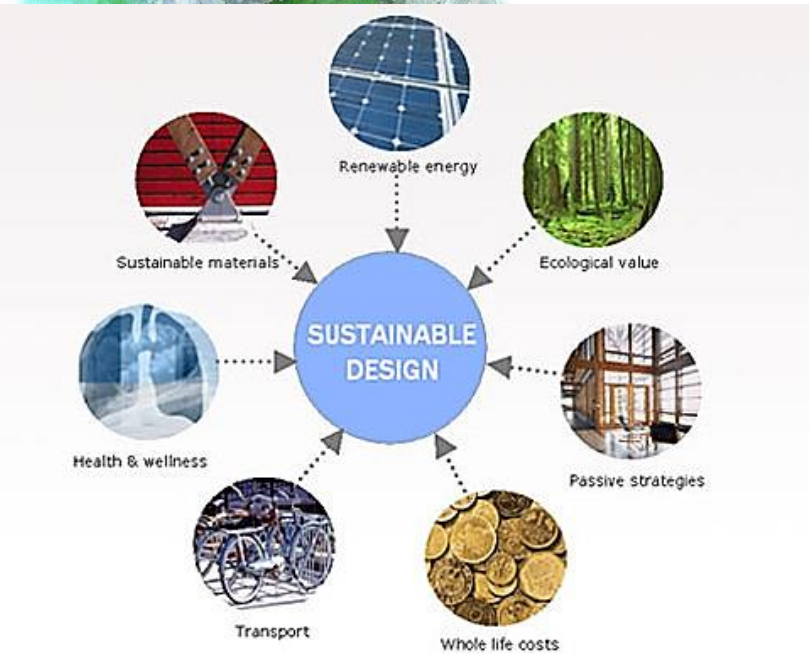
Module 3:

Sustainable Design and Communication

Sustainable Design



Sustainable design seeks to reduce negative impacts on the environment.

Sustainable design acts as a philosophy that is applied by different companies, governmental entities, and non-governmental organizations to achieve a better future for the human race through the wise and low-volume consumption of Earth's resources.

Principles of Sustainable Design

Form:

- Visual shape of the product
- The design should save energy consumption, packaging and transporting cost

Function & Usability:

- It helps consumers use the product in less time with less energy
- Less waste and throwaways

Cost-Effective Solution:

- Reducing the cost of current sustainable products

Renewable Energy:

- Not carbon energy, maybe solar or wind energy

Durable Design Solutions:

- Should reach zero waste
- Decrease the dependence on Earth's resource

Design for Reuse and Recycling:

- Afterlife of the product

Bio mimicry:

- redesigning industrial systems on biological lines

Life Cycle Assessment (LCA)

LCA

Life-cycle assessment (LCA) is a technique to assess environmental impacts associated with all the stages of a product's life from raw material extraction through materials processing, manufacture, distribution, use, repair and maintenance, and disposal or recycling.

The 4 steps of LCA methodology

1. Goal and scope:
   - ensures the LCA is performed **consistently**.

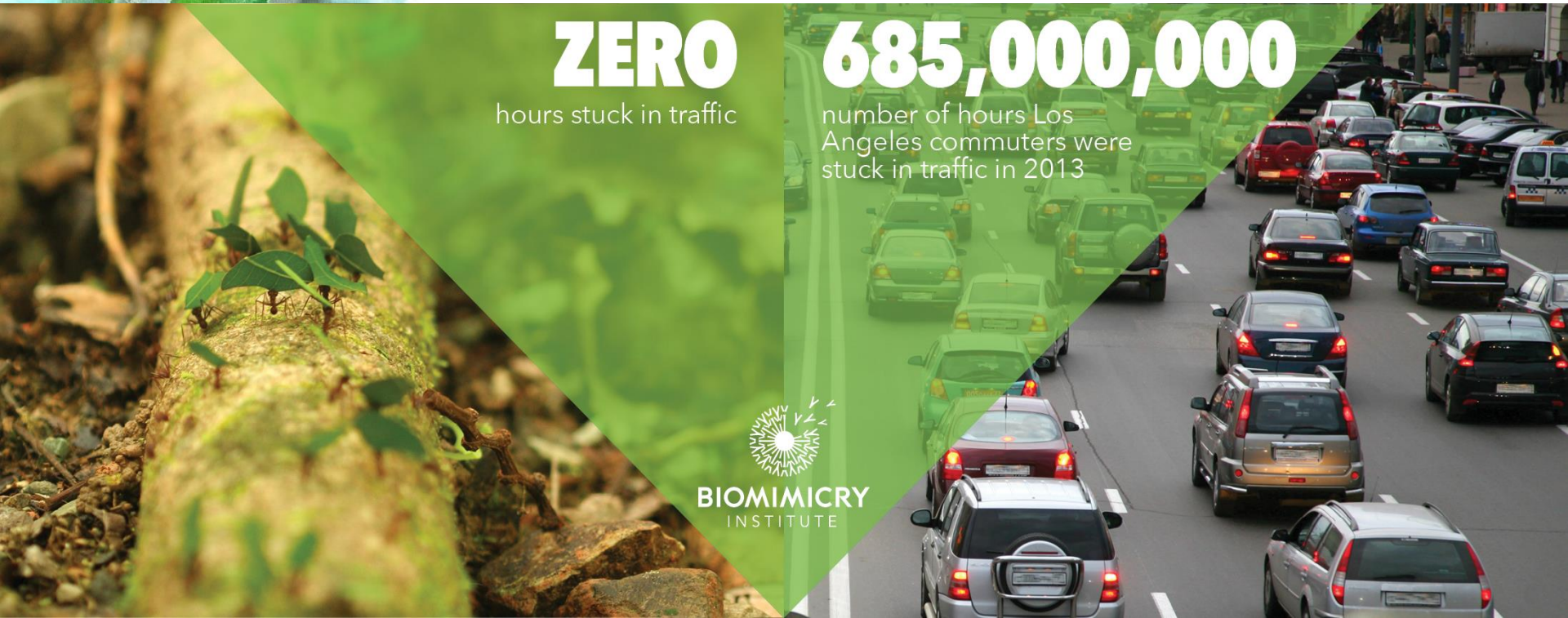
2. Inventory analysis:
   - look at all the environmental inputs and outputs associated with a product or service

3. Impact assessment:
   - environmental impacts, impact on human health

4. Interpretation:
   - check that your **conclusions are well-substantiated**

Bio mimicry

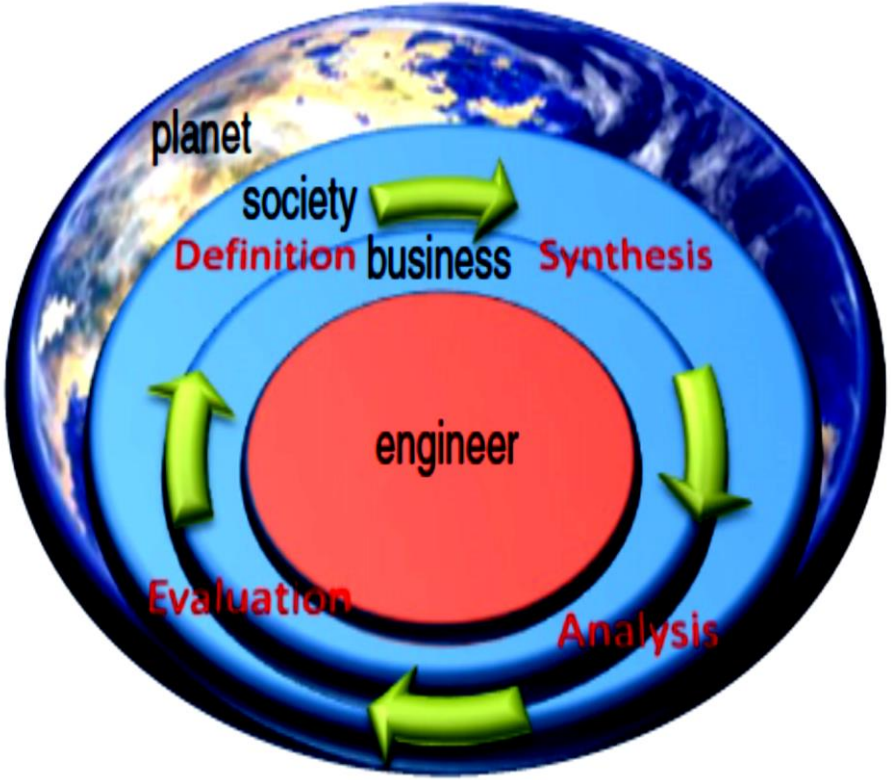
Bio mimicry is an approach to innovation that seeks sustainable solutions to human challenges by emulating nature's time-tested patterns and strategies.




ZERO
pigments and dyes used to
create these brilliant colors
750,000
metric tons of textile dyes used
annually to color our fabrics
BIOMIMICRY
INSTITUTE


RAW MATERIAL EXTRACTION
MATERIAL PROCESSING
PART MANUFACTURING
ASSEMBLY
PRODUCT USE
END OF LIFE
SUSTAINABLE DESIGN

Schematic overview of making a sustainable design



Ref: Engineering for sustainabilitya practical guide for sustainable design gerald jonker and jan harmsen, university of groningen

RECYCLING

- Recycling is the recovery of materials or components from products for processing.
- The recycling of metals has been an established process for many years.
- It is generally done through one of two methods: shredding and separation to recover both ferrous and non ferrous metals, and disassembly and recycling to recover metals and some other materials.
- Plastics recycling is not as well established.

RECYCLING

Plastics can be recovered using a variety of technologies.

- The mechanical recycling of plastics involves melting, shredding and granulation of waste plastics. Plastics must be sorted prior to mechanical recycling into polymer types and/or color. The plastic is then melted down directly and moulded into a new shape or melted down after being shredded into flakes and then processed into granules called regranulate.
- Some components such as PCBs, batteries, CRT require specialist recycling. Many PCBs found in e-waste have a low intrinsic value and therefore are not economic to recycle.

Generally, only those found in IT and telecommunications equipment have any intrinsic value. These can be processed to recover materials such as: silver, lead, copper, and gold using a process called Pyrolytic treatment (smelting) which extracts the precious metals from the boards.

Design for Recyclability

In the wake of concept of sustainable development, there has always been a thrust on environment preservation in the manufacturing sector. Various government regulations and circulars have been issued to employ the concept of design-for-recycling. The design guidelines for"green" products and processes can be summarized as:

- Increase efficiency of energy use, while considering environmental impact.
- Minimize the amount of materials used.
- Use recyclable and biodegradable materials where possible. remanufacturing

ECODESIGN AND DESIGN FOR SUSTAINABILITY

Over the years environmental philosophies have evolved from green design to eco-design through to design for sustainability.

Green Design	Green design focuses on single issues, for example the inclusion of recycled or recyclable plastic, or consideration of energy consumption.
Ecodesign	Environmental considerations are considered at each stage of the design process.
Design for sustainability	Design that considers the environmental (for example resource use, end of life impact) and social impact of a product (for example usability, responsible use).
Sustainability	Sustainability is considered to be more of a direction than a destination that we will actually reach.

Table: Differentiation of environmental design philosophies

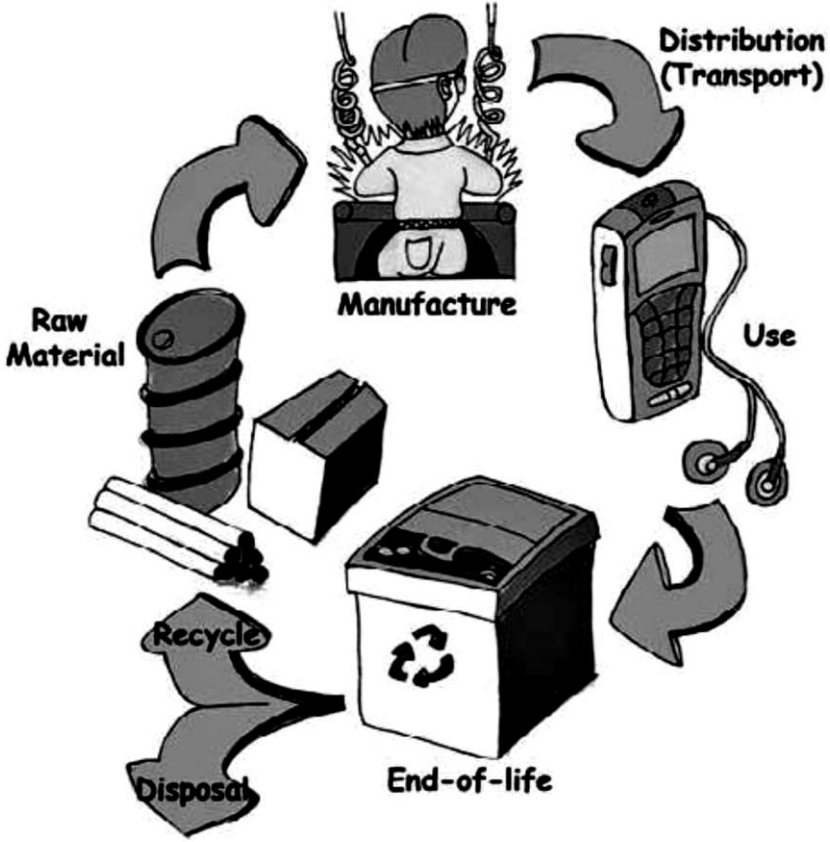
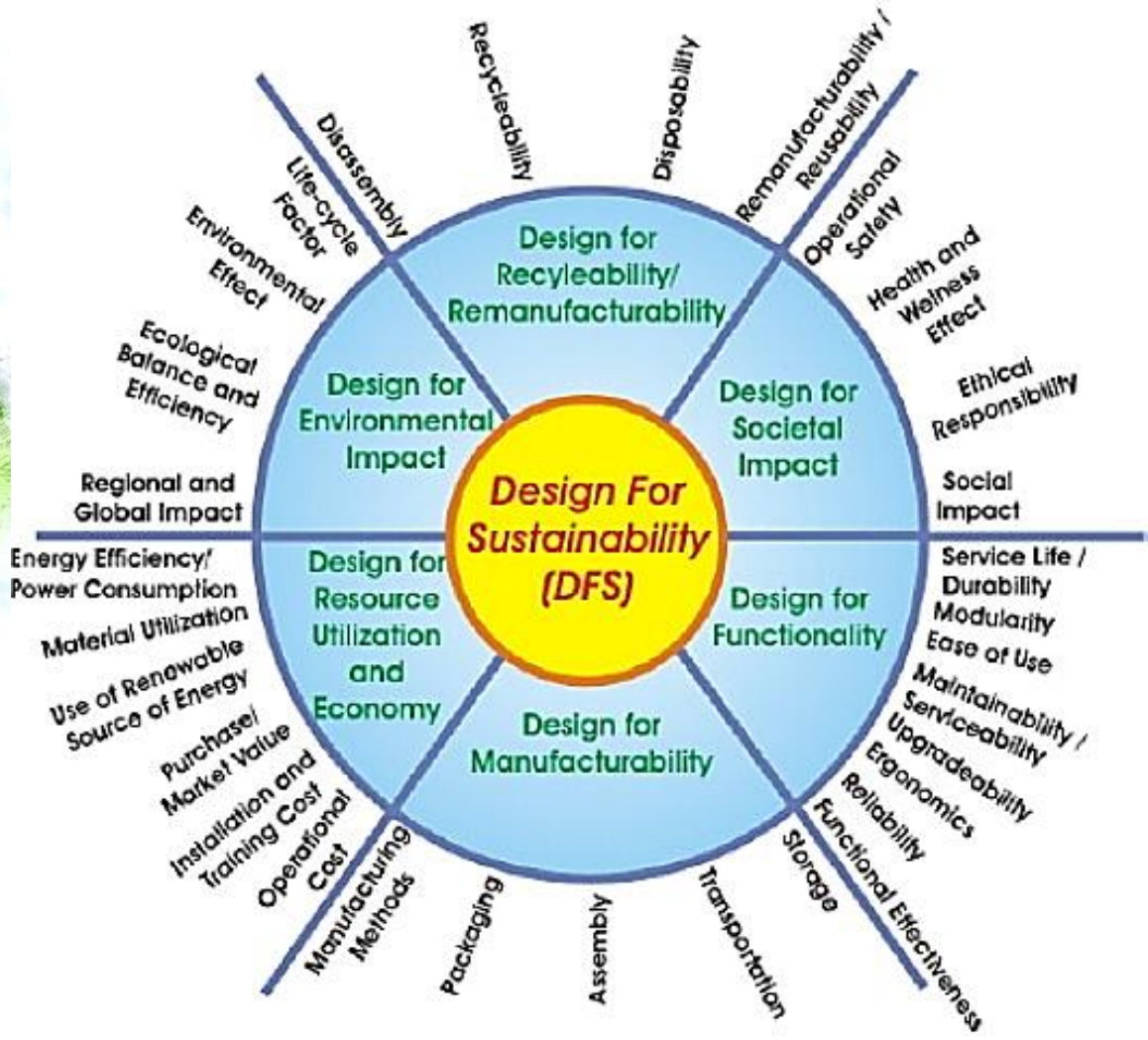


Figure: The different elements affecting the product lifecycle

- Good design will ensure a product contains a rationalized number of materials and components; that consumer health and safety issues are considered; that it functions appropriately and effectively and communicates this function clearly; that it is 'styled' appropriately; is ergonomically correct and complies with legislation requirements.
- Eco-design goes further by aiming to reduce the environmental impact of each stage of the product life cycle.
- As illustrated in Figure, in product development terms, the product life cycle covers the whole life of the product from 'cradle to grave', including: the extraction of the raw materials to make the product, the manufacturing process; its distribution, its use and what happens to it at the end of its life.
- Eco-design is concerned with improving the environmental impact at each of these stages.


Design For Sustainability (DFS)
Design for Recyleability/ Remanufacturability
Design for Societal Impact
Design for Functionality
Design for Manufacturability
Design for Resource Utilization and Economy
Design for Environmental Impact
Recycleability
Disposability
Remanufacturability / Reusability
Disassembly
Life-cycle Factor
Environmental Effect
Operational Safety
Health and Wellness Effect
Ecological Balance and Efficiency
Ethical Responsibility
Regional and Global Impact
Social Impact
Energy Efficiency/ Power Consumption
Material Utilization
Use of Renewable Source of Energy
Service Life / Durability
Modularity
Ease of Use
Maintainability / Serviceability
Upgradeability
Purchase/ Market Value
Installation and Training Cost
Operational Cost
Ergonomics
Reliability
Functional Effectiveness
Manufacturing Methods
Packaging
Assembly
Transportation
Storage

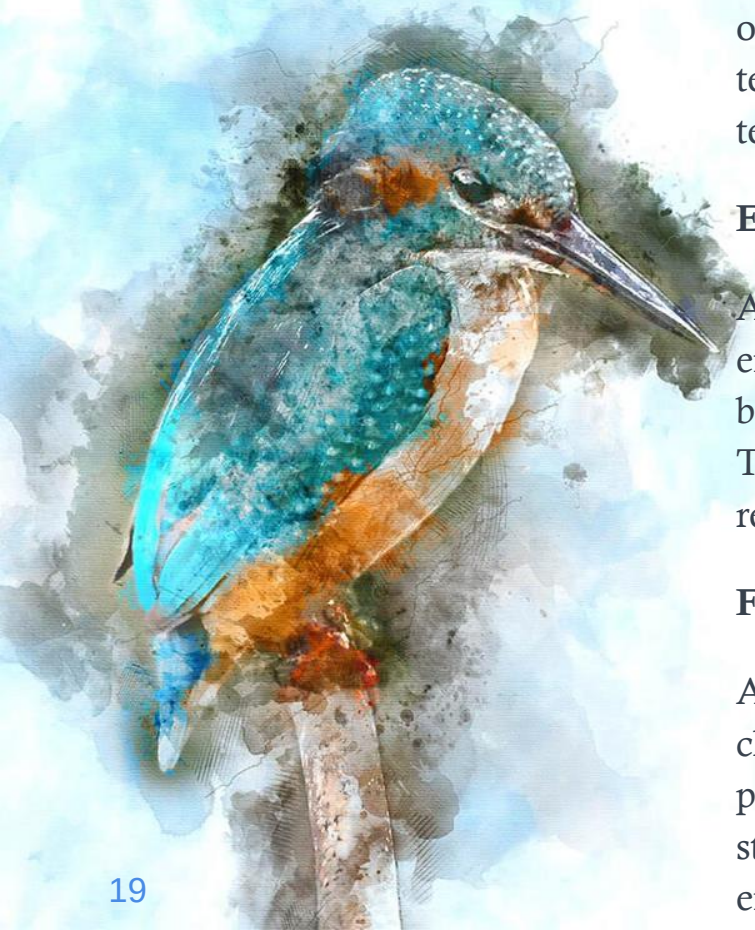
- ✓ Design for sustainability goes further still to include the consideration of social issues such as usability, socially responsible use, sourcing and designing to address human needs.
- ✓ However many of these issues are often considered under a range of other banners such as ergonomics, inclusive design, design for the aged, and design against crime rather than under the overall remit of design for sustainability. Furthermore,
- ✓ Some social issues such as sustainable procurement, ethical finance, and ethical labour sourcing fall outside the remit of the designer as they need dealing with at a strategic level.
- ✓ Alternatively, design for sustainability can be approached in a completely different way by focusing on needs.

Social Innovation

"Social innovation is the process of developing and deploying effective solutions to challenging and often systemic social and environmental issues in support of social progress".

https://www.gsb.stanford.edu/faculty-research/centers-initiatives/csi/defining-social-innovation

Recent Examples of Social Innovation



Charter Schools

Publicly funded primary or secondary schools that operate free from some of the regulations that typically apply to public schools. Administrators, teachers, and parents thus have the opportunity to develop innovative teaching methods.

Emissions Trading

A pollution control program that uses economic incentives to reduce emissions. A cap is set on the total amount of a certain pollutant that can be emitted, and permits to pollute are issued to all participating businesses. Those with higher emissions can buy credits from businesses that have reduced their emissions. Over time, the cap is reduced.

Fair Trade

An organized movement that establishes high trade standards for coffee, chocolate, sugar, and other products. By certifying traders that pay producers a living wage and meet other social and environmental standards, the fair trade movement improves farmers' lives and promotes environmental sustainability.

Social Innovation Drivers

The three key mechanisms that are driving contemporary social innovation:

- Exchange of ideas and values
- Shifts in roles and relationships
- Integration of private capital with public and philanthropic support

Ultimately, the most difficult and important problems cannot be understood, let alone solved, without involving the nonprofit, public, and private sectors.

Thanks!