SCIENCE AND TECHNOLOGY CAREER PATHWAYS II

SEMESTER II

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Chapter 5

Approach for sustainable production

Course Outline

- Introduction to Sustainable Production
- Industrial ecology
- Remanufacturing and the Circular Economy
- Eco-design
- Careers in Sustainable Development

Introduction to Sustainable Production

- This chapter provides an overview of the concept of sustainable production, emphasizing the need for industries to adopt environmentally friendly practices. It highlights the importance of minimizing environmental impacts while maximizing efficiency and resource conservation within industrial processes. Sustainable production is presented as a crucial aspect of addressing global environmental challenges and achieving long-term economic and social sustainability.

Industrial ecology

- Industrial ecology is a way of managing industries that mimics how natural ecosystems operate. It aims to create systems where resources are used efficiently and waste is minimized. In this regard, it goes beyond traditional actions that address different issues separately: energy efficiency, pollution control, recycling, and others.

- Industrial systems are viewed as ecosystems themselves, designed to function in harmony with their surroundings. They aim to optimize the utilization of resources such as water, raw materials, and energy, while concurrently exploring avenues for material reutilization and recycling to minimize waste and maximize efficiency.

The role of industrial ecology in the circular economy

Industrial ecology plays a vital role in the circular economy by optimizing resource use, minimizing waste, and fostering symbiotic relationships between industry and ecosystems. Its key contributions include maximizing resource efficiency, reducing waste through recycling and reuse, promoting eco-design and innovation, facilitating collaboration among stakeholders, and supporting policy development.

Remanufacturing and the Circular Economy

- Within the technical loops of value regeneration in the Circular Economy, products can undergo repair, renovation, reconditioning, remanufacturing, and materials can be recycled.
- The Circular Economy model applied to these different technical loops relies on the reuse of products and components reaching the end of their life as incoming resources for various activities aimed at restoring their performance levels.
- Remanufacturing is implemented through a well-defined industrial process, the most rigorous and structured among all other value regeneration processes.
- The industrial process of remanufacturing involves restoring a used product or component (whether faulty, at the end of its life, obsolete, or in a state of waste) to a level of performance and quality equal to or greater than its original state.

Technical Loops in Circular Economy for Lifespan Extension

- ***Materials***
  - Recycling: This involves extracting raw materials from a product and transforming them to be used in making new products or as a source of energy. It's particularly useful for recovering valuable materials from products with simple structures and few components.

Technical Loops in Circular Economy for Lifespan Extension

- *Products*
  - Reuse: Simply using a product again without making any changes to it. For example, passing it on to someone else to use.
  - Repair: Fixing a defect in a product, although there's no guarantee that the product will perform as well as it did originally.
  - Renovation: Primarily focusing on improving the appearance of a product to make it look 'like new,' with perhaps some minor functional improvements.
  - Reconditioning: Bringing a product back to a working condition and making it look 'like new,' though it may not perform exactly as it did when it was brand new.
- Remanufacturing is a precise industrial process aimed at restoring the value of components (materials, energy, knowledge) from products at the end of their life cycle. These components are then reused to create products that perform just as well as, or even better than, they did originally.

Remanufacturing process

- The remanufacturing process aims to restore a used product to a condition that is functionally and aesthetically similar to new. Key stages of this process include:
  - Collection: The process begins with the collection of used products that will be remanufactured.
  - Disassembly: The collected products are then disassembled to access their individual components. This process separates damaged or obsolete parts from those that can be reused or repaired.
  - Sorting: The retrieved parts are sorted based on their condition and quality.
  - Cleaning: The sorted parts are thoroughly cleaned to remove any dirt, grease, or other contaminants.
  - Testing: The cleaned parts are then tested to ensure their proper functioning.
  - Refurbishment: The tested and approved parts are refurbished according to the original manufacturer's specifications. This may involve repairs, adjustments, or enhancements.
  - Reassembly: Once all parts have been refurbished, the product is reassembled using precise methods and techniques.

The advantages of Remanufacturing

- *For the consumer*
  - Remanufactured products are affordable, offering quality at lower prices.
  - Consumers gain access to cutting-edge technology and features more frequently.
  - Enhanced quality is achieved through rigorous debugging and improved processes.
  - Improved after-sales services include broader options like same-day product replacement.
  - Opting for remanufactured products contributes to environmental sustainability.
- *For the manufacturer*
  - Cost reduction through remanufacturing enhances competitiveness.
  - Designing products for remanufacturing increases productivity.
  - Analysis of remanufactured products informs future product quality improvements.
  - Offering new services with remanufactured products can build customer loyalty.
  - Reusing remanufactured products reduces environmental impact.

Eco-design

- Eco-design is both a principle and a practice involving the integration of environmental preservation criteria from the outset of a product or service project's conception and throughout its development. Its aim is to minimize negative environmental impacts while maintaining the product's quality at an optimal level.
- The principles of eco-design were formalized in 2002 through the international standard ISO/TR 14062. This last provides guidelines for integrating environmental aspects into product design and development processes.

The eco-design approach

- The eco-design approach encompasses a comprehensive process, known as "multi-stage" and "multi-criteria," which addresses the entire product lifecycle with a focus on circular economy principles, aiming to maximize resource efficiency and recycling.
- *The successive stages include*
  - Extraction of raw materials and sourcing
  - Production
  - Product distribution
  - Consumer use
  - End-of-life (recovery and recycling)

The eco-design approach

- *Key criteria considered in this approach include*
  - Raw material consumption
  - Energy consumption
  - Environmental emissions and other pollutants
  - Climate impacts
  - Biodiversity impacts
- The eco-design process involves not only the initiator (such as a company or public service) but also all individuals and entities involved in the product lifecycle, including consumers/users

The tools of eco-design

- To implement an eco-design approach, it is necessary to understand how the manufacturing and use of a product affect the environment. Are the materials used eco-friendly? At which stage of the manufacturing and use of the product are the environmental impacts most significant? The answers to these questions help identify the measures to be taken to effectively reduce the environmental impacts of the product under study.
- One of the most commonly used tools to identify these answers is Life Cycle Assessment (LCA), which identifies the stages of the process with the greatest environmental impact. This helps designers take action to reduce these impacts, such as using eco-friendly materials or improving energy efficiency.

Example of eco-design:

- *Malongo Ek'Oh espresso machine (2013 Eco-product for sustainable development award):*
  - Designed with anti-planned obsolescence features,
  - modular design,
  - easy to repair,
  - made from durable materials,
  - energy-efficient,
  - recyclable (75%)...

Careers in Sustainable Development

- These are all professions dedicated to preventing and treating pollution, protecting biodiversity, and anticipating natural risks:
  - Eco-industrial companies,
  - Consulting firms,
  - Local authorities,
  - Associations