PIE Tech

POLLACHI INSTITUTE OF ENGINEERING AND TECHNOLOGY

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Department of Mechanical Engineering

Regulation 2021

III Year – VI Semester

CME350 ENVIRONMENT SUSTAINAILITY AND IMPACT ASSESSMENT

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UNIT – I ENVIRONMENTAL IMPACT ASSESMENT 9

Environmental impact assessment objectives – rationale and historical development of EIA - Conceptual frameworks for EIA Legislative development – European community directive – Hungarian directive.

UNIT – II ENVIRONMENTAL DECISION MAKING 9

Strategic environmental assessment and sustainability appraisal – Mitigation, monitoring and management of environmental impacts- Socio economic impact assessment.

UNIT – III ENVIRONMENTAL POLICY, PLANNING AND LEGISLATION 9

Regional spatial planning and policy – Cumulative effects assessment – Planning for climate change, uncertainty and risk.

UNIT – IV LIFE CYCLE ASSESSMENT 9

Life cycle assessment; Triple bottom line approach; Industrial Ecology. Ecological foot printing, Design for Environment, Future role of LCA, Product stewardship, design, durability and justifiability, measurement techniques and reporting

UNIT – V SUSTAINABLE URBAN ECONOMIC DEVELOPMENT 9

Spatial economics – Knowledge economy and urban regions.

TEXT BOOKS:

1. The Application of Science in Environmental Impact Assessment, by Aaron J. MacKinnon, Peter N. Duinker , Tony R. Walker , Routledge; 1st edition (14 May 2019), ISBN-10 : 0367340194

2. Routledge Handbook of Environmental Impact Assessment, by Kevin Hanna, Routledge; 1st edition (11 April 2022), ISBN-10 : 0367244470

REFERENCES:

1. Clive George, C. Collin, H. Kirkpolarice – Impact Assessment and sustainable development – Edward Elgar Publishing, 2007

2. Robort B Gibsan, Sustainability Assessment, Earth Scan publishers, 2005

3. Simon Dresner, The principle of sustainability – Earth Scan publishers, 2008

4. Canter, R.L., "Environmental Impact Assessment", McGraw Hill Inc., New Delhi, 1996.

5. Shukla, S.K. And Srivastava, P.R., "Concepts In Environmental Impact Analysis", Common Wealth Publishers, New Delhi, 1992.

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UNIT 1

Environmental Impact Assessment (EIA)

Environmental Impact Assessment (EIA) is a process of evaluating the likely environmental impacts of a proposed project or development.

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Environmental Impact Assessment (EIA) is a process of evaluating the likely environmental impacts of a proposed project or development taking into account inter-related socio-economic, cultural and human-health impacts, both beneficial and adverse.

Significance of EIA

The significance of EIA is:

1) EIA is more than technical reports, it is a means to a larger intention – the protection and improvement of the environmental quality of life.

2) EIA is a procedure to identify and evaluate the effects of activities (mainly human) on the environment - natural and social. It is not a single specific analytical method or technique, but uses many approaches as appropriate to the problem.

3) EIA is not a science but uses many sciences in an integrated inter-disciplinary manner, evaluating phenomenon and relationships as they occur in the real world.

4) EIA should not be treated as an appendage, or add-on, to a project, but be regarded as an integral part of project planning. Its costs should be calculated as an adequate part of planning and not regarded as something extra.

5) EIA does not give decisions but its findings should be considered in policyand decision-making and should be reflected in final choices. Thus it should be part of the decision-making process.

EIA objectives are to

i. Design the project proposal with greener approach.
ii. Assure that resources are used appropriately and efficiently.
iii. Recognize suitable measures to reduce the likely impacts of the proposal.
iv. Safeguard human health and safety.
v. Reduce irreparable changes and serious damages to the environment.
vi. Protect assessed resources, natural environment and ecosystem components.
vii. Increase the social aspects of the proposal.
viii. To disclose significant environmental effects of proposed projects to decision-makers and the public.
ix. To enhance public participation

Impacts of environment

Impacts of environment have been classified in to primary and secondary impacts. They are as follows.

Primary Impacts:

Primary impacts are those impacts which can be associated directly to the proposed action. For example, the proposed activity is construction of an amenity like waste water treatment plant or construction of a residential society, the primary impacts on the action would be waste removal and disposal, land use changes at the facility site and local environment damage.

Secondary Impacts:

Secondary impacts are those impacts which are indirect or induced changes like investments and deviation in normal social and economic activities. In the above example, the secondary impacts would include the environmental impacts related to indirect changes in the pattern of land use, density of population, and related effects on air, water and other natural eco systems will be affected.

Environmental Impact Assessment is a procedure which has three important purposes.

They are

i. To facilitate decision making: EIA provides a coherent evaluation of the environmental consequences of a proposed activity and occasionally provide options; before a decision is taken up by the decision-maker may be the local authority. The decision-maker compile all relevant documents of the planned proposed activity can consider the Environmental Impact Statement (EIS).

ii. To assist in the formation of development: Most of the project proposers feel that EIA as another barrier to cross. The process has various steps involved in obtaining the approvals from different competent authorities, which is expensive and time consuming exercise. But in fact, EIA can be of huge benefit to them, since it will provide a meaningful framework to overcome the location and design in addition to the environmental issues. It assists in formulation of project activities, specified areas where the project can be reviewed to reduce or eliminate completely the adverse impacts on the environment. This helps in earlyidentification of environmental impacts in the planning stage of development, which leads to effective project development, healthy relations between the developer, the planning authority and the local communities for successful completion of the project and financial return on the incurred expenditure.

iii. To become a management tool for sustainable development:

The concept of sustainable development includes meet the needs of the present, continuous improvement of quality of life by economic growth without compromising the ability of future generations to meet their own needs and without environmental damage. Institutional responses to sustainable development are, therefore, required at several levels.

The EIA process

The environment impact assessment consists of eight steps with each step equally important in determining the overall performance of the project.

Screening: First stage of EIA, which determines whether the proposed project, requires an EIA and if it does, then the level of assessment required.

Scoping:This stage identifies the keyissues and impacts that should be further investigated.This stage also defines the boundary and time limit of the study.

Impact analysis:This stage of EIA identifies and predicts the likely environmental and social impact of the proposed project and evaluates the significance.

Mitigation: This step in EIA recommends the actions to reduce and avoid the potential adverse environmental consequences of development activities.

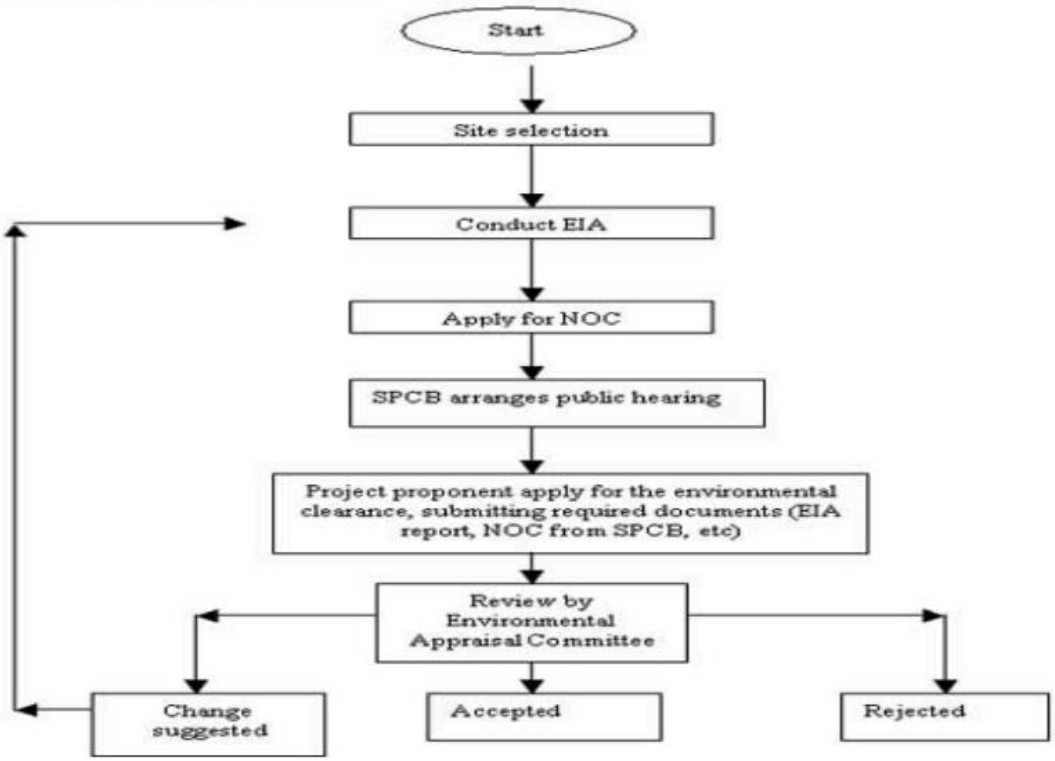
Reporting: This stage presents the result of EIA in a form of a report to the decision-making body and other interested parties.

Review of EIA: It examines the adequacy and effectiveness of the EIA report and provides the information necessary for decision-making.

Decision-making: It decides whether the project is rejected, approved or needs further change.

Post monitoring: This stage comes into play once the project is commissioned. It checks to ensure that the impacts of the project do not exceed the legal standards and implementation of the mitigation measures are in the manner as described in the EIA report.

Figure 1: Generalised process flow sheet of the EIA process



The process is guided by six key principles which help control developments and ensure these sustainable environmental management practices are followed. These 6 key principles are as discussed below:

1. Environmental Concerns Must be Accounted for in all Development Plans

2. Public Participation

As a decision-making process, the EIA provides a means for all stakeholders in a project to be heard and to participate in the process of selection of alternatives and mitigation of adverse effects.

3. Recognition of Social and Cultural Principles

Traditionally Used in the Management of the Natural Environment Traditionally, the community affected by the project/development plan has always interacted with the

environment around them. There a cultural and social practices that they have always employed to take care of and sustainably manage the natural environment.

4. International Cooperation in the Use and Wise Management of Shared Resources

Where a proposed project, plan or programme affects natural resources shared among different nations, the principle is that these two nations should cooperate in the management of these resources.

5. The “Polluter Pays” Principle

This principle is interpreted to mean that the polluter, who has directly or indirectly damaged the environment or created conditions that led to environmental damage, should bear the cost of carrying out measures to ensure the environment is reinstated after the pollution incident.

6. The Precautionary Principle

The precautionary principle is based on the idea that prevention is better than remediation. It is more cost-effective to take early action to ensure that environmental damage does not occur. In the face of uncertainty, this principle calls for early measures to avoid and mitigate environmental damage and health hazards.

Rationale of EIA

The Rationale of EIA The effective EIA should possess three fundamental values.The first value is integrity; it states that the EIA procedure should be equitable, objective, impartial and well balanced. The second would be utility; it provide stable and reliable information for decision making. The third value is sustainability; where it should result in environmental stewards to diminish significant unfavorable effects and escape irreparable loss of natural resource and functions of ecosystem.

The EIA report was formulated to fulfill its objectives as defined in the Environmental Protection Act (EPA)2002. Relevant mitigating measures will be deduced, aimed at preventing, minimizing and balance the adverse effects that are most likely to occur

because of proposed project. The following core components that may be affected by the project were properly considered in this report

i. Disruption due to construction

ii. Oil spills on land and sea

iii. Wastewater disposal

iv. Solid waste disposal

v. Air emissions

vi. Storm Run-off

vii. Noise Pollution

viii. Traffic

ix. Socio-economic impact

The sensitivity of these components to the effects caused by the project was evaluated and eventually, mitigating measures had been defined to avoid, minimize and reduce the environmental consequences. Best Professional Judgment (BPJ), previous occurrence from similar projects served as a fundamental basis for predicting environmental impact of the project. The adverse effects of the proposed project were assessed at the following two stages

i. Throughout the construction phase which are short term or temporary nature

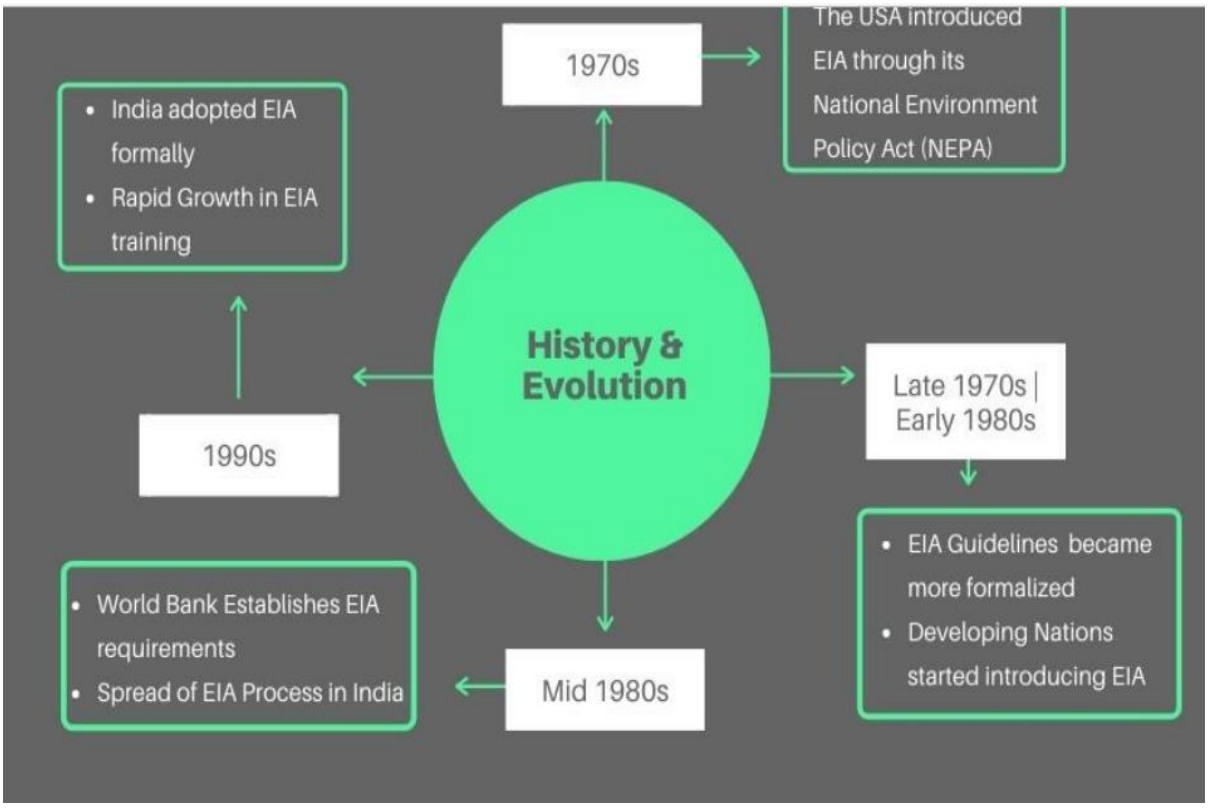
ii. Throughout the operational phase when the effects are permanent and lasting

Historic Development of EIA

As the world progressed in science and technology, the various projects which were intended to provide benefits to the people started to show negative effects in terms of their effects on the environment, thus compelling us to consider alternatives. As such laws were introduced to counter the adverse effects, thus highlighting the need for

Environment Impact Assessment (EIA) The first country to give importance to EIA through its National Environmental Protection Act (NEPA) of 1969 was the United States . A large number of countries followed, which were having industries. Canada, Australia, the Netherlands and Japan adopted EIA legislation in 1973, 1974, 1981 and 1984, respectively. In July 1985, the European Community (EC) made EIA mandatory.

EIA in India was started in 1976-77, when the Planning Commission asked the then Department of Science and Technology to examine the river-valley projects from the environmental angle. This was subsequently extended to cover those projects, which required approval of the Public Investment Board. These were administrative decisions. The Government of India enacted the Environment (Protection) Act on 23rd May 1986.



To achieve the objectives of the Act, one of the decisions taken was to make EIA statutory. After following the legal procedure, a notification was issued on 27th January

1994 and subsequently amended on 4th May 1994, 10th April 1997 and 27th January 2000 making environmental impact assessment statutory for 30 activities. This is the principal piece of legislation governing EIA in India. Besides this, the Government of India under Environment Protection Act 1986 issued a number of notifications, which are related to environmental impact assessment.

These are limited to specific geographical areas, and are summarised below: *Prohibiting location of industries except those related to Tourism in a belt of 1 km from high tide mark from the Revdanda Creek up to Devgarh Point (near Shrivardhan) as well as in 1 km belt along the banks of Rajpuri Creek in Murud Janjira area in the Raigarh district of Maharashtra (6th January 1989). *Restricting location of industries, mining operations and regulating other activities in Doon Valley (1st February 1989). *Regulating activities in the coastal stretches of the country by classifying them as coastal regulation zone and prohibiting certain activities (19th February 1991). *Restricting location of industries and regulating other activities in Dahanu Taluka in Maharashtra (6th June 91). *Restricting certain activities in specified areas of Aravalli Range in the Gurgaon district of Haryana and Alwar district of Rajasthan (7th May 1992). *Restricting industrial and other activities, which could lead to pollution and congestion in the north west of Numaligarh in Assam (July 1996).

ENVIRONMENTAL CLEARANCE PROCEDURE IN INDIA:

The EIA process in India is made up of the following phases: (1) Screening. (2) Scoping and consideration of alternatives. (3) Baseline data collection. (4) Impact prediction. (5) Environmental Impact Assessment (EIA) (6) Assessment of alternatives, mitigation measures and environmental impact statement. (7) Public hearing. (8) Environment management plan (EMP). (9) Decision-making. (10) Monitoring the clearance conditions.

EIA is an assessment of the impact of an identified project, programme or any human activity with environment impacts and consist of socio economic and environmental aspects. The UN conference on 'environment and development' states that the "Environmental impact assessment as a national instrument shall be undertaken for proposed activities that are likely to have a significant adverse impact on the environment and are subject to a decision of a competent national authority" (Donelly et al, 1998, p.7). It is the process of identifying, predicting, evaluating and mitigating the biophysical (http://en.wikipedia.org/wiki/Biophysics), social, and other relevant effects of development proposals prior to major decisions being taken and commitments made (IAIA, 1999, p.2). According to Lawrence (2003, p.7), EIA is defined as a systematic process of determining and managing (identifying, describing, measuring, predicting, interpreting, integrating, communicating, involving, and controlling) the potential (or real) impacts (direct and indirect, individual and cumulative, likelihood of occurrence) of proposed (or existing) human actions (projects, plans, programmes,

4 Conceptual frameworks for EIA Legislative development

4.1 Policy framework

Increasingly, at the national level, new environmental policies are being introduced, perhaps including a National Environmental Action Plan or National Plan for Sustainable Development. Such policies are often supported by legislation. Government policies in areas such as water, land distribution and food production, especially if supported by legislation, are likely to be highly significant for irrigation and drainage projects.

An EIA should outline the policy environment relevant to the study in question. Results are also likely to be most easily understood if they are interpreted in the light of prevailing policies. Policies and regulations are sometimes conflicting and can contribute to degradation. It is within the scope of an EIA to highlight such conflicts and detail their consequences in relation to the irrigation and drainage proposal under study. An example of conflicting policies would be an agricultural policy to subsidize agrochemicals to increase production and an environmental policy to limit the availability of persistent chemicals. A totally laissez-faire policy will result in unsustainable development, for

example through uncontrolled pollution and distortions in wealth. This creates problems which future generations have to resolve. On the other hand, excessive government control of market forces may also have negative environmental impacts. For example, free irrigation water leads to the inefficient use of this scarce and expensive resource, inequities between head and tail users and water logging and salinity problems. Legal and policy issues have far-reaching consequences for the environment and are included here to illustrate the complex nature of environmental issues. The FAO Legislative Study 38, "The environmental impact of economic incentives for agricultural production: a comparative law study", is a useful reference. A forthcoming FAO/World Bank/UNDP publication, "Water Sector Policy Review and Strategy Formulation: A General Framework", will address the need for environmental issues to be integrated into water policy. If a regional, sector or basin-wide EIA is needed, such issues will form an important part.

4.2. Social context

A project or programme and its environmental impacts exist within a social framework. The context in which an EIA is carried out will be unique and stereotype solutions to environmental assessments are therefore not possible. Cultural practices, institutional structures and legal arrangements, which form the basis of social structure, vary from country to country and sometimes, within a country, from one region to another. It is a fundamental requirement to understand the social structure of the area under study as it will have a direct impact on the project and the EIA. Local, regional and national regulations, laws and organizations are interlinked. The way in which they are interlinked needs to be explicitly understood as part of the EIA. An understanding of the institutional and legal framework concerning the environment and irrigation and drainage development is critical to the success of any project or programme. Indeed, it is likely that recommendations arising from the EIA will include restructuring or strengthening institutions, particularly at a local level, for example, ensuring adequate maintenance or effective monitoring of drain water quality. Recommendations for new legal controls or limits may also form part of the EIA output; for example, stipulating a particular flow regime in order to maintain a wetland. At a local or regional level there may be particular regulations and customary practices which will influence environmental aspects of any project and these must be understood. The participation of local groups and the direct beneficiaries, mainly farmers, is essential to successful EIA. This may best be achieved by involving district councils. At the district level there is more interaction between sectors. Consultation with local interest groups, including non-governmental

organizations (NGOs), will enable local views to be taken into account and their concerns addressed. An awareness of social and cultural problems may enable solutions to be found and conflicts to be averted before project implementation commences. Ignorance of a problem will prevent a satisfactory solution being found. If land acquisition, economic rehabilitation (providing an alternative source of income) or resettlements of displaced people are factors in any proposed development, special care will be needed in carrying out the EIA. In most countries such issues are socially and politically sensitive and legally complex and must be identified early, during screening. They should be highlighted so that they are adequately studied by experts early in project preparation. Poor people often find themselves in a vicious circle. They are forced by their poverty to exploit natural resources in an unsustainable manner and suffer from increasing poverty because of environmental degradation. They often inhabit fragile, marginal eco-zones in rural and, increasingly, semi-urban areas. High population growth is linked to poverty and further contributes to the dynamics of the vicious circle as ever increasing demands are made on finite natural resources. Therefore, the needs of the poor, their influence on the project and the project's impact on vulnerable groups all require particular attention in an EIA.

4.3. Institutional framework and EIA

Environmental, water and land issues involve many disciplines and many government bodies. Data will therefore have to be collected and collated from a wide range of technical ministries, other government authorities and parastatals. The interests of some bodies may not initially appear to be relevant to irrigation and drainage. However, they may hold important information about the project and surrounding area on such topics as land tenure, health, ecology and demography. The link between different ministries and departments within ministries are often complex and the hierarchy for decision making unclear. There is a tendency for each ministry to guard "its project" and not consult or seek information from other government bodies unless forced to. This is directly contrary to the needs of an EIA. Even if formal structures exist there may be a lack of coordination between different organizations. Informal links may have been established in practice in order to overcome awkward bureaucratic structures. These issues must be understood and not oversimplified. There may be conflict between government organizations, particularly between the institution promoting the development and that given the mandate for environmental protection. In countries where some planning processes are

undertaken at the regional or district level, the regional or district councils make it easier for affected communities to put forward their views, which may differ from those of the central authorities. They will have different agendas and approaches. The EIA process must be interactive and be sympathetic to the differing views; not biased towards a particular organization. One of the main conflicts arising from irrigation and drainage projects is between those responsible for agriculture and those for water. In some countries, there are several key ministries with differing responsibility, such as agriculture, public works and irrigation, plus several parastatal organizations and special authorities or commissions, some perhaps directly under the Office of the President. The institutional aspects are complex; for example in Thailand, over 15 institutions have responsibility for various aspects of soil conservation work.

4.4. Legal framework for EIA

Environmental policy without appropriate legislation will be ineffective as, in turn, will be legislation without enforcement. Economic and financial pressures will tend to dominate other concerns. In many developing countries legislation on environmental issues has been in existence for many years. For example, laws exist in most countries for the prevention of water pollution, the protection of cultural heritage and for minimum compensation flows. Much of the existing legislation or regulations have not been considered "environmental". Recently, much specific new environmental legislation has been enacted. This may be as a response to major disasters, or may result from government policy, public pressure or the general increased international awareness of the environmental dangers that now exist in the world. Relevant water and land law as well as environmental protection legislation needs stating, understanding and analysing as part of an EIA. New legislation may include a statutory requirement for an EIA to be done in a prescribed manner for specific development activities. When carrying out an EIA it is thus essential to be fully aware of the statutory requirements and the legal responsibilities of the concerned institutions. These are best given as an annex to the terms of reference. The legal requirements of the country must be satisfied. New laws can impose an enormous burden on the responsible agencies. The statutory requirement to carry out an EIA for specific projects will, for example, require expert staff to carry out the study, as well as officials to review the EIA and approve the project. Laws designating what projects require EIA should, ideally, limit the statutory requirements to prevent EIA merely becoming a hurdle in the approval process. This will prevent large volumes of work being carried out for little purpose. Most legislation lists projects for which EIA is a discretionary requirement. The discretionary authority is usually the same

body that approves an EIA. This arrangement allows limited resources to be allocated most effectively. However, it is essential that the discretionary authority is publicly accountable. When external financial support is required it will also be necessary to satisfy the obligations of the donor organization. Most major donors now require an EIA for projects relating to irrigation and drainage. Chapter 6 gives details of publications outlining the requirements of the main donors. The function of environmental legislation can vary. It is not easy to give a precise definition of when an EIA is needed. Therefore the statutory requirement for an EIA is not particularly well suited to law. On the other hand many of the most important environmental hazards are easily addressed by law. For example, it is straightforward to set legal limits for pollution, flow levels, compensation etc: here the problem is one of enforcement. It is normal for an EIA to assess the acceptability or severity of impacts in relation to legal limits and standards. However, it is important to highlight cases where existing standards are insufficiently stringent to prevent adverse impacts and to recommend acceptable standards. Enforcement problems can be partially addressed by changing institutional structures. Laws relating to irrigated lands are complex and according to an FAO study of five African countries they are not generally applied (FAO, 1992). There are conflicts between modern and customary laws: the former tend to be given prominence although the latter are usually strong locally. Traditional and customary rights have often developed in very different historical and political contexts and can vary greatly over a short distance. They may also be mainly oral and imprecise. Local participation in the preparation of the EIA will help to understand important customary rights and highlight possible weaknesses in any proposed development.

5. European community directive

The European Community (EC) was developed after World War II in the hopes that a more unified Europe would find it harder to go to war with one another. When the European Community was created in 1957 there were six countries on the roster: Belgium, Germany, France, Italy, Luxembourg, and the Netherlands.

The original European Community was comprised of three organizations and governed by a series of treaties. These treaty organizations worked together to ensure fair and even policies were enacted and enforced across participating countries.

In 1993, the European Community was rolled into the European Union (EU) when the Maastricht Treaty went into effect. As of 2021, there are 27 countries in the EU:

Austria, Belgium, Bulgaria, Croatia, Cyprus, Czechia, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, Netherlands, Poland, Portugal, Romania, Slovakia, Slovenia, Spain, and Sweden.

A directive is a legal act adopted by the EU institutions addressed to the EU Member States.

Regulations

A "regulation" is a binding legislative act. It must be applied in its entirety across the EU. For example, when the EU's regulation on ending roaming charges while travelling within the EU expired in 2022, the Parliament and the Council adopted a new regulation both to improve the clarity of the previous regulation and make sure a common approach on roaming charges is applied for another ten years.

Directives

A "directive" is a legislative act that sets out a goal that EU countries must achieve. However, it is up to the individual countries to devise their own laws on how to reach these goals. One example is the EU single-use plastics directive, which reduces the impact of certain single-use plastics on the environment, for example by reducing or even banning the use of single-use plastics such as plates, straws and cups for beverages.

There is a wide range of EU legislation in force concerning the environment. The main areas covered are:

Nature and biodiversity

Integrated pollution control

Waste management

Air pollution

Water pollution

Noise pollution

Environmental impact assessment

Genetically modified organisms

Much of EU legislation to protect the environment is quite technical, in that it sets out detailed technical and scientific standards. It is also usual for the legislation to require member states to provide information to the European Commission about how they are implementing the rules and about how effective they have been.

In addition, there are several international conventions on environmental protection. In general, these are ratified by the EU and then implemented through EU legislation.

The European climate law writes into law the goal set out in the European Green Deal for Europe's economy and society to become climate neutral by 2050. The law also sets the intermediate target of reducing net greenhouse gas emissions by at least 55% by 2030, compared to 1990 levels.

Hungarian directive

1.The principle of precaution and prevention states that besides repairing environment damage, one should also try to prevent or minimise it, through prudent decisions and through the use of modern technology.

2.The “polluter pays” principle states that the user of the environment shall be liable for all environmental impacts of its activity;

3.The principle of co-operation states that the users of the environment and the various authorities shall co-operate with each other in the protection of the environment;

4.The principle of public participation states that the general public shall be involved in the environmental-decision making procedure and shall have access to all relevant information regarding the environment;

5.The principle of long-range planning states that the government and the municipalities shall have an overriding plan about the future state of their environment and this should influence all their decisions and actions;

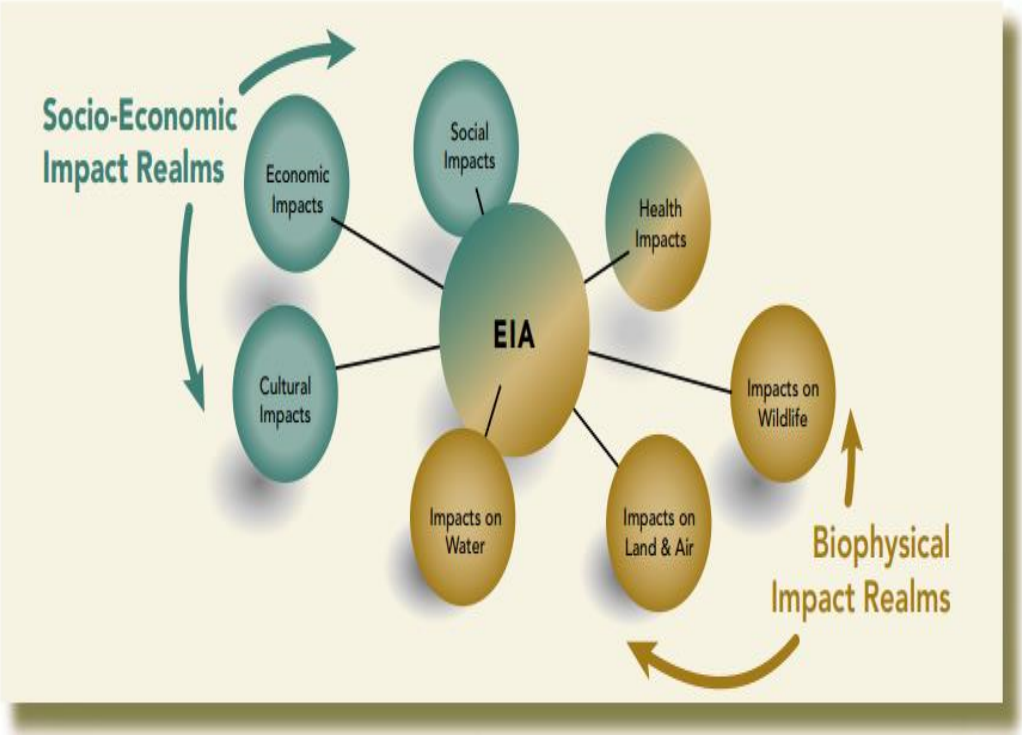
6The principle of integrated pollution abatement states that all environmental media shall be regulated and defended against pollution together as one system.

7. The transport of pollutant waste into the territory of Hungary for the purpose of disposal shall be prohibited.

UNIT II

Socio-Economic Impact Assessment

FIGURE 1 Realms of Environmental Impact



The SEIA Guidelines address impacts on traditional economic activities such as hunting, fishing and trapping. These economic activities are inherently social, cultural and interrelated with the biophysical environment.

There is a great deal of overlap between different “types” of impacts; many additional subcategories could be included in each type. For example, impacts on cultural maintenance may include:

loss of language

loss of time on the land

loss of practicing of traditional laws

an altered relationship with the land and animals and

altered relationships between youth and elders.

The following Table provides examples of valued socio-economic components and associated issues.

Valued Socio-Economic Component	Issues
Health and well-being	Individual and population health Cultural maintenance
Sustainable wildlife harvesting, land access and use	Hunting, trapping and gathering – traditional economy Tourism
Adequate sustainable income and lifestyle	Adverse lifestyle changes – increased gambling, crime, substance abuse Local and regional cost of living
Adequate services and infrastructure	Housing pressures – affordability, availability,
Population sustainability	Change in social and cultural makeup of affected communities
Equitable business and employment opportunities	Employment opportunities for local, regional and territorial residents Training and career development for local, regional, territorial residents

Protecting heritage and cultural resources	Maintenance of traditional language, education, laws and traditions

Those impacts may result from, or be accelerated in part, by any of the following:

having large work camps near small communities

additional in-migration by new workers

the presence of more disposable income in the community and

altered cultural norms.

The main goal of SEIA is identifying such impacts and finding ways to mitigate these impacts.

Six Steps of SEIA

1. Scoping

A preliminary analysis that identifies and prioritizes SEIA considerations and required information. Early and effective scoping narrows the focus of SEIA onto issues of potential significance.

2. Profiling Baseline Conditions

Focuses on gathering information about the socio-economic environment and context of the proposed development. This can include defining measurable indicators of valued socio-economic components.

3. Predicting Impacts

Based on the analysis of information gathered from issues scoping, baseline profiling and past experiences to predict possible socio-economic impacts. Identifying tradeoffs between the adverse and beneficial impacts of a proposed development is part of this analysis.

4. Identifying mitigation

Predicted adverse impacts require mitigation. Mitigation includes strategies, plans and programs to reduce, avoid or manage impacts.

5. Evaluating Significance

Involves determining whether a proposed development is likely to cause significant adverse impacts on valued socio-economic components. If appropriate mitigation measures cannot be identified, a proposed development may not be approved.

6. Applying Mitigation & Monitoring

Good mitigation for socio-economic impacts requires good monitoring programs (also known as “follow up”) to ensure the mitigation is working effectively, and, when necessary, the mitigation is adapted as required.

stages of SEA or SA briefly

Stage 1 – Screening (SEA only)

■ To determine if a plan or programme requires an SEA

Stage 2 – Scoping (SA and SEA)

■ To decide on the scope and level of detail and to develop assessment framework

Stage 3 – Developing plan options, refining alternatives and assessing likely effects (SA and SEA)

■ To test plan objectives against SEA framework

■ Develop reasonable alternatives

■ Evaluate likely effects

■ Mitigation and monitoring

Stage 4 – Undertaking the assessment (SA and SEA)

Stage 5 – Publication, consultation and adoption (SA and SEA)

Stage 6 – Monitoring (SA and SEA)

Screening:

Screening is the process of determining whether or not SEA is required for a particular plan – in historic environment terms, this is likely to relate to neighbourhood plans, supplementary planning documents or in certain circumstances world heritage site management plans. The SEA process also covers programmes such as national transport proposals and offshore energy.

Whether a plan requires an SEA will depend on the existing character of the area, including the local historic environment, and the likely environmental effects of the plan or programme.

Scoping

It is necessary to identify the scope and level of detail of information to be included in the final SA or SEA report.

A scoping report usually therefore :

Collects baseline information to establish current situation

Develops the assessment framework

The review of related plans, programmes and policies will vary depending on the specific circumstances and the type of plan being assessed in order to be proportionate.

Developing plan options, refining alternatives and assessing likely effects

Identification and prediction of significant effects (both positive and negative) on the historic environment may involve

Loss of, or damage to, any heritage asset and/or its setting.

Loss, or erosion, of the historic character of the landscape/seascape/townscape;

Conservation and enhancement of any heritage asset.

Mitigation

The avoidance of damage to all heritage assets remains highly desirable owing to the finite nature of the resource.

Stages 4 & 5 – preparing, publishing and consulting on the report

The report will be proportionate to the type of plan under consideration and the environmental sensitivity of the area in question.

However, a comprehensive and robust SEA/SA report may demonstrate the following in respect of the historic environment:

- What steps can be taken to avoid or minimise any adverse impacts on the significance of heritage assets

- What steps can be taken to optimise any benefits to the significance of heritage assets, including their settings.

The importance of monitoring in SEA process

The primary purpose of monitoring is to cross-check significant environmental effects that arise during the implementation stage against those predicted during the plan preparation stage, as well as to identify any unforeseen adverse effects.

Monitoring reports should also be made available online to allow for future analyses for other purposes.

Monitoring is often based on indicators, which measure changes in the environment, especially changes that are critical in terms of environmental quality (such as air or water pollution levels, or impacts on recorded monuments).

Monitoring indicators should be made as specific as possible to ensure that they are well understood and can be easily measured using existing or newly gathered data. The frequency of monitoring and reporting should also be designed carefully (for example, regularity, defined seasons, etc.).

Monitoring normally does not require new research; existing sources of information can be used.

Monitoring results are typically made available in a publicly accessible report including online access.

Mitigation

As there is a direct relation between global average temperatures and the concentration of greenhouse gases in the atmosphere, the key for the solution to the climate change problem rests in decreasing the amount of emissions released into the atmosphere and in

reducing the current concentration of carbon dioxide (CO_2) by enhancing sinks (e.g. increasing the area of forests). Efforts to reduce emissions and enhance sinks are referred to as "mitigation".

The Convention requires all Parties, keeping in mind their responsibilities and capabilities, to formulate and implement programmes containing measures to mitigate climate change. Such programmes target economic activity with an aim to incentivize actions that are cleaner or disincentive those that result in large amounts of GHGs. They include policies, incentives schemes and investment programmes which address all sectors, including energy generation and use, transport, buildings, industry, agriculture, forestry and other land use, and waste management. Mitigation measures are translated in, for example, an increased use of renewable energy, the application of new technologies such as electric cars, or changes in practices or behaviours, such as driving less or changing one's diet. Further, they include expanding forests and other sinks to remove greater amounts of CO2 from the atmosphere, or simply making improvements to a cookstove design.

Developing countries are encouraged to contribute to mitigation actions in the forest sector by undertaking activities to reduce emissions from deforestation and forest degradation, conserve forest carbon stocks, implement sustainable management of forests and enhance forest carbon stocks.

Mitigation can mean using new technologies and renewable energies, making older equipment more energy efficient, or changing consumer behaviour. It can be as complex as a plan for a new city, or as a simple as improving a cook stove design.

Mitigation is an action to reduce the loss of life and property by lessening the impact of disasters. Mitigation can keep natural hazards, like flooding and hurricanes, from having catastrophic impacts.

Options for Homeowners

Flood Mitigation Options

Elevate your home. Raise its lowest floor above the BFE.

Anywhere it rains, it can flood. Protect your investment in your home by getting flood insurance, even if you do not live in a high-risk flood zone.

Wind Mitigation Options

- Add hurricane shutters to protect the windows and glass doors.
- Consider fastening the roof to the walls with hurricane straps.

Unit III

Regional spatial planning and policy

Regional policy means improving the quality of life in all regions. Spatial development policy coordinates the different demands placed in the common living environment by the society.

Spatial planning includes all levels of land use planning including urban planning, regional planning and national spatial plans. There are numerous definitions of spatial planning. Regional/spatial planning gives geographical expression to the economic, social, cultural and ecological policies of society. It is at the same time a scientific discipline, an administrative technique and a policy developed as an interdisciplinary and comprehensive approach directed towards a balanced regional development and the physical organisation of space according to an overall strategy.

Spatial planning is an administrative technique and a broader policy developed at different scales, which goes beyond land use regulation by including economic, social, and environmental development policies. It comprises a complex system of different levels of plans that adhere to the principle of hierarchy of norms. On all spatial levels, different professional orientations, such as urban development, housing, traffic, landscape, infrastructure or the legal framework are considered as both independent and interrelated conditions. It presumes to anticipate and prepare, to make preparations and supplies for the future. This involves preparing for future land uses, addressing city demands and strengthening regulations of land use and buildings.

Spatial planning tries to coordinate and improve the impacts of other sectoral policies on land use, in order to achieve a more even distribution of economic development within a given territory than would otherwise be created by market forces.

Spatial planning could also be defined as regional planning activities, including strategies, policies and sectoral programs and specific integrated documentation for balanced spatial development and sustainable set of methods used by the public sector to ensure a rational organization of planning, environmental protection and economic and social goals.

Spatial planning is rooted over space or territory. It is a kind of regional planning where planning is made on certain physical as well as socio cultural and economic region. It refers to the methods used by the public sector to influence the distribution of people and activities in spaces of various scales. Spatial planning includes land use, urban, regional, transport and environmental planning. Other related areas are also important, including economic and community planning. Spatial planning takes place on local, regional, national and international levels and often result in the creation of a spatial plan. Spatial economic development is a vital part of government's national economic policy focus.

Good policy choices and well executed planning can ensure balanced economic development of a nation and can help to address marginalization and poverty, particularly in rural areas. Regional/spatial planning gives geographical expression to the economic, social, cultural and ecological policies of society. It is at the same time a scientific discipline, an administrative technique and a policy developed as an interdisciplinary and comprehensive approach directed towards a balanced regional development and the physical organization of space according to an overall strategy. The main characteristics include Spatial planning focuses only in the overall development of certain region. It is an approach in regional planning. Spatial planning put emphasis on socio-economic development of the region. It varies from one region to other. It is more holistic in nature. It is more objective Spatial planning is much applicable in developing as well as under developed countries.

Spatial planning at the regional level is of key importance for the country's harmonious regional and balanced spatial development. The instrument of spatial planning at the regional level is the regional spatial strategy. It is a spatial strategic act by which the state and municipalities agree and harmonise on the spatial development of individual development regions on the basis of the Spatial Development.

Content of the regional spatial strategy

The regional spatial strategy sets the goals and priorities of spatial development and contains guidelines for the spatial development of the region, especially guidelines for the development of settlements, the public service infrastructure and landscaping by preserving the landscape's identity. Among other things, it defines towns, other urban settlements and any other settlements that are important for the region's development, defines wider urban areas, sets out the design of social infrastructure networks, the public service infrastructure, residential areas and the green system of the region and identifies

priority areas for the development of individual activities that are important for regions and connections with neighbouring areas. The key role of the regional spatial strategy is to harmonise municipalities on its implementation and to determine spatial arrangement designs of local importance such as public passenger transport, housing development areas, large shopping centres,

Cumulative effects assessment

Cumulative effects assessment (CEA) is the process of systematically analyzing and assessing cumulative environmental change. The practice of CEA is complex because of the need to consider multiple sources of change, alternate pathways of accumulation, and temporally and spatially variable effects.

Cumulative effects assessment (CEA) is a sub-discipline of environmental impact assessment that is concerned with appraising the collective effects of human activities and natural processes on the environment.

Environmental Impact Assessment (EIA) is a process by which the outcomes of a project are identified, predicted, evaluated, and (where necessary) mitigated before major decisions and commitments are made.

four objectives of EIA:

to ensure that the environment is considered in the decision-making process surrounding new developments;

to minimize or offset adverse effects;

to protect ecological processes and functions;

and to promote sustainability and optimal resource use.

The following is intended as a comprehensive description of CEA, and an illustration of logical connections among its components.

P1: Earth's biosphere and ecosystems provide the essentials for life, and enable our survival as a species

P2: Earth's biosphere is finite, as are its ecosystems.

P3: As a foundation for human life and well-being, there is no substitute for Earth's biosphere.

P6: Ecosystems have three domains: physical habitat, biota, and interactions between habitat and biota

P8: Effects can arise because of natural processes or because of "stressors" related to human activities.

P9: Land-uses or environmental issues

P10: CEA is a process by which the potential environmental effects of one or more alternate visions for a particular place, sector, or other entity are systematically assessed.

CEA is a sub-discipline of EIA. It is "the process of predicting the consequences of development, relative to an assessment of existing environmental quality".

CEA's operational practice includes the following seven steps

1. Select VECs.

2. Define the physical and temporal boundaries of the appraisal.

3. Identify activities (past, present, future) that may affect VECs.

4.Characterize baseline (this step includes the selection of indicators, description of environmental condition, and determination of stakeholders that should be involved in the process).

5. Analyze and predict cumulative effects on VECs.

6. Determine significance of effects (given planned mitigation).

7. Monitor outcomes and CEA performance.

The leading role that cumulative effects have in shaping environmental change coupled with the need for sustainable development has led to high expectations of CEA. However, assessing cumulative effects in complex adaptive systems is challenging.

Recognising that change in governance systems takes time but that we need change now.

CC

Climate change is one of the most complex issues facing us today. It involves many dimensions–science, economics, society, politics, and moral and ethical questions–and is a global problem, felt on local scales, that will be around for thousands of years. Carbon dioxide, the heat-trapping greenhouse gas that is the primary driver of recent global warming, lingers in the atmosphere for many thousands of years, and the planet (especially the ocean) takes a while to respond to warming. So even if we stopped emitting all greenhouse gases today, global warming and climate change will continue to affect future generations. In this way, humanity is "committed" to some level of climate change.

How much climate change?

That will be determined by how our emissions continue and exactly how our climate responds to those emissions. Despite increasing awareness of climate change, our emissions of greenhouse gases continue on a relentless rise. In 2013, the daily level of carbon dioxide in the atmosphere surpassed 400 parts per million for the first time in human history. The last time levels were that high was about three to five million years ago, during the Pliocene Epoch.

Because we are already committed to some level of climate change, responding to climate change involves a two-pronged approach:

1 Reducing emissions of and stabilizing the levels of heat-trapping greenhouse gases in the atmosphere ("mitigation");

2 Adapting to the climate change already in the pipeline ("adaptation").

Mitigation and Adaptation

Mitigation –reducing climate change –involves reducing the flow of heat-trapping greenhouse gases into the atmosphere, either by reducing sources of these gases (for example, the burning of fossil fuels for electricity, heat, or transport) or enhancing the "sinks" that accumulate and store these gases (such as the oceans, forests, and soil). The goal of mitigation is to avoid significant human interference with Earth's climate , "stabilize greenhouse gas levels in a timeframe sufficient to allow ecosystems to adapt naturally to climate change, ensure that food production is not threatened, and to enable economic development to proceed in a sustainable manner"

Adaptation

adapting to life in a changing climate –involves adjusting to actual or expected future climate. The goal is to reduce our risks from the harmful effects of climate change (like sea-level rise, more intense extreme weather events, or food insecurity). It also includes making the most of any potential beneficial opportunities associated with climate change (for example, longer growing seasons or increased yields in some regions). Throughout history, people and societies have adjusted to and coped with changes in climate and extremes with varying degrees of success. Climate change (drought in particular) has been at least partly responsible for the rise and fall of civilizations. Earth's climate has been relatively stable for the past 10,000 years, and this stability has allowed for the development of our modern civilization and agriculture. Our modern life is tailored to that stable climate and not the much warmer climate of the next thousand plus years. As our climate changes, we will need to adapt. The faster the climate changes, the more difficult it will be. While climate change is a global issue, it is felt on a local scale. Local governments are therefore at the frontline of adaptation. Cities and local communities around the world have been focusing on solving their own climate problems. They are working to build flood defenses, plan for heat waves and higher temperatures, install better-draining pavements to deal with floods and storm water, and improve water storage and use.

Planning for climate change

The first underlying principle places the greatest responsibility for fighting climate change on the countries that emitted the majority of gases – the developed countries.

In this way it differentiates based on both history (who caused the problem) and capability (who has the resources to fix it).

The second underlying principle means that if an action or policy has a suspected risk of causing substantial harm to the public or to the environment, those who want to take the action must prove that it is not harmful.

There are four main funding sources for developing countries to support adaptation activities, all managed through the Global Environment Facility.

The Special Climate Change Fund (SCCF) was established first, in 2001, and focuses on capacity building in developing countries. Included projects can address: adaptation; technology transfer and capacity building; energy, transport, industry, agriculture, forestry and waste management; and economic diversification.

The newest funding mechanism is the Green Climate Fund. Its purpose is: "to make a significant and ambitious contribution to the global efforts towards attaining the goals set by the international community to combat climate change. The Fund will promote the paradigm shift towards low-emission and climate-resilient development pathways by providing support to developing countries to limit or reduce their greenhouse gas emissions.."

Challenge in relation to climate change

Floods –

Droughts –

Heat –

Dust pollution due to wind of sand

Approaches to CC Planning

There is no single right way approach to planning for climate change mitigation or adaptation. Different situations will be best served by different approaches. The task is to identify what will be right for your situation.

Mainstreaming can also mean assuring that climate is addressed in standard plans and regulatory documents.

These may include: • Medium/long-term urban/municipal development and strategic plans;

• Master plans;

• Strategic land-use plans; •

Development orders; •

Strategies and plans for water, solid and sanitary waste, energy; •

Management plans for coastal zones.

Planning Processes

In this section of the module, we will discuss:

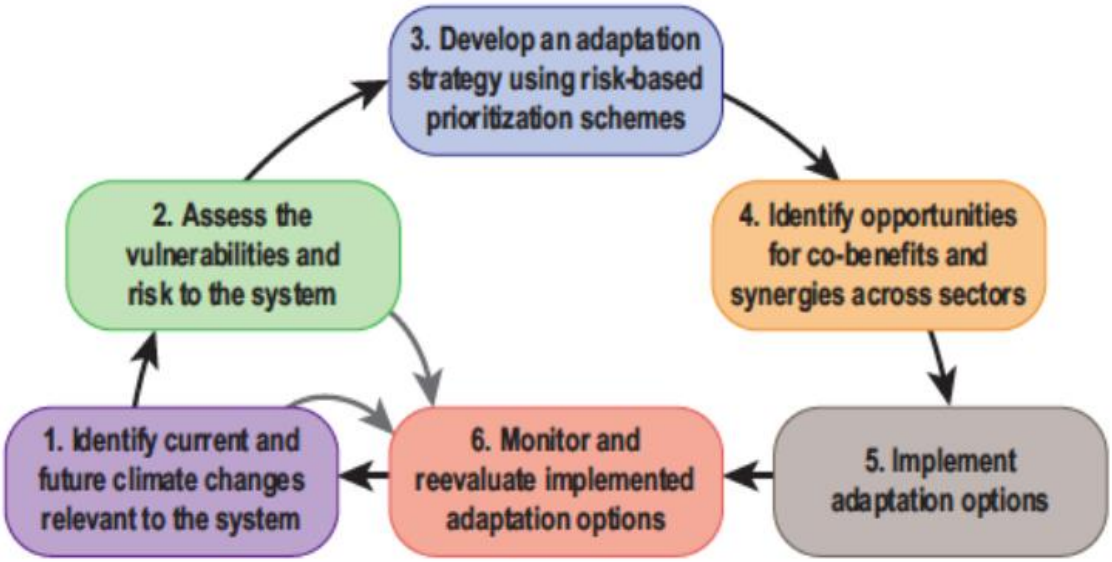
• Planning process to reduce greenhouse gases

• Planning process for adaptation

• A recommended combined approach

• The roles of participation and traditional knowledge in these processes

• How to reduce uncertainty, which is one of the major barriers to moving toward implementation



1. “Measure their emissions of greenhouse gases, generated through the actions of their local government administration (government emissions) and through the actions of the community they serve (community emissions),” ICLEI has produced an International Protocol that describes how emissions at the local government as well as the community can be measured with some specificity. This Protocol has the advantage of having been widely reviewed and providing comparability across governments.

2. “Commit for an emissions (government or community) reduction target with respect to a base year and a target year.” For LDCs, this may mean commit to minimizing increased emissions as part of sustainable development, rather than commit to reductions.

3. “Plan their actions (e.g. energy efficiency in buildings and transport, introduction of renewable energy, sustainable waste management) at the government and community

level to reach this committed reduction target." There is increasing information available about specific actions that can be taken – see reading list for some ideas.

4. "Implement their Local Climate Action Plan" Implementation will be more likely if the initial plan identifies which agencies have to do what, includes those agencies in the determination, and looks for ways to avoid mal adaptation – policies which achieve one goal while getting in the way of others .

5. Monitor emissions reductions achieved by their mitigation actions.

strategic climate plan should involve seven main tasks, as follows:

1. "Engaging stakeholders: ensuring that all relevant parties are aware of the challenge of climate change and committed to addressing it;

2. Understanding the local climate change impacts: identifying climate threats to the town or city;

3. Identifying local contributions to climate change: a first step towards reducing greenhouse gas emissions;

4. Assessing vulnerable areas, people and sectors: analyse patterns of vulnerability to identify the critical locations and groups in need of enhanced resilience;

5. Participatory strategic planning for climate change: mobilising stakeholders to create an overall vision;

6. Putting plans into practice: implementing the plans;

7. Monitoring and evaluation: ensuring that the desired outcomes are achieved."

"Integration of local knowledge with additional scientific and technical knowledge can improve disaster risk reduction and climate change adaptation.

Managing Uncertainty

From a policy perspective, climate uncertainty can be characterized as a function of magnitude, direction, and timing of change. Magnitude is a function of total emissions and the interactions of those emissions with the complex climate system. Generally this is discussed as a 2 degree global change, or 4 degree global change, etc. Recent estimates suggest that a 4 degree global change is likely. What is more important locally is how that global change will be experienced regionally, and this varies enormously based on geography. The direction of impacts is fairly well known for temperature and sea level rise, but in many locations precipitation patterns and totals are harder to predict, as the systems they are based on are very complex. Perhaps the most difficult issue is timing. Over the next 10-15 years there is a high degree of consensus about what the likely levels of impacts are, but beyond that, different assumptions and different models show quite different timing patterns.

It is important, therefore, to have strategies in place to address the uncertainty. Two general types are those that seek to improve the information through using climate scenarios, and those that seek to manage the policy process to build in resilience to uncertainty.

The way to reduce uncertainty is through improving information about expected climate.

While this provides very useful information, it requires extensive resources and expertise and can be difficult to communicate effectively to decision-makers once complete.

A simpler approach to forecasts involves a search through existing studies that may have been made for your region, and then mapping out the different scenarios reported in these.

A second major way to reduce uncertainty is through matching the timing of policy to the timing of the intervention.

The third approach is the safety margin approach, and is particularly relevant for large infrastructure.

An example in urban planning is preventing development in an area that projections suggest will be underwater in the future.

UNIT IV

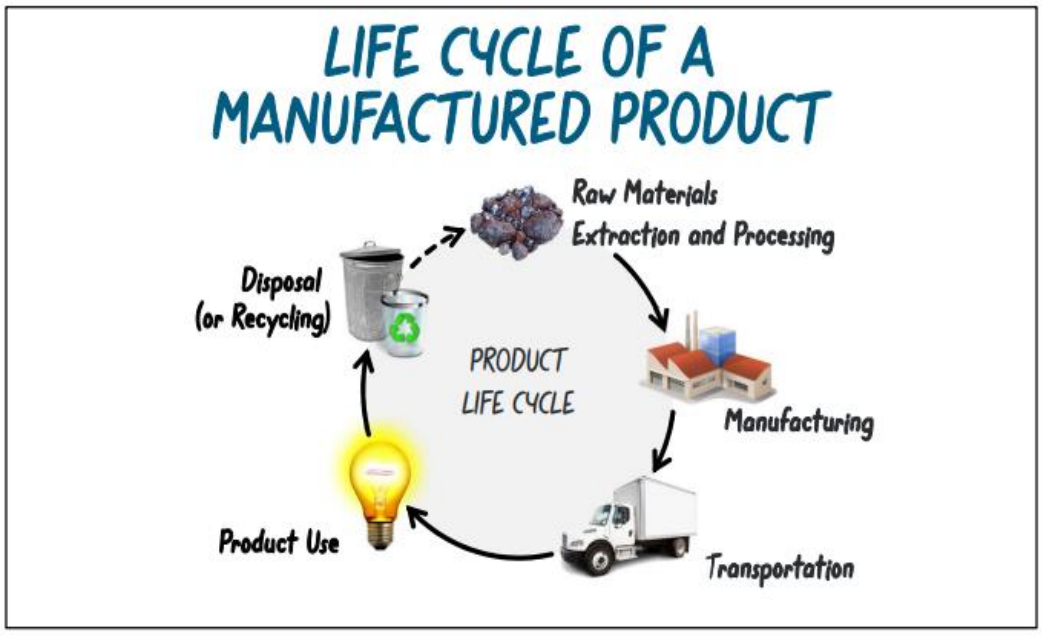
Life cycle assessment

Life cycle assessment, or LCA, is a methodology for assessing the environmental impacts associated with the entire life cycle of a particular product or process.

Life cycle assessment

LCA techniques are often referred to as “cradle to grave” techniques, emphasizing the holistic focus on the overall life cycle rather than impacts on any one facility, user, or stakeholder. If recycling and reuse of materials is included in an LCA analysis, the techniques may also be termed “cradle to cradle,” implying a continuous production loop or circular economy.

5 stages of LCA



For example, the life cycle stages of a manufactured product include: Raw materials extraction and processing• Product manufacturing• Transportation of the product to its point-of-use• Product use; and• Final disposal (or end-of-life recycling•

Material Usage

The first stage of a life cycle assessment is to quantify emissions from raw material usage. This stage involves evaluating the environmental impact of different materials and will form the basis for choosing the most sustainable option. Factors such as resource depletion, energy consumption, and emissions are considered during this stage. Opting for renewable or recycled materials can significantly reduce the environmental footprint of a product.

Implementing cleaner production methods, such as using renewable energy sources and reducing waste through recycling and reuse, can significantly enhance the sustainability of the manufacturing process. Through the incorporation of eco-friendly practices, businesses can reduce their environmental impact and contribute to a more sustainable future.

Assessing carbon emissions in the first three stages can be collectively referred to as cradle-to-gate assessment.

Manufacturing

The manufacturing stage of a life cycle assessment focuses on the environmental impact of the actual production process. This includes energy consumption, water usage, emissions, and waste generation. Identifying energy-efficient manufacturing techniques and implementing sustainable practices can reduce the environmental footprint of the manufacturing stage.

Upstream Transportation

The transportation stage of a life cycle assessment examines the environmental impact of moving raw materials, components, and finished products between various locations.

This stage considers fuel consumption, emissions, and the distance travelled. Optimal transportation routes and methods can be identified to minimise the carbon footprint associated with transportation.

Downstream Distribution

Transportation appears twice within the life cycle assessment stages. The first takes place within the manufacturing stage (i.e., upstream). The second, downstream transportation takes place within the delivery stage, when the product is transported to the desired location for the implementation stage or the first client if the product is a final product and does not require further implementations.

Implementation & Use

The implementation stage of a life cycle assessment involves the installation/implementation and use of the product. This stage evaluates the energy consumption, emissions, and overall environmental impact of the product during its operational lifespan. Assessing the efficiency and durability of the product can help identify opportunities for improvement.

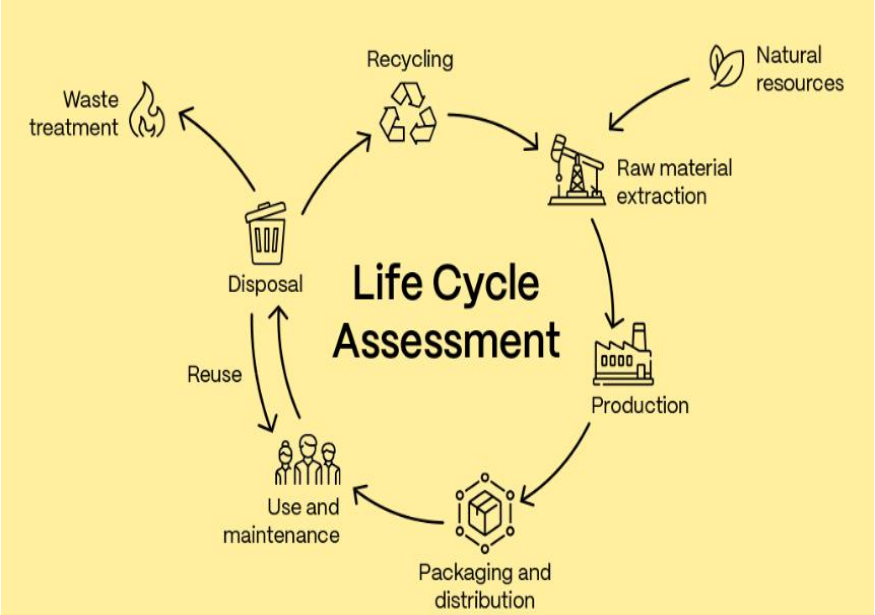
Promoting energy-efficient use and providing clear instructions for proper product usage can contribute to reducing the environmental impact during the implementation stage. Additionally, encouraging responsible consumption habits among consumers can further enhance the sustainability of the product's use phase.

An important factor to consider throughout a life cycle assessment is the emissions from the use of the product. For example, take a paper shopping bag vs a reusable bag for life; the bag for life will more than likely have a lower impact on the environment because they are stronger so they can be reused many times. Whereas a paper bag is more likely to break after limited use.

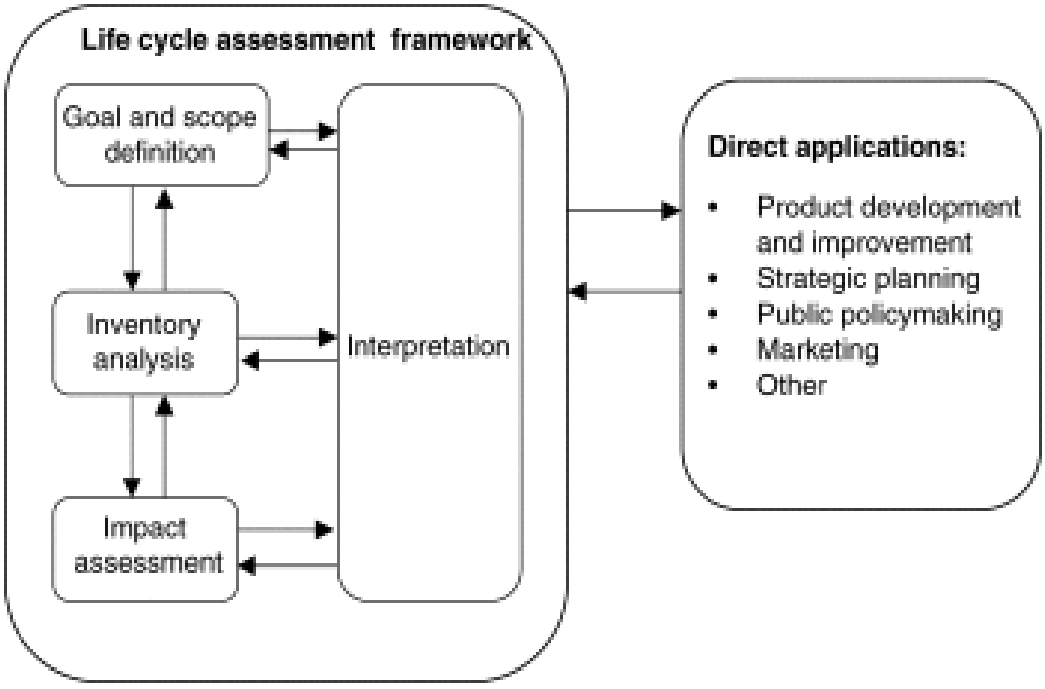
End of Life

The final stage of a life cycle assessment is the end of life, which encompasses the disposal or recycling of the product. This stage evaluates the environmental impact of different disposal methods, such as landfilling, incineration, or recycling. Opting for recycling or proper disposal methods can significantly reduce the environmental burden associated with the end of life stage.

Implementing comprehensive recycling programs and promoting responsible disposal practices can divert waste from landfills and encourage the circular economy. By embracing recycling and sustainable waste management, businesses and consumers can contribute to a more sustainable future.



The Main Phases of Life Cycle Assessment



1. Goal definition and scoping. The application and type of LCA are described, the product systems to be evaluated are defined, and the geographical and temporal scope are defined as well. This step also includes the definition of the functional unit, which will act as the reference for the subsequent steps.

2. Inventory analysis. The environmental releases (e.g., emissions, resource extractions) for the product systems and the functional unit are determined.

3. Impact assessment. The (potential) environmental impacts caused by the environmental releases analyzed in the previous step are determined.

4. Interpretation. The results of the inventory analysis and impact assessment are discussed, conclusions are drawn, and recommendations are made.

These four steps in an LCA are further discussed in subsequent sections of this article.

6 benefits of conducting a Life Cycle Assessment.

Environmental Impact Assessment

One of the primary benefits of a Life Cycle Assessment is its ability to provide a comprehensive understanding of a product's environmental impact. By examining every stage of a product's life cycle, from raw material extraction to disposal, an LCA helps identify the hotspots and allows for targeted improvements. This assessment can lead to a reduction in energy consumption, greenhouse gas emissions, water usage, and waste generation, ultimately contributing to a more sustainable and eco-friendly approach.

Resource Efficiency and Waste Reduction:

A Life Cycle Assessment helps organisations identify opportunities for resource optimisation and waste reduction. By analysing the entire life cycle of a product, businesses can identify areas where materials or energy can be conserved, leading to cost savings and improved efficiency. Additionally, an LCA can identify waste management strategies, such as recycling or reuse, which can minimise the environmental impact of waste disposal.

Sustainable Product Design

A Life Cycle Assessment plays a crucial role in guiding sustainable product design. By evaluating different alternatives and scenarios during the early stages of product development, organisations can make informed decisions that prioritise environmental performance. An LCA helps identify opportunities to use renewable materials, reduce energy consumption, and design products that are durable and easy to repair or recycle, promoting a circular economy.

Supply Chain Optimisation

Another benefit of a Life Cycle Assessment is that it extends beyond an individual product or process and encompasses the entire supply chain. It allows organisations to evaluate the environmental impact of their suppliers and make informed decisions when selecting partners. By considering the life cycle of inputs and outputs, an LCA helps

identify opportunities for collaboration, innovation, and improvement throughout the supply chain, ultimately leading to increased sustainability.

Corporate Social Responsibility
Conducting a Life Cycle Assessment demonstrates a commitment to corporate social responsibility. It showcases that an organisation is willing to evaluate and mitigate the environmental impact of its products or services, contributing to a sustainable future. Results of an LCA can be used to communicate with stakeholders, customers, and investors, highlighting a company's dedication to transparency and sustainability.

Regulatory Compliance and Risk Management
In many industries, regulatory bodies require companies to assess and report the environmental impact of their products or processes. By conducting a Life Cycle Assessment, organisations can ensure compliance with relevant regulations and avoid potential legal issues. Furthermore, a LCA helps identify potential risks associated with a product or process, enabling businesses to proactively address them and improve their reputation.

LCA techniques can be used to evaluate impacts in a wide range of categories.

Cumulative energy demand

Emissions

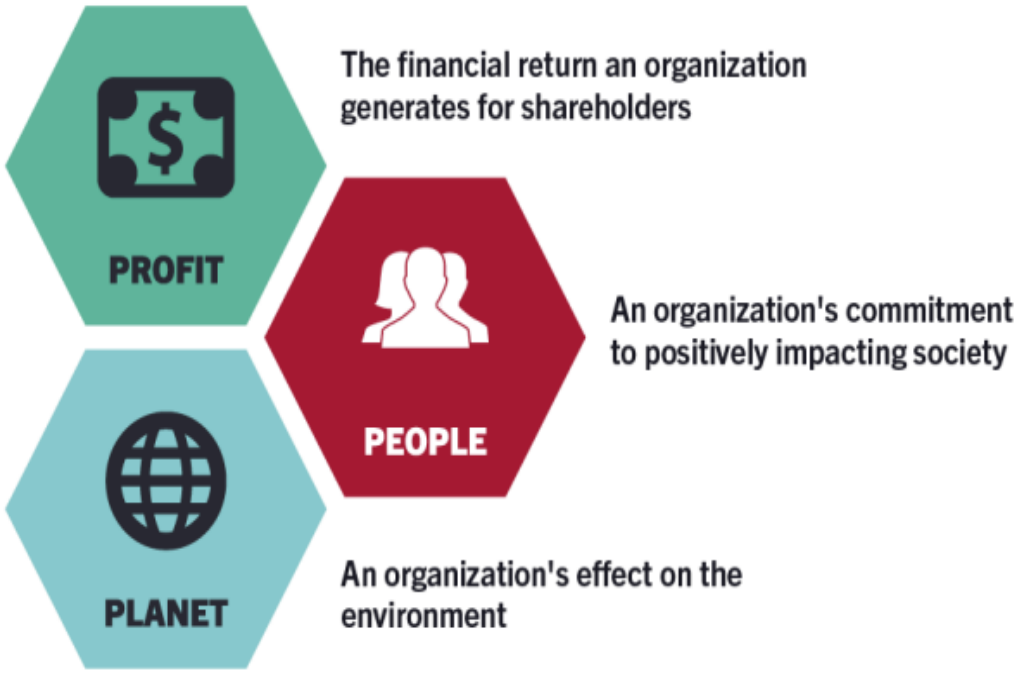
Ozone layer depletion

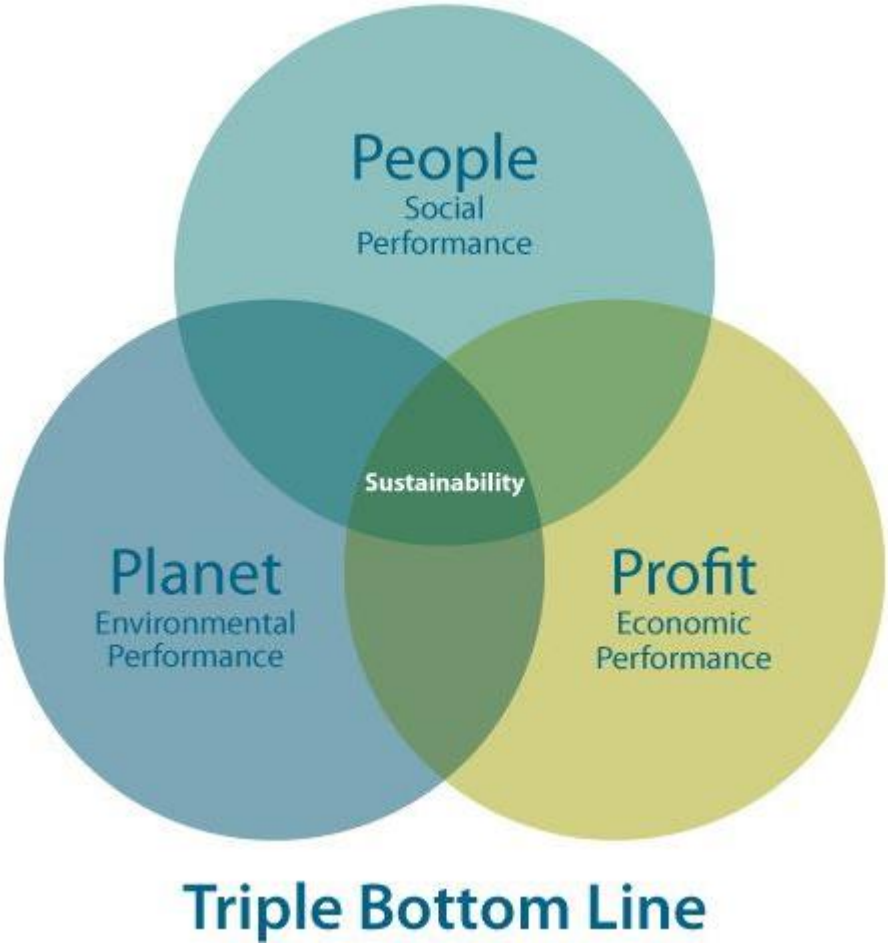
Resource depletion.

the depletion of important resources, such as fossil fuels, water, and critical elements.

Triple bottom line approach (TBL)

The triple bottom line can be broken down into “three P's”: profit, people, and the planet.


PROFIT
The financial return an organization generates for shareholders
PEOPLE
An organization's commitment to positively impacting society
PLANET
An organization's effect on the environment



Profit

Profit In a capitalist economy, a firm’s success most heavily depends on its financial performance, or the profit it generates for shareholders. Strategic planning initiatives and key business decisions are generally carefully designed to maximize profits while reducing costs and mitigating risk.

People

This measures an organization's social impact, including its commitment to not just shareholders but all stakeholders: employees, suppliers, customers, the residents of local

communities and more. The impact on future generations of people can also be considered.

The second component of the triple bottom line highlights a business's societal impact, or its commitment to people. It's important to make the distinction between a firm's shareholders and stakeholders. Traditionally, businesses have favored shareholder value as an indicator of success, meaning they strive to generate value for those who own shares of the company. As firms have increasingly embraced sustainability, they've shifted their focus toward creating value for all stakeholders impacted by business decisions, including customers, employees, and community members. Some simple ways companies can make an impact on people—and serve future generations—include ensuring fair hiring practices and encouraging volunteerism in the workplace. They can also look externally to effect change on a larger scale. For instance, many organizations have formed successful strategic partnerships with nonprofit organizations that share a common purpose-driven goal.

The Planet

The final component of the triple bottom line is concerned with making a positive impact on the planet. Since the birth of the Industrial Revolution, large corporations have contributed a staggering amount of pollution to the environment, which has been a key driver of climate change and environmental concerns. A report by the International Energy Agency found that the global energy industry released 135 million tonnes of methane into the atmosphere in 2022. While businesses have historically been the greatest contributors to climate change, they also hold the keys to driving positive change. Many business leaders are now recognizing their social responsibility to do so. This effort isn't solely on the shoulders of the world's largest corporations—virtually all businesses have opportunities to make changes that reduce their carbon footprint. Adjustments like using ethically sourced materials, cutting down on energy consumption, and streamlining shipping practices are steps in the right direction toward long-term sustainability.

Why is the triple bottom line important?

the TBL framework provides the following opportunities for organizations:

- New ways to generate revenue and profits, such as attracting new customers who want to lessen their own impact on the environment.
- A healthier work environment for employees.
- An improved standing in surrounding communities.

Business benefits of the triple bottom line

Organizations that use the triple bottom line can also gain tangible business benefits, such as the following:

- Lower energy consumption and costs, plus reduced CO2 emissions and carbon footprints that can be highlighted in corporate marketing efforts.
- Higher employee retention rates and an increased ability to attract new hires.
- Enhanced brand perception and reputation that can lead to higher sales.
- Improved productivity and reduced operating costs through operational efficiencies.
- Increased transparency and accountability in business operations, potentially attracting new investors.

Industrial Ecology

Industrial ecology (IE) is the study of industrial systems that operate more like natural ecosystems.

Industrial ecology is the study of systemic relationships between society, the economy, and the natural environment. It focuses on the use of technology to reduce environmental impacts and reconcile human development with environmental stewardship while recognising the importance of socioeconomic factors in achieving these goals.

Industrial ecology studies often quantify the use and cycling of materials and energy in society and their exchanges (extraction and emissions) with nature.

Methods and approaches used in industrial ecology include:

- Material flow analysis - the quantification of mass and energy flows in systems ranging from industrial plants to the global economy, including in temporally dynamic states
- Life cycle assessment - the systemic analysis of environmental flows and related impacts that arise throughout the life cycles of products and services, from raw material extraction to end-of-life disposal
- Environmentally extended input-output analysis - a method to quantify environmental footprints based on the exchanges between economic sectors, and with the environment
- Industrial symbiosis - the study of the exchange of waste as a resource among nearby industrial facilities, akin to synergistic physical relationships among biological species
- Other approaches, such as socioeconomic metabolism for national economies, urban metabolism for cities, and the analysis of important socioeconomic factors such as consumer behaviour, business models, and public policy

Ecological foot printing

The ecological footprint is a way of measuring human impact on the environment.

The ecological footprint (also called "environmental footprint", is an indicator developed by the Global Footprint Network. It measures the impact of Man on the environment, by determining the amount of raw materials consumed and the amount of harmful substances (or greenhouse gasses) generated, then released into the atmosphere.

What is an Ecological Footprint?

The ecological footprint is a method that determines how dependent humans are on natural resources.

What are the benefits of ecological footprint?

By measuring the human ecological footprint, we can determine the sustainability of our lifestyle and the Earth's biocapacity. It's a good starting point for assessing the current situation and limiting the impact of people's activities to protect and care for the environment.

An ecological footprint is used to calculate the degree of impact our lifestyle has on the environment. Hence, it's also known as environmental footprint.

What is the ecological footprint used for?

After having defined the ecological footprint, we know that it's an important indicator for measuring sustainability. Therefore, knowing what it is used for helps us understand what happens if we extract more natural resources from the planet than can be regenerated naturally.

The purpose of this indicator is to measure the productive land used and to determine if the planet is capable of taking on the waste that is generated afterwards. Currently, this balance indicates that resource consumption and waste production are higher than the planet's biocapacity, hence the importance of measures aimed at caring for the environment and preserving natural resources.

he simplest formula to understand how to calculate an ecological footprint would look like this:

Ecological footprint = Consumption / Productivity

Now that we know this information, we have to subtract the resources consumed by each individual from the resources generated by the planet in a single year. The result will be the global hectares (hag) required by each person to satisfy their lifestyle and assimilate the waste it generates.

It calculates the biologically productive land and sea area required to support (provide resources and absorb waste) a given population. The ecological footprint is expressed in “global hectares” (GHA) and can be measured at individual, national, or global levels.

They help us compare how much natural capital we are using and how much is being regenerated. So, they are important tools for measuring the sustainability of human activities.

the ecological footprint is the amount of resources needed to produce goods and services that support an individual/group’s lifestyle.

William Rees introduced the concept of ecological footprints in 1992.

It takes into account various factors such as food consumption, energy use, transportation, etc., and then calculates the area of land and water required to support these activities.

Examples Of Ecological Footprint

1. Transportation

Description: Transportation requires energy in the form of fossil fuels (which produce emissions) and large areas of land for roads. It also produces noise pollution that can harm humans and wildlife.

Examples of Activities: Driving to and from work, taking public transit, transport of food to your local supermarket, flying and catching trains.

How to Reduce this Footprint: On a personal level, we can reduce the ecological footprint of transportation by using public transport, sharing vehicles, and adopting active transportation (walking, cycling, etc.). On a larger scale, we can move towards alternative fuels, and governments can develop sustainable transportation.

2. Energy Consumption

Description: Energy consumption contributes to the ecological footprint in various ways. This includes the direct consumption of non-renewable resources like fossils and the indirect consumption associated with the production, transportation, and distribution of energy. The ecological footprint can be found by calculating the area of land & water required to produce the given energy; it also takes into account the emissions. We can lower our EF by reducing energy consumption and switching to renewable sources of energy.

Examples of Activities: Using your air conditioner, using computers, lighting, internet usage, kitchen appliances.

How to Reduce this Footprint: Use renewable energy sources such as solar panels, wind, and hydroelectric energy. Unplug unused devices around the house. Moderate your air conditioning usage.

3. Food Production

Description: Food production has a significant ecological footprint. Agriculture requires a large amount of land, which can lead to deforestation and habitat destruction. Moreover, about 70% of global freshwater goes into agriculture. Food production creates a significant amount of waste, such as carbon dioxide from the use of fertilizers, methane from livestock digestion, etc.

Examples of Activities: The use of natural resources (land, water, and energy) for farming purposes, the production of wastes & emissions during farming, transportation of food to supermarkets and houses.
How to Reduce this Footprint: Eat local to reduce your food transport footprint, purchase waste-free foods, and grow your own food. Some people also eat vegetarian to reduce their ecological footprint from meat production.

4. Carbon Emissions
Description: Carbon footprint is the fastest growing part of the ecological footprint, and it accounts for 60% of humanity's total ecological footprint (Lin et al., 2018).
Examples of Activities: Carbon emissions are produced when fossil fuels (coal, oil, etc.) are burned for energy. Other activities like transportation and agriculture also add to carbon emissions. This causes air pollution, ocean acidification, and global warming.
How to Reduce this Footprint: There is an urgent need to transition to renewable sources of energy and reduce carbon footprint.

5. Waste Generation
Description: Waste generation can occur at various stages (manufacturing, transportation, etc.), and it harms ecosystems and human health. The disposal of waste requires land, which can deplete resources and damage ecosystems; improper disposal can also lead to pollution. Waste disposal also contributes to greenhouse gas emissions.
Examples of Activities: Every time you use the bin, you're contributing to waste generation.
Waste reduction strategies, composting, and individual actions can reduce the ecological footprint of waste generation.

How to Reduce this Footprint: Purchase zero waste products, use reusable shopping bags, go digital.

6. Development And Construction
Description: Construction contributes to the ecological footprint by using natural resources and producing waste. The vast areas of land needed for destruction can destroy natural habitats. The production of building materials (cement, glass, etc.), the use of equipment, and transportation require a significant amount of energy. Finally, construction debris and air pollution from equipment add to pollution.
Examples of Activities: Growing suburban sprawl, deforestation for new agricultural, commercial and residential land.
How to Reduce this Footprint: The use of environment-friendly and recycled materials, incorporation of renewable energy sources, and demand reduction can help lower construction's ecological footprint.

7. Tourism

Description: The ecological footprint of visitors to a popular location is known as the tourist ecological footprint (Anderson, 2019). It depends on the behavior of the tourists and can be quite damaging in fragile ecosystems.

Examples of Activities: Tourist accommodation, transportation, and recreational activities require energy, water, and land while also producing waste.

How to Reduce this Footprint: Travel locally to reduce your transport footprint, use sustainable tourist services, embrace zero waste camping. By comparing tourism ecological footprints, we can find out about alternative tourist destinations to reduce the pressure from crowded ones.

8. Water Usage

Description: Excessive water use can deplete natural water resources and harm the environment. It can dry up rivers and lakes, lower groundwater levels, and destroy ecosystems relying on water. Industrial and agricultural activities also pollute water.

Examples of Activities: Damming of water for farming, farming of water intensive crops such as cotton.

How to Reduce this Footprint: To reduce the ecological footprint of water use, we can practice water conservation, adopt sustainable agricultural practices, and treat water before disposal.

9. Product Manufacturing

Description: The manufacturing of products depletes resources (minerals, woods, fossil fuels, etc.), consumes energy, and produces waste. The use of sustainable materials, such as recycled goods or sustainably harvested goods, can reduce the environmental impact. Incorporating sustainability in waste management, product design, and supply chain management can also lower the ecological footprint.

Examples of Activities: Planned obsolescence and fast fashion lead to shorter lifespans of consumer goods, causing increased landfill.

How to Reduce this Footprint: Reduce, reuse, and recycle your products.

10. Plastic Use

Description: Plastic use has become a major environmental issue due to the large amount of waste it generates and its persistence in the environment. Plastic pollution harms

wildlife and ecosystems and can even enter the food chain, posing a threat to human health.
Examples of Activities: Single-use plastic items like straws, plastic bags, and packaging materials.

How to Reduce this Footprint: Reducing the use of single-use plastics, using reusable alternatives, and properly disposing of plastic waste through recycling or composting can help reduce the ecological footprint of plastic use. Additionally, supporting policies that reduce plastic production and promote circular economies can also help tackle this issue.

Tips for reducing our ecological footprint

As we have seen, an ecological footprint is directly related to each individual's lifestyle. Therefore, the commitment of all members of society, whether it be as a group or individually, is fundamental.

Sustainable households

- At home, we can sort and recycle the trash properly by using the different types of containers and waste collection facilities available, which extends the life cycle of products and materials
- Opt for high energy efficiency appliances and avoid appliances that use the most electricity
- Fit your home with double-pane windows and insulate the walls and ceilings to keep it warm in the winter and cold in the summer

Sustainable transportation

- Use public transportation to aid in reducing air and noise pollution
- Choose a means of transportation such as a bicycle or scooter to prevent greenhouse emissions

- Another sustainable mobility option is a temporary car rental service known as carsharing, which makes it possible to rent a car by the minute to travel short distances

Save energy

- Use the heating and air conditioning responsibly as it's an excellent way to cut your ecological footprint, while maintaining the recommended temperature in buildings between 19-2ºC in winter and 23-25ºC in summer
- Unplug electronic devices when not in use
- Only run appliances like the washer or dishwasher on a full load

Commit to a sustainable diet

- Choose local foods in season as that avoids medium and long distance transportation, and therefore, reduces CO2 emissions
- Control the consumption of red and processed meats by limiting the intake to 200-300 grams per week as recommended by the World Health Organization (WHO)
- Use bags and containers made with sustainable materials

Recycle your waste

- Optimize recycling, to offer a second life to waste and avoid the extraction of new natural resources ;
- Use recycled materials;
- Buy less or second-hand.

reporting

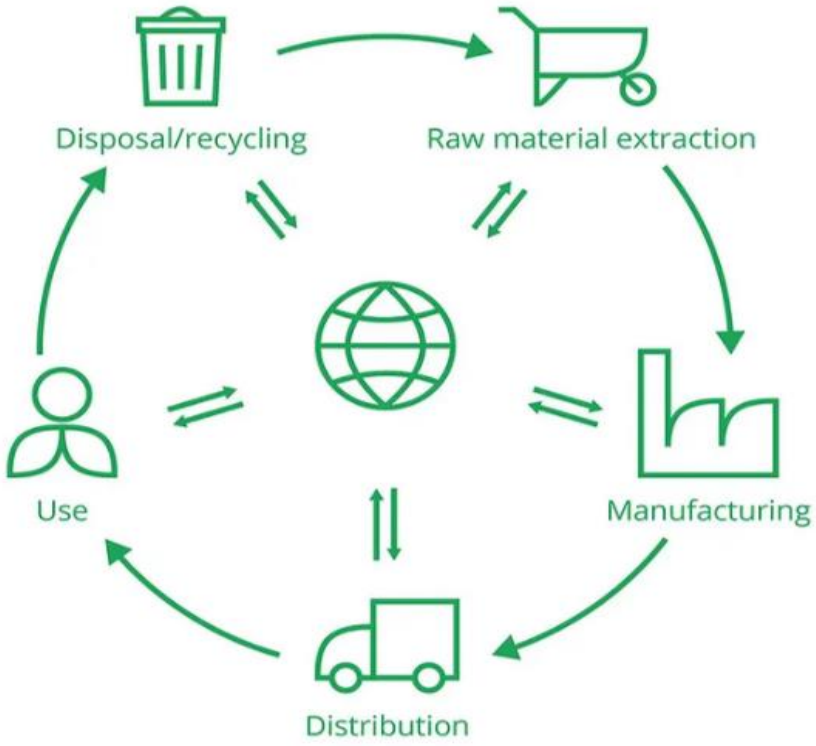
Documenting the LCA study in a comprehensive and transparent manner in accordance with ISO 14044 requirements.

Design for Environment

Design for the Environment refers to a series of techniques, principles, and methodologies used in engineering, economics, technology, business, environment, and policy disciplines to incorporate environmental considerations into the design, process, and manufacturing of products and services.

Design for the Environment (DfE) attempts to reduce the impact of product design on the environment of a product or service. It considers the whole life cycle — beyond using recycled materials or proper packaging or disposal.

Effective DfE practices maintain or improve product quality and cost while reducing environmental impacts.



The DfE approach includes five aspects that follow the life cycle of a product and enable companies to be more environmentally friendly in their work:

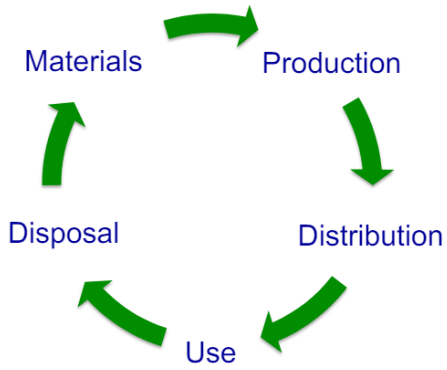
1. Raw Material Extraction

2. Manufacturing

3. Packaging + Distribution

4. Use

5. End of life, Design For Disassembly, and Design for Recycling



Environmentally responsible material choices

Stage 1: Production

In the production stage, a more efficient manufacturing process may translate into a more sustainable product. By choosing the correct materials, parts may be formed more efficiently, using less material.

a reduction in the variety of materials used to construct the product will make its recycling easier. A product that is easier to disassemble is also easier to recycle.

Stage 2: Consumption

During the main stage, the consumption of the product, the product design has the possibility of saving the most energy or releasing the fewest toxic or harmful materials. The product may be designed to only use as much energy as is necessary in its current state, effectively creating sleep and on modes, or any other variation necessary to be in the most efficient state at that moment. More specifically, use batteries that lose

energy less quickly, reduce current and/or voltage demands in the circuitry, active power management to turn off segments of the electronics not in use, and combine functions in the ICs, so that less circuitry is required overall (Farnell, 2009).

Stage 3: Destruction

For the final stage, destruction, the components of the product must be thrown away, reused, or recycled. For most electronics, it is often not possible to reuse them, as they are not repairable.

The driving force behind DfE includes customers, international agencies, governmental agencies, and all stakeholders in environmental well-being.

There are many ways to minimize a product's environmental impacts. However, the most incredible opportunity occurs during the product design phases.

Therefore, organizations that develop new products need to consider many factors related to the environmental impact of their products, including government regulations, consumer preferences, and corporate environmental objectives.

Although this requires more effort than treating emissions and hazardous waste, it protects the environment. It reduces life-cycle costs by decreasing energy use, reducing raw material requirements, and avoiding pollution control.

Design for Environment (DfE) tools, methods, and strategies have become an important set of activities for product development organizations.

Environmentally friendly materials:

Recycled content:

Recyclability:

Clean energy:

Emissions

Returnable and recyclable packaging:

Product Stewardship means whoever designs, produces, sells, or uses a product takes responsibility for minimizing the product's environmental impact throughout all stages of the products' life cycle, including end of life management.

Principles for Product Stewardship Policy

1. Producer Responsibility

1.1 All producers selling a covered product into the State are responsible for designing, managing, and financing a stewardship program that addresses the lifecycle impacts of their products including end-of-life management.

1.2 Producers have flexibility to meet these responsibilities by offering their own plan or participating in a plan with others.

1.3 In addressing end-of-life management, all stewardship programs must finance the collection, transportation, and responsible reuse, recycling or disposition of covered products. Stewardship programs must:

Cover the costs of new, historic and orphan covered products.

Provide convenient collection for consumers throughout the State.

1.4 Costs for product waste management are shifted from taxpayers and ratepayers to producers and users.

1.5 Programs are operated by producers with minimum government involvement.

2. Shared Responsibilities

2.1 Retailers only sell covered products from producers who are in compliance with stewardship requirements.

2.2 State and local governments work with producers and retailers on educating the public about the stewardship programs.

2.3 Consumers are responsible for using return systems set up by producers or their agents.

3. Governance

3.1 Government sets goals and performance standards following consultation with stakeholders. All programs within a product category are accountable to the same goals and performance standards.

3.2 Government allows producers the flexibility to determine the most cost-effective means of achieving the goals and performance standards.

3.3 Government is responsible for ensuring a level playing field by enforcing requirements that all producers in a product category participate in a stewardship program as a condition for selling their product in the jurisdiction.

3.4 Product categories required to have stewardship programs are selected using the process and priorities set out in framework legislation.

3.5 Government is responsible for ensuring transparency and accountability of stewardship programs. Producers are accountable to both government and consumers for disclosing environmental outcomes.

4. Financing

4.1 Producers finance their stewardship programs as a general cost of doing business, through cost internalization or by recovering costs through arrangements with their distributors and retailers. End of life fees are not allowed.

5. Environmental Protection

5.1 Framework legislation should address environmental product design, including source reduction, recyclability and reducing toxicity of covered products.

5.2 Framework legislation requires that stewardship programs ensure that all products covered by the stewardship program are managed in an environmentally sound manner.

5.3 Stewardship programs must be consistent with other State sustainability legislation, including those that address greenhouse gas reduction and the waste management hierarchy.

5.4 Stewardship programs include reporting on the final disposition, (i.e., reuse, recycling, disposal) of products handled by the stewardship program, including any products or materials exported for processing.


01
RAW MATERIALS
02
PRODUCT DEVELOPMENT
03
PRODUCTION & OPERATION
04
LOGISTICS & DISTRIBUTION
05
PRODUCT USE & END OF PRODUCT LIFE
PRODUCT STEWARDSHIP


Product Stewardship
Materials & Energy Use
Manufacture
Emissions, Discharges & Exposures
Risk?
Opportunity!
Supply
Use
Yield & Transfer Efficiency
Recover
Toxicity & Safety Hazards

Future roles of LCA

It is anticipated that LCA or the life cycle approach can and will be integrated with other decision support tools in almost all areas where environmental issues are important. The amount of LCA-relevant information is increasing, giving the possibility of extending LCA into new production areas as well as all the application areas mentioned in this chapter. With the increasing amount of information, the applications of LCA will become more varied and the results will be more precise. But it is worth remembering that there are only few situations where LCA can be used as the only decision support tool.

LCA should also be an integral part in the development of extended producer responsi bility (EPR) as suggested by OECD. EPR can for instance be employed by governments as a strategy to transfer the costs of municipal waste management from local authorities to those actors most able to influence the characteristics of products which can be come problematic at the post-consumer stage. Design for Environment, Risk Assess ment and LCA can give input from different angles to the decision makers, ensuring that sub-optimal solutions are not implemented.

Unit V

Spatial economics

Producers and buyers are dispersed in space, and overcoming the distances between them can be costly. Much commercial activity is concerned with “space bridging,” and much entrepreneurship is aimed at making good use of locational opportunities and cutting the costs of transport and communication. Spatial economics is the study of how space (distance) affects economic behavior.Spatial economics deals with bringing location, transport, and land into economics.

Throughout history, transport costs have hampered specialization, and improvements in transport and communications have been among the main driving forces of economic progress.

In Europe and China, most ordinary people never moved farther than twenty miles from their birthplaces, and before the advent of book printing, most people knew very little about what happened beyond those narrow horizons. Firms that depended on heavy inputs, such as steel makers, used to locate near the source of major inputs—coal mines, in particular. By contrast, firms that interacted intensively and frequently with customers tended to locate near the demand. Thus, gasoline stations are still found near busy intersections.

In recent decades, technical and organizational progress has caused the costs of transport to fall steadily. Between 1950 and 2000, the price of bulk sea freight and port handling dropped.

The inflation-adjusted price of a long-distance phone call from New York to London is now less than 1 percent of what it was in 1950. Fax machines, portable video cameras, satellite TV, computers, and cell phones have all cut communication costs greatly. More recently, the Internet has made global communication so cheap and user friendly that words and images can be distributed by almost anyone globally, without delay and at near-zero cost. These technologies have opened new, easily accessible channels of communicating, so that entirely new forms of the division of labor between different locations have become feasible.

This reduction in transport costs has revolutionized decisions about where goods and services are produced. The relative costs of employing immobile production factors, such as land and labor, have become relatively more important in influencing the spatial

arrangement of industries, irrespective of national borders. Yet, most businesses still take account of transport and communication costs (and the risks of disruptions) between the locations from which their inputs are supplied and the locations where they find their market demand.

Spatial economics deals with other important issues. Housing and transport, which are space-related commodities, rank first and second in household expenditure.

Locations are linked through various types of flows: of goods, people (commuters and passengers), factors of production (capital and labor), and information. Therefore, one could expect trade theory to be the economic field that paid the most attention . Moving Goods, People, and Information Remains Costly

A high number of personal services are not tradable, i.e., they must be consumed where they are produced. In addition, what has been built, e.g., roads, subways, and housing, cannot be moved. In those cases, transport costs may be considered as infinite.

Goods.—

The great many estimations of the gravity equation show that distance remains a strong barrier to the spatial exchange of goods. Transportation economics spans both regional and urban economics, but each in a different way. In the regional context, transportation economics studies the interregional and international freight trips of inputs and outputs, as well as passenger trips (whether for business or leisure).

People.—

To the best of our knowledge, there is no integrative work on migration comparable to that in the trade literature on the gravity equation, though several papers suggest that frictions exist that would make migration gravitational in nature. That many people continue living in deprived areas should be evidence that migration costs are of first-order importance. Due to family bonds, social networks, tacit information, and language and cultural differences, people are heterogeneous in their attitudes toward migration.

Information.

It is perhaps more surprising that informational frictions remain substantial in certain activities.

It is, therefore, convenient to organize the various mechanisms associated with population density in the following three categories: sharing, matching, and learning Their common feature is that they all lead to an aggregate production function displaying increasing returns.

(i) Sharing

primarily refers to local public goods that contribute to enhancing firm productivity, such as facilities required by the use of new information and communication technologies and various transportation infrastructures.

ii) Matching

means that the number of opportunities to better match workers and job requirements, or the suppliers and customers of business-to-business services, is greater in a thick market with many different types of workers and jobs than in a thin one.

(iii) Learning in cities

may come as a surprise to those who believe that the new information and communication technologies have eliminated the need to meet in person. When different agents possess different bits of information, gathering them generates knowledge spillovers, which is a shorthand expression for the external benefits that accrue to people from the proximity of research centers, knowledge-based firms, and high-skilled workers.

knowledge economy

The knowledge economy is a system of consumption and production that is based on intellectual capital. In particular, it refers to the ability to capitalize on scientific discoveries and applied research. The knowledge economy represents a large share of the activity in most highly developed economies.

The knowledge economy is a postindustrial era characterized by automation, digitization, knowledge discovery, abundance of information, open innovations, and increased investments in research, science, and education.

The knowledge economy is characterized by the presence of a higher percentage of highly skilled employees whose jobs require special knowledge or skills. Unlike in the past, when the economy depended heavily on unskilled labor jobs and consisted primarily of producing physical goods, the modern economy is comprised more of services industries and jobs that require thinking and analysis of data.

In the new knowledge economy, the most valuable assets that a company owns are often intangible assets – such as patents, copyrights, or proprietary software or processes.

The knowledge economy both supports, and is fueled by, innovation, research, and rapid technological advancement. The overwhelming majority of workers in the knowledge economy are extremely computer literate and skilled at creating business and financial models. The knowledge economy is transforming our cities.

The use of mobile devices, learning technologies, and Internet of Things (IoT) devices has expanded the participation of people from around the world in the new economy.

Online and distant education emerged as one of the biggest beneficiaries of the digital economy. The COVID-19 pandemic would have had a more severe impact in the education sector without the ability by educational institutions to deliver instruction online.

While the pandemic significantly affected certain sectors of the economy, such as travel, hospitality, and tourism, other sectors, such as technology, medicine, and education, were better able to adjust and continue to grow.

The Growth of STEM Jobs

The knowledge economy is considered the primary driver of the massive expansion of as STEM jobs. STEM is short for "science, technology, engineering, and mathematics." Careers within the STEM fields – which include occupational paths such as computer science, engineering, chemistry, and biology – are where many of the greatest opportunities for career advancement, higher compensation, and top-level executive positions can be found.

Occupational paths such as computer science, engineering, chemistry, and biology offer the greatest opportunities for career growth and executive leadership positions. Skills like data analysis, working with financial models, and the ability to innovate are in high demand in this economy. In a knowledge economy, there is also an increased demand for teamwork, problem-solving, communication, and certain computer skills. These skills are seen as complements to education, not substitutes. Knowledge economy workers are typically highly-educated. However, a high level of education is not required.

The bottom line is that knowledge provides the foundation for the necessary technical expertise, data collection and analysis skills, and innovative management practices that enable companies and businesses to compete in the modern, global economy. Specialized knowledge and skills may serve as either productive assets for a business to employ, or as products for a business to market and sell.

Another characteristic of the knowledge economy is the development of "clusters" of industries that are centered in a particular geographic area. Examples include the concentration of automotive engineering businesses in Germany, computer technology in "Silicon Valley" in the United States, and the electronics industry in South Korea.

Problems Created by the New Economy

The transition from an industrial economy to a knowledge economy is not without its challenges. There are currently many workers who lack the requisite skill sets to function and be optimally productive in a knowledge economy.

In order to facilitate the transition, companies need to develop more extensive on-the-job training programs, along with supporting employees in obtaining further education and training outside of the workplace – such as subsidizing employees attending university classes or learning new skills elsewhere.

In addition, universities must be aware of the most valuable skills in the marketplace, so that they can offer the best possible education for students. For example, schools should offer and emphasize expanded programs to prepare students for STEM careers.

10 Characteristics Of The Knowledge Economy

Below are a few characteristics of the knowledge economy:

1. Institutional structures that provide incentives for entrepreneurship and the use of knowledge
2. Availability of skilled labor and a good education system
3. Access to information and communication infrastructures (ICT)
4. A vibrant innovation landscape that includes the academic world, the private sector, and civil society
5. An increased demand for workers in STEM subjects
6. The development of "clusters" of industries in certain geographic regions
7. A steep rise in the number of patents
8. Knowledge exchange between industries
9. Innovation-driven producers and uses (example: open-source software and customer feedback)
10. The global diffusion of knowledge.

Knowledge Economy In Developing Countries

The relative weakness of the knowledge economy in developing countries creates countless opportunities for business through the spread of information and technology from developed countries.

3. Explain about the characteristic of knowledge economy?

Characteristics of the Knowledge Economy

Besides the fact that knowledge is considered a key factor in the production of goods and services, the realization of the knowledge economy was not possible without the

technological advancement and the policies put in place to protect innovations and intellectual capital. The knowledge economy is not a bunch of fragmented ideas, but rather is a system of production and consumption based on intellectual capital. The followings are some of the major characteristics of the knowledge economy as well as the factors that contribute to the realization of the concept:

Knowledge as a factor of production

One of the main characteristics of the knowledge economy is the realization of the importance of knowledge as a factor of production and wealth generation. The transformation from industrial society to information and knowledge society was a natural evolution given the technological advances and the need for organizations to adjust and adapt to survive. For societies that did not go through the industrial revolution, the recognition of knowledge as a factor of production could be more challenging given the need for sizable investments in human capital and infrastructure. Part of the realization is also the need to establish a knowledge-based infrastructure where intellectual capital rights are respected and protected.

Globalization and the borderless

The advent of the knowledge economy removed physical and geographical barriers and allowed people to reach wider audiences using advanced technologies, such as websites, e-mail, and social media. The use of specialized marketing software such as Salesforce allowed for tracking customers and identifying new markets. The globalization of the economy placed increased pressure on countries and companies to adapt and adjust to the economic transformation. At the same time, globalization provided organizations the opportunity to expand their business beyond the traditional geographical boundaries, forge new partnerships, and offer new products and services.

The War of Talent

The knowledge economy opened the door for global competition at all levels including top talent. Knowledge workers and knowledge professionals are now more mobile, resourceful, and, at the same time, like to be challenged. McKinsey in 1997 coined the phrase “war for talent” highlighting the fierce competition for organizations to recruit and

retain knowledge professionals. Organizations small and big are also starting to recognize the importance of a diverse, multicultural workforce. The need to be responsive and flexible has forced many companies to downsize their staff, flatten bureaucratic hierarchies, and organize themselves into smaller units with ad hoc styles of management.

Emergence of new management style

The new management thinking advocates that the best and more successful companies are those whose managers work with people differently, helping them utilize their potential and making them full participants in the business. Therefore, enterprises must increasingly develop knowledge-based strategies that focus on helping their knowledge workers to continuously innovate, learn, and improve the productivity of their work. Interest in knowledge management as a part of management practice has led to the creation of new management positions, such as Chief Knowledge Officer, Chief Learning Officer, and Chief Information Officer.

Increased collaboration and open innovation

Many companies and organizations around the world are recognizing the importance of collaboration to deal with competition from larger organizations and conglomerates operating globally. Open innovation, on the other hand, provides these companies with the ability to work with people outside the organizational silo mentality and avoid the secrecy associated with the corporate research culture. The Gig economy and the preference of researchers and knowledge workers for a more flexible and portable work arrangement aligned with the shift toward more collaboration and open innovation, for example, open innovations and increased collaborations between universities and industry benefit small- and medium-enterprises (SMEs) and entrepreneurship .

The worth of an organization is normally measured by the value of intellectual capital and physical capital. Intellectual capital is the intangible value of an organization and deals with human capital, customer capital, relationship management, and intellectual property. On the other hand, physical capital deals with tangible assets, such as buildings, equipment, and natural resources. In recent years and because of the transition to the knowledge economy, we have seen companies dealing with intangible assets and

intellectual capital exceeding those dealing with physical capital. Apple and Amazon are good examples of companies exceeding a trillion dollars valuation. It is defined that intellectual capital as "packaged useful knowledge." It is further elaborated that intellectual capital consists of knowledge embodied in various organization's processes and practices, intellectual property in the form of patents, trademarks, and trade secrets, and human capital in the form of employee skills and competencies. Employees have long been recognized as an important and valuable resource in the organization that needs to be recognized and nurtured.

Intellectual Capital Components

Intellectual capital is intricately linked to the knowledge activities that take place in the organization. It is the cumulative knowledge derived from skills, competencies, experiences, relationships, research activities, innovations, trade secrets, and any other form of documented data and information. The following is a brief description of intellectual capital components.

- **Human Capital**

The expression "our people are our main asset" is a phrase used to describe and emphasize the importance of human capital to the organization and the economy. Human capital is measured by the collective contribution made to the organization by the employees. In addition to individual skills and experiences, human capital is shaped by the organizational learning dynamics and the ability to nurture creativity and innovations (Popescu et al., 2016).

Human capital is one of the most complex types of intellectual capital. Knowledge embedded in organizational processes and practices is largely human based and it is normally transferred from one person to another in the form of tacit knowledge. Most organizations go the extra mile to recruit top talent but sometimes fail to recognize the value and importance of retaining existing talents that can make or break the organization. Programs, such as mentoring, shadowing, and apprenticeship, are a form of knowledge-management practice designed to help in transferring tacit knowledge from one person to another.

- **Customer and Relationship Capital**:

Customer capital is the investment an organization makes to grow and sustain their business. Partnerships, franchises, licenses, and any other types of arrangements are

based on trust and mutual understanding. Some of the performance indices that can be used to measure customer capital include repeat business transactions, market dominance due to market strategy, customer feedback, and so on. Customer relationship management (CRM) refers to practices, processes, and technologies the organization uses to capture and manage customer information and interaction. CRM is a fast-growing area. CRM is a critical success factor in today's increasingly competitive business environment. It is important for organizations to have a stronger focus on customer relations and the ability to measure and manage their customer capital.

- **Structural Capital**

Structural capital consists of all nonphysical capital owned by organizations. This includes processes, procedures, practices, methods, techniques, and intellectual property. Intellectual property consists of patents, trademarks, copyrights, databases, software, and design work (Sherwood, 2019). Structural capital also includes organizational structure, philosophy, norms, and practices.

The ability of the organization to leverage knowledge and intellectual in its operations has direct impact on the organization performance and market value. Unlike traditional accounting systems, accounting systems for intellectual capital are more complex and they depend on the organization's ability to demonstrate potential and leverage existing knowledge assets. The source of the organization's economic value depends on its ability to manage intellectual capital and intangible knowledge resources.

Intellectual Property rights

Intellectual Property rights mean providing property rights through patents, copyrights and trademarks. Holders of intellectual property rights have a monopoly on the usage of property or items for a specified time period.

The 4 main types of intellectual property are listed below.

1. Patents – It is used for protecting new inventions, ideas, or processes. Patent holders need to pay periodic government renewal fees. An approved patent is for a limited time period..
2. Copyrights – It protects the ideas, examples would be written works, music, art, etc.

3. Trademarks – It is something that protects the symbols, colors, phrases, sounds, design etc.

4. Trade Secrets – It may be strategies, systems, formulas, or other confidential information of an organization that provides them a competitive advantage in the market.