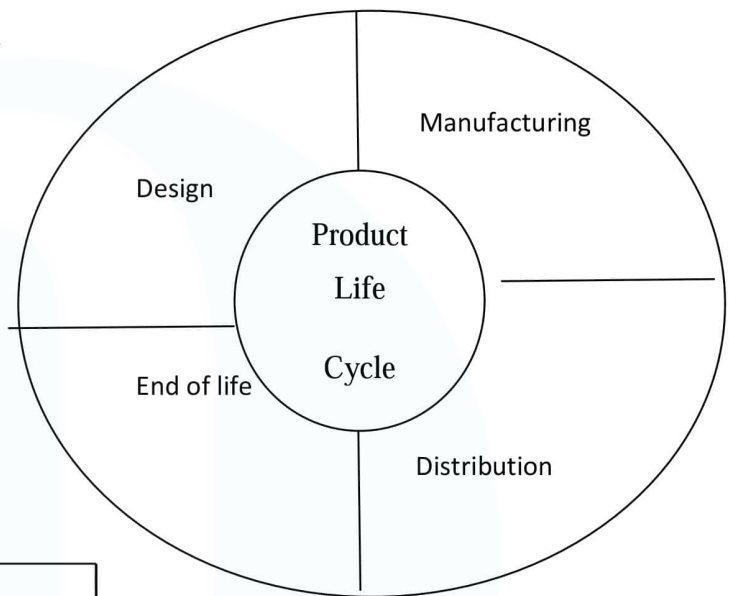


Life cycle Assessment (LCA)

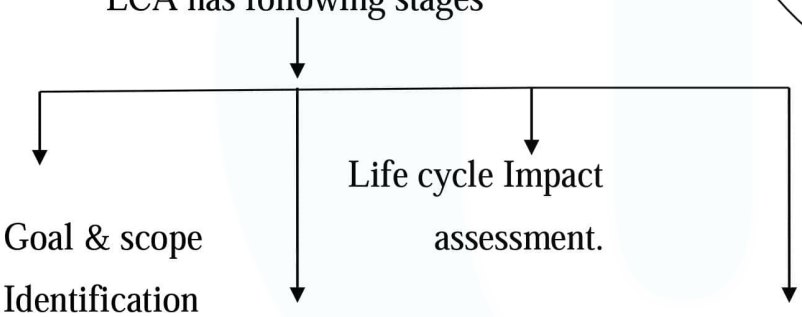
- Evaluating the environmental effects of a product, process or activity by looking at the entire life cycle of the product or process from raw material extraction through customer use.
- Also known as **cradle to grave** analysis.
- Evaluation stages include raw material extraction, design stage, manufacturing stage, packaging, distribution, use and disposal.
- Goals :-

  -systematic evaluation environmental consequences of a product

  -Identify magnitudes of impact in each stage



LCA has following stages



Goal & scope Identification

Life cycle Inventory analysis (LCI)

Life cycle Impact assessment.

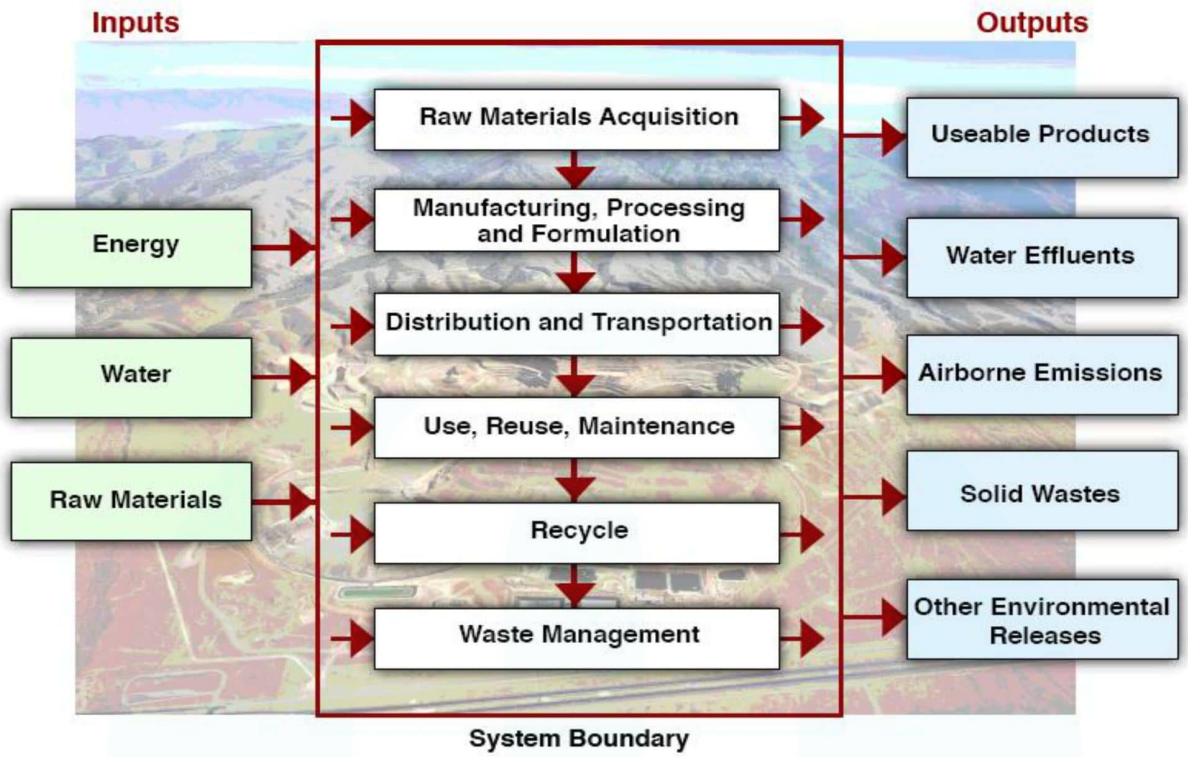
Interpretation

Goal & scope Identification:

- Identify the purpose of conducting LCA of the concerned product.

Life cycle Inventory analysis

- Analyzing the inflows from and outflows to the nature for a product.
- For any product, we use raw materials & energy from the nature and release products, emission to the environment.



- LCI provides informations on all inflows and outflows corresponding to a product.

Life cycle Impact assessment

Evaluating the significance of potential environmental impacts based on LCI flow results

Interpretation

Results from inventory analysis and impact assessment are summarized.

BIO MIMICKING

- Design tool based on copying the strategies used by living things.
- It makes our industrial system sustainable by obeying the laws of nature.
- It is the practice of learning from the nature and copying life's best ideas to create a sustainable world.
- Nature works as a model, mentor and measure
- Examples -

- **Shinkansen Bullet train** in Japan was designed by imitating the Kingfisher.

The Shinkansen Bullet Train has a streamlined forefront and structural adaptations to significantly reduce noise resulting from aerodynamics in high-speed trains. Engineers of the Shinkansen bullet train needed to quiet down the noise level of the train, which exceeded environmental standards, whenever it traveled through a narrow tunnel, The engineers turned to nature and found the kingfisher's unique ability to go from one medium (air) to another medium (water) without disturbing the surface.(It creates only very little splashes in water while catching its prey.) The streamlined shape of the kingfisher's beak and head became the design for the new bullet train, completely solving the sound problem and even increasing the maximum speed. It was biomimicry in action.

-**Eastgate complex** ,Harare, Zimbabwe sought inspiration for the ventilation design from termite mounds. Cool air always circulates inside the building through a proper ventilation system inspired from termite mounds. Thus the usage of artificial cooling system is reduced.

-**Gecko tape** is inspired from gecko lizard.

-**Walking stick for the blind** is inspired from the bats. The ultrasonic waves used by bats have inspired a new piece of technology which can help blind people to detect obstacles. Developers have come up with stick which can vibrate when it's near objects, so that the user can sense their way around. Ultrasonic transmission and reception technique is used here.

- Principles of bio mimicking :-

--nature runs on sunlight
--nature fits form to function
--nature rewards cooperation
--nature demands local expertise
--nature uses energy only if it needs
--nature recycles everything
--nature banks on diversity
--nature curbs excesses from

Environmental Impact Assessment EIA

- Process of identification,evaluation and mitigation (reducing) the potential environmental impacts of proposed projects,plans and programs prior to decision making/commitements made relative to :-
  - -physical or chemical components
  - -biological components
  - -cultural components
  - -socio-economic components
  - -environmental components
- Direct and indirect effects of a development project can be measured through EIA.
- For eg:- If we are planning to construct a new roadway / railway line through a forest region , we have to conduct a detailed study at first to assess its future benefits and problems. A detailed study should be conducted to check how this project will affect the wildlife, how much forest areas will be cleared, how it will affect the bio-diversity , what will be the pollution status of the concerned forest region in future etc.

Objectives

- Predict environmental impacts of projects
- Find ways to reduce impacts
- Redesign the proposed project to suit local environment
- Present predictions before decision makers

EIA notification has 3 schedules
- Schedule I : list of projects requiring environmental clearance from govt.
- Schedule II : Application form
- Schedule III : Composition of expert committee

Procedures of EIA in India

- Project Proposal/description

  It is the description of all aspects of project showing project boundary, site layout, project duration, expected cost etc.

- Screening

  It is the process of scrutinizing an application to check whether a project requires environmental clearance or not.

- Scoping and consideration of alternatives

  If it is difficult to grant permission to the project based on existing proposal, alternative proposals with slight modifications in our existing proposal can be considered for the EIA study. All the available options with respect to project site, technology ,operations etc should be considered in this stage.

- Base line data collection

  Studying the existing environmental status (environmental status, water quality, air quality ,wildlife ,plants etc) of the identified area.

- Impact prediction and Assessment of Alternatives

  Predicting the magnitude of environmental impacts of the project based on baseline studies

- EIA Report

  Report of the study has to be submitted to the decision makers.

- Public hearing

  Public must be informed and consulted about the project. Suitable changes should be made to the project proposal as per public suggestion.

- Decision-making

  Analyzing EIA report and public opinion, project is approved or rejected or changed by Expert Appraisal Committee EAC

- Monitoring the clearance conditions

  Monitoring is done during construction & operation phase to check whether works progress according to the decisions taken by authorities.

- Final EIA report is known as EIS -Environmental Impact Statement.

Previous University examination Questions

1) Life cycle assessment takes the concept of "cradle to grave". Explain this with any example. (5 marks)

2) A hospital is situated in the middle of a densely populated area. What are the possible environmental impacts that can happen to the surroundings? Suggest any methods for reducing these impacts. (5 marks)

3) Case study

Case on Ecological Habitat Development

The project on ecological housing in Setagaya-Ku Fukasawa Tokyo, Japan provided environmentally sustainable housing in one of the most densest cities of the world with the normal public housing cost financed totally from public funds. Five apartment buildings were constructed with 70 dwellings, 43 of which were for low income residents. High levels of thermal insulation and technologies saving energy such as solar collector for heating and hot water, solar cells and wind turbines were attached and water saving techniques such as permeable pavement and rainwater collection were installed. Various passive lighting, heating and cooling methods were applied and the design was made according to local wind patterns to enable natural ventilation during hot and humid summers. The building materials were selected to have minimal impacts on the environment and health of residents. Many trees were preserved and moved to the site, a garden established, a green rooftops installed, which is important in the context of low urban greenery and a major heat island effect. Thirty percent saving of average household energy bills were achieved. Shared community facilities were constructed. The project had a social dimension resulting in a social mix that is very rare in Tokyo.

(a) Highlight the significance of life cycle cost evaluation when applied to such projects to establish the advantage of environmentally sustainable housing projects. (3)

(b) If you are asked to evaluate the environmental impact of the above project, state any two factors that can be identified as the key impacts on the environment. Also specify the necessary information required for the assessment of impact due to these factors. (4)

(c) If standardisation of these practices need to be attained how can ISO 14000 help the organisations to ensure quality of practice in environmentally sustainable housing projects? (3)

4) Demonstrate the basic concept of LCA with an example (5 marks)

5) What is meant by bio mimicry? Give any 3 examples (2+3 = 5 marks)

6) Case study

The three-and-a-half pound microchip: Environmental implications of the IT revolution

PUBLIC RELEASE: 5-NOV-2002 AMERICAN CHEMICAL SOCIETY

Microchips may be small, but their impact on our world has been huge. And this impact goes beyond the obvious effects of e-mail, cell phones and electronic organizers: A new study shows that the "environmental weight" of microchips far exceeds their small size. Scientists have estimated that producing a single two-gram chip -- the tiny wafer used for memory in personal computers -- requires at least 3.7 pounds of fossil fuel and chemical inputs. The results have crucial implications for the debate on dematerialization- the concept that technological progress should lead to radical reductions in the amount of materials and energy required to produce goods. The microchip is often seen as the prime example of dematerialization because of its high value and small size, but the new findings suggest this might not be the case. The researchers performed a life cycle assessment of one 32-megabyte DRAM chip, tracing it through every level of production, from raw materials to the final product. In doing so, they estimated the total energy, fossil fuels and chemicals consumed in production processes. Fossil fuel use correlates with carbon dioxide emissions, and chemical use is suggestive of potential pollution impacts on local air, water and soil. Each chip required 3.5 pounds of fossil fuels, 0.16 pounds of chemicals, 70.5 pounds of water and 1.5 pounds of elemental gases (mainly nitrogen).

(a) What does the life cycle assessment of one 32-megabyte DRAM chip reveal? (3 marks)

(b) What are the estimated amount of fossil fuel and chemicals required for producing a single two-gram chip? (2 marks)

(c) Discuss the importance of life cycle analysis. (2 marks)

(d) Elaborate on the debate on dematerialization. (3 marks)

7) EMS framework follows a PDCA cycle. Explain (5 marks)

8) List out various procedures for EIA in India. (5 marks)

9) Write the LCA of shoes made of leather (10 marks)

10)

A3. (a). Suppose you are required to do the Life Cycle Assessment of an Electric Vehicle. In the utilisation stage, the assessment must be made for the energy used to drive the vehicle. List any three possible impacts of the Electric Vehicle during the usage stage? Suggest a possible way to reduce the impact during utilisation of the vehicle. (3+2=5)

11) a) Match the items in the following sets: (2 marks)

Set A: {ISO 14006; ISO 14041; ISO 14048; ISO 14012}

Set B: {LCA Data Documentation Format; Environmental Auditing qualifying criteria; Eco design guidelines; LCA inventory analysis)

b) Which steps in Environmental Impact Assessment involve participation from the public? What are the steps involved after the final public consultation? (3 marks)

12) Discuss the LCA analysis of polythene carry bags (10 marks)

INDUSTRIAL SYMBIOSIS

Industrial symbiosis is the sharing of services, utility, and by-product resources among industries in order to add value, reduce costs and improve the environment. Industrial symbiosis is a subset of industrial ecology, with a particular focus on material and energy exchange. Industrial ecology is a relatively new field that is based on a natural paradigm, claiming that an industrial ecosystem may behave in a similar way to the natural ecosystem wherein everything gets recycled. Example of Industrial symbiosis: waste steam from a waste incinerator (right) is piped to an ethanol plant (left) where it is used as in input to their production process

INDUSTRIAL ECOLOGY

Industrial ecology (IE) is the study of material and energy flows through industrial systems. The global industrial economy can be modelled as a network of industrial processes that extract resources from the Earth and transform those resources into commodities which can be bought and sold to meet the needs of humanity. Industrial ecology seeks to quantify the material flows and document the industrial processes that make modern society function. Industrial ecologists are often concerned with the impacts that industrial activities have on the environment, with use of the planet's supply of natural resources, and with problems of waste disposal. Industrial ecology is a young but growing multidisciplinary field of research which combines aspects of engineering, economics, sociology, toxicology and the natural sciences.

CIRCULAR ECONOMY

A circular economy (often referred to simply as "circularity") is an economic system aimed at eliminating waste and the continual use of resources. Circular systems employ reuse, sharing, repair, refurbishment, remanufacturing and recycling to create a closed-loop system, minimising the use of resource inputs and the creation of waste, pollution and carbon emissions. The circular economy aims to keep products, equipment and infrastructure in use for longer, thus improving the productivity of these resources. All "waste" should become "food" for another process: either a by-product or recovered resource for another industrial process or as regenerative resources for nature (e.g., compost). This regenerative approach is in contrast to the traditional linear economy, which has a "take, make, dispose" model of production.