

# Chapter 4

## CSD indicator themes

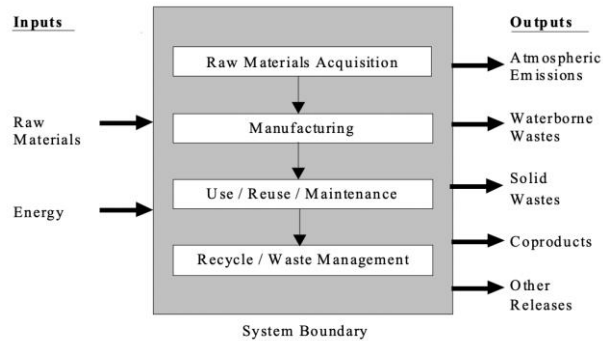
- Poverty
- Governance
- Health
- Education
- Demographics
- Natural hazards
- Atmosphere
- Land
- Oceans, seas and coasts
- Freshwater
- Biodiversity
- Economic development
- Global economic partnership
- Consumption and production patterns

### Getting Started

The following six basic decisions should be made at the beginning of the LCA process: use of time and resources:

1. Define the Goal(s) of the Project
2. Determine What Type of Information Is Needed to Inform the Decision-Making
3. Determine the Required Specificity
4. Determine How the Data Should Be Organized and the Results Displayed
5. Define the Scope of the Study
6. Determine the Ground Rules for Performing the Work

Life cycle assessment is a “cradle-to-grave” approach for assessing industrial systems



The LCA process is a systematic, phased approach and consists of four components: goal definition, scoping, inventory analysis, impact assessment, and interpretation as illustrated in Exhibit 12.1.

1. **Goal Definition and Scoping** - Define and describe the product, process or service. Establish the context in which the assessment is to be made and identify the environmental effects to be reviewed for the assessment.
2. **Inventory Analysis** - Identify and quantify energy, water and materials usage and environmental releases (e.g., air emissions, solid waste disposal, waste water discharges).
3. **Impact Assessment** - Assess the potential human and ecological effects of the environmental releases identified in the inventory.
4. **Interpretation** - Evaluate the results of the inventory analysis and impact assessment. Select the preferred product, process or service with a clear understanding of the uncertainty and the assumptions used to generate the results.

### What is a Life Cycle Inventory (LCI)?

A life cycle inventory is a process of quantifying energy and raw material requirements, atmospheric emissions, waterborne emissions, solid wastes, and other releases for the entire life cycle of a product, process, or activity

### Key steps of life cycle inventory

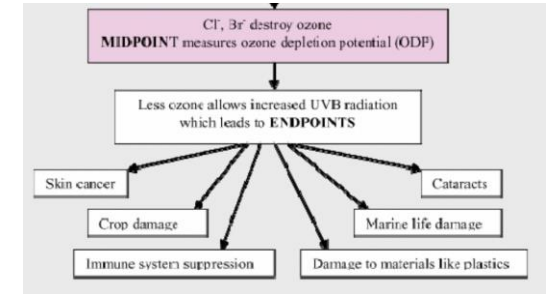
1. Develop a flow diagram of the processes being evaluated.
2. Develop a data collection plan.
3. Collect data.
4. Evaluate and report results.

### What is a Life Cycle Impact Assessment (LCIA)?

The Life Cycle Impact Assessment (LCIA) phase of an LCA is the evaluation of potential human health and environmental impacts of the environmental resources and releases identified during the LCI.

### Key Steps of a Life Cycle Impact Assessment

- 1- Selection and Definition of Impact Categories
- 2- Classification - assigning LCI results to the impact categories
- 3- Characterization - modeling LCI impacts
- 4- Normalization - expressing potential impacts
- 5- Grouping - sorting or ranking the indicators
- 6- Weighting - emphasizing the most important potential impacts
- 7- Evaluating and Reporting LCIA Results



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## Chapter 2

### The Seven C's Framework for Engineering Problem Solving

#### 1. Concepts

- *Definition:* Core ideas, theories, and principles forming the problem-solving foundation.
- *Usage:* Essential for formulating, solving, and interpreting problems.
- *Key Tip:* Build a strong conceptual base; think of it as “bricks and beams” in solution construction.

#### 2. Compass

- *Definition:* A directional guide or set of steps tailored to specific problem types.
- *Usage:* Connects all C's, providing structured problem-solving without stifling creativity.
- *Example Steps:* Drawing Free Body Diagrams (FBDs) includes defining a coordinate system, identifying forces, labeling critical points, etc.
- *Key Tip:* Follow a Compass to manage complex problems and reduce cognitive load.

#### 3. Computations

- *Definition:* Mathematical skills for solving problems, like algebra, calculus, and unit handling.
- *Usage:* Ensure numerical precision, accuracy, and correct usage of significant figures.
- *Key Tip:* Regular practice of computations promotes accuracy and prepares for more complex problem solving.

#### 4. Communication

- *Definition:* Presenting solutions clearly, from defining problems to interpreting results.
- *Usage:* Organize solutions to tell a coherent “story” that includes assumptions, steps, and diagrams.
- *Key Tip:* Use labeled diagrams, consistent notation, and logical organization to enhance clarity.

#### 5. Consistency

- *Definition:* Maintaining reliable steps, notations, and conventions for efficiency and accuracy.
- *Usage:* Applying uniform processes across problems helps prevent errors and reinforces best practices.
- *Key Tip:* Develop consistent solution patterns and adhere to them to build effective problem-solving habits.

#### 6. Checks

- *Definition:* Verifying the solution's accuracy through methods like boundary checks or repeated calculations.
- *Usage:* Essential for validating solutions and preventing errors.
- *Key Tip:* Use different validation methods (e.g., cross-product checks for moments) to catch mistakes.

#### 7. Collaboration

- *Definition:* Engaging teamwork skills for group problem-solving.
- *Usage:* Critical in multidisciplinary teams and project work.

- *Key Tip:* Regularly practice teamwork and leadership within study groups or clubs to enhance collaborative skills.

## Chapter 1

Scientists investigate our natural world  
Engineers help create the human-designed world  
Technology (or technologies) denotes the product and processes created by an engineer and often used by a scientist

**Nanotechnology:** The science and technology of building devices, such as electronic circuits, from single atoms and molecules

**Process:** Human activities used to create, invent, design, transform, produce, control, maintain, and use products or systems; a sequence of actions that combines resources to produce an output

**System:** A group of interacting, interrelated, or interdependent elements/parts that function together as a whole to accomplish a goal

## Chapter 3

- **Stakeholder/utilitarian theory:** greatest good to the greatest number
- **Rights Theory:** Respecting and protecting individual rights to fair and equal treatment, privacy, freedom to advance, etc.
- **Justice Theory:** fair distribution of benefits and burdens: can harm to individual be justifiable?
- **Categorical Imperative:** “what if everyone took such action?”
- **“Front Page Test:”** What if my decision was reported on the front page of the Los Angeles Times?

1. Whistle blowing
  1. “If an engineer’s professional judgment is overruled resulting in danger to the life,

- health, welfare, or property of the public, the engineer shall notify his/her employer or client and any appropriate authority”
2. Clean Hands” Rule
    1. “Engineers shall not enter business ventures or permit their names or their firm’s names to be used by any persons or firm which is engaging in dishonest, fraudulent, or illegal business practice”
  3. Final Obligation to Society
    1. “Engineers who have knowledge of possible violation of any of the rules listed in this and the following two parts shall provide pertinent information and assist the state board in reaching final determination of the possible violation
  - 4 The Validity of Approvals
    1. “Engineers may coordinate an entire project provided that each design component is signed or sealed by the engineer responsible for that design Component”

**Plagiarism** --use of another’s intellectual property without permission or credit

**Trimming:** smoothing irregularities in data

**Cooking** -disregarding data points that do not fit the theory

**Intellectual Property** is property that results from mental labor; can be patented, copyrighted, or trademarked

**Trade Secret** is a formula, pattern, device, or compilation of information which is used in business to gain advantage over competitors who do not possess the trade secret

A **patent** is a document issued by government which allows the owner exclusive use of the device or system for 20 years from the date of filing.

**Trademark** - words, phrases, designs, sounds, or symbols associated with a good or service...

**Copyright** -- rights to creative products (e.g. books, pictures, graphics, sculpture, music, movies, software) are retained by the author for 50 years after his/her death.

**Expert witness** - Engineers hired in legal cases requiring technical knowledge (ie., accidents, structural defects, patent infringements, defective products)

**Actual conflict of interest** - John is a purchasing agent for JayCo. For the past 100 years, John’s family has owned a company that makes bolts. JayCo needs to purchase 100,000 bolts. If JayCo purchases the bolts, the value of John’s stock in the family business will increase by 20%.

**Potential conflict of interest** - John is a purchasing agent for JayCo. For the past 100 years, his fiancée's family has owned a company that makes bolts. JayCo needs to purchase 100,000 bolts. If John marries his fiancée, he stands to gain financially if JayCo purchases the bolts from his fiancée’s company.

**Apparent conflict of interest:** John is a purchasing agent for JayCo. For the past 100 years, John’s family has owned a company that makes bolts. Ten years ago, John had a fight with his family and has not spoken to them since. John owns no stock in the bolt company. JayCo needs to purchase 100,000 bolts.

#### Chapter 4

- 1983- UN Established a commission
- World commission on environment & development.
- Headed by Gro Harlem Brundland.
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- 1987- published findings “ Our common Future”.
- **1.Adverse outcomes Indicator (AOI):**Destruction of value due to impacts on individuals, communities, business enterprises or natural environment.
- **2.Resource flow Indicator(RFI):** Indicates Pressures associated with rate of consumption of resources ( Materials, water,land,energy).
- **3.System condition Indicator( SCI):**Indicates the state of the system in question.
- Individual,communities,business enterprises,natural environment.
- **4.Value creation Indicator:** Indicates the creation of value ( both economic & wellbeing ) through enhancement of individuals, communities, business enterprises, natural environment
- **Sustainable indicator:** measurable aspects of economic, environmental / social systems for monitoring human& environmental well being.

Theme	Sub-theme	Core indicator	Other indicator
Poverty	Income poverty	Proportion of population living below national poverty line	Proportion of population below \$1 a day
	Income inequality	Ratio of share in national income of highest to lowest quintile	
	Sanitation	Proportion of population using an improved sanitation facility	
	Drinking water	Proportion of population using an improved water source	

Theme	Sub-theme	Core indicator	Other indicator
<b>Poverty (continued)</b>	Access to energy	Share of households without electricity or other modern energy services	Percentage of population using solid fuels for cooking
	Living conditions	Proportion of urban population living in slums	
<b>Governance</b>	Corruption	Percentage of population having paid bribes	
	Crime	Number of intentional homicides per 100,000 population	
<b>Health</b>	Mortality	Under-five mortality rate	
		Life expectancy at birth	Healthy life expectancy at birth
	Health care delivery	Percent of population with access to primary health care facilities	Contraceptive prevalence rate
		Immunization against infectious childhood diseases	
Nutritional status	Nutritional status of children		
Health status and risks	Morbidity of major diseases such as HIV/AIDS, malaria, tuberculosis		Prevalence of tobacco use
			Suicide rate

Theme	Sub-theme	Core indicator	Other indicator
<b>Education</b>	Education level	Gross intake ratio to last grade of primary education	Life long learning
		Net enrolment rate in primary education	
		Adult secondary (tertiary) schooling attainment level	
	Literacy	Adult literacy rate	
<b>Demographics</b>	Population	Population growth rate	Total fertility rate
		Dependency ratio	
	Tourism		Ratio of local residents to tourists in major tourist regions and destinations

Theme	Sub-theme	Core indicator	Other indicator
<b>Oceans, seas and coasts</b>	Coastal zone	Percentage of total population living in coastal areas	Bathing water quality
	Fisheries	Proportion of fish stocks within safe biological limits	
	Marine environment	Proportion of marine area protected	
			Area of coral reef ecosystems and percentage live cover

Theme	Sub-theme	Core indicator	Other indicator
<b>Natural hazards</b>	Vulnerability to natural hazards	Percentage of population living in hazard prone areas	
	Disaster preparedness and response		Human and economic loss due to natural disasters
<b>Atmosphere</b>	Climate change	Carbon dioxide emissions	Emissions of greenhouse gases
	Ozone layer depletion	Consumption of ozone depleting substances	
	Air quality	Ambient concentration of air pollutants in urban areas	
<b>Land</b>	Land use and status		Land use change
			Land degradation
	Desertification		Land affected by desertification
	Agriculture	Arable and permanent cropland area	Fertilizer use efficiency
			Use of agricultural pesticides
		Area under organic farming	
Forests	Proportion of land area covered by forests	Percent of forest trees damaged by defoliation	
		Area of forest under sustainable forest management	

Theme	Sub-theme	Core indicator	Other indicator
<b>Economic development (continued)</b>	Research and development		Gross domestic expenditure on R&D as a percent of GDP
	Tourism	Tourism contribution to GDP	
<b>Global economic partnership</b>	Trade	Current account deficit as percentage of GDP	Share of imports from developing countries and from LDCs
			Average tariff barriers imposed on exports from developing countries and LDCs
	External financing	Net Official Development Assistance (ODA) given or received as a percentage of GNI	Foreign direct investment (FDI) net inflows and net outflows as percentage of GDP
			Remittances as percentage of GNI

Theme	Sub-theme	Core indicator	Other indicator
<b>Freshwater</b>	Water quantity	Proportion of total water resources used	
		Water use intensity by economic activity	
	Water quality	Presence of faecal coliforms in freshwater	Biochemical oxygen demand in water bodies
			Wastewater treatment
<b>Biodiversity</b>	Ecosystem	Proportion of terrestrial area protected, total and by ecological region	Management effectiveness of protected areas
			Area of selected key ecosystems
			Fragmentation of habitats
	Species	Change in threat status of species	Abundance of selected key species
			Abundance of invasive alien species

Theme	Sub-theme	Core indicator	Other indicator
<b>Economic development</b>	Macroeconomic performance	Gross domestic product (GDP) per capita	Gross saving
		Investment share in GDP	Adjusted net savings as percentage of gross national income (GNI)
			Inflation rate
	Sustainable public finance	Debt to GNI ratio	
Employment	Employment-population ratio		Vulnerable employment
		Labor productivity and unit labor costs	
		Share of women in wage employment in the non-agricultural sector	
Information and communication technologies	Internet users per 100 population		Fixed telephone lines per 100 population
			Mobile cellular telephone subscribers per 100 population

