L–18: SUSTAINABILITY: CRADLE TO CRADLE APPROACH

Contributors

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Lesson – 18
Sustainability: Cradle to Cradle Approach

Learning Outcome: At the end of this lesson, you will be able to plan activities and projects for effective curriculum implementation adopting cradle-to-cradle approach in all teaching-learning processes for promoting sustainability in design and use of materials, products and systems.

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'Cradle to Cradle' means "Doing good" instead of "Doing less bad" in all human endeavours.

1.0 INTRODUCTION

The above slogan in black and white ecstatically reverberates what the 'cradle-to-cradle' is all about and that a positive outlook is required for sustainability. The phrase 'cradle-to-cradle' was coined by Walter R. Stahel in the 1970. Today 'cradle-to-cradle' is a registered trademark of McDonough Braungart Design Chemistry (MBDC) consultants. 'Cradle to Cradle: Remaking the Way We Make Things is a 2002 non-fiction book by German chemist Michael Braungart and U.S. architect William McDonough'. The book talks about how to achieve 'cradle-to-cradle' (as against the conventional cradle-to-grave) Design model. Therefore, this lesson is specifically written to link the sustainability aspects with the concept of 'cradle-to-cradle' and how the technical education teachers could play a major role using this concept in the design of curriculum and while implementing the curriculum. The teacher is encouraged to think as to how to weave this concept in classroom teaching, laboratory instruction and type of projects that can be given to the students during the entire tenure of the engineering UG programme of 4 years duration.

2.0 CONCEPTUAL FRAMEWORK FOR SUSTAINABILITY

A brief recap of the conceptual framework for sustainability is essential before introducing the concept of 'cradle-to-cradle' approach. The conceptual framework commonly referred regarding sustainability is Triple Bottom line (TBL) proposed by Elkington (1998). TBL is succinctly described by 3Ps (profit, planet and people) or alternatively by economic, environmental and societal components. These components are interrelated and inter dependent. None of the two components alone can achieve sustainability. Thus, sustainable development will be an integration of these three dimensions with a relation among all the components (TBL).

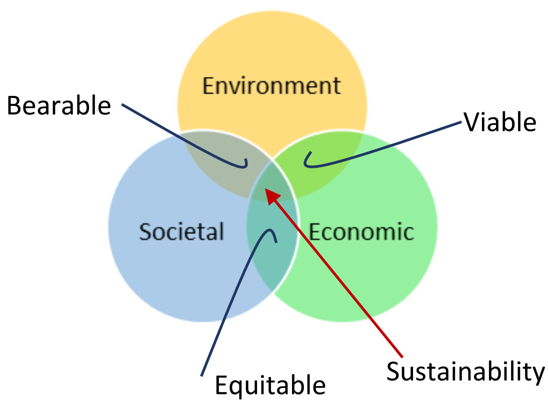

Figure 1: Triple Bottom Line Framework

As shown in Figure 1, environment together with the economic component provide viable options, economic and societal together provide equitable option for all creatures, societal and environment together provide bearable options. The region where all these three meet or have their existence is referred as sustainability.

This concept is also mentioned in Programme Outcome PO7 for Engineering UG programme which is on *'Environment and sustainability: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development'*. It is therefore essential that when students are working on real life problems and projects, they need to analyse the problems with respect to society, environment and economic consideration. Creative, innovative and sustainable solutions proposed by them must be brought to the knowledge of masses for discussion, further improvement and to spread the message that sustainable solutions to engineering-based problems are the need of the hour.

3.0 NEED FOR TRIPLE BOTTOM LINE APPROACH IN TECHNICAL EDUCATION

Sustainable development philosophy revolves around re-organisation of a threatened and fragile environment. Today, the planet earth faces the risks of irreversible damage to the human environment for which the population growth, technological growth, rising living standards and many more are responsible.

Here, it is pertinent to mention that profit is purely economic in nature and is the bottom most line as shown in *Figure 2*. People and planet though non-economic as far as revenue generation is concerned, but these have positive impact on the value system of any organisation and its sustainability. This concept needs to be percolated down to the bottom most level in organisations for sustainable development. The engineers and technologists coming out of technical education system need to be made brand ambassador for this. This can be achieved when they try to integrate this concept during their undergraduate and graduate courses, where they create, innovate and propose material, product and system based on this approach. As a teacher, your responsibility is to make all the stakeholders aware of the TBL concept. This concept benefits the natural order as much as possible with the sole purpose of saving the environment. The need to apply the concept of TBL in all walks of life right from education, training to businesses is due to concern of all stake holders for environmental regulations and associated legal costs, human rights, global warming, sensitivity towards safe and healthy eco system and many more.

Figure 2: 3Ps Sustainability Framework

4.0 SUSTAINABILITY PRINCIPLES

For sustainable future, Anastas and Warner (1998) have introduced 12 principles and methodologies which take care of environmentally friendly and cost-effective design considering ***TBL– environment, economy and society***. List of these principles are given in Appendix A. Understanding of these principles is essential for cradle-to-cradle design of materials, products and systems for promoting sustainability. Focus of these principles is mainly on use of non–hazardous and renewable material, preventing waste, minimising energy consumption and maximising energy efficiency, disintegration under natural condition, avoiding *'one-size-fit-all'* solutions, promoting dismantle for cyclic use and promoting after life for material products and systems.

5.0 PROMOTING SUSTAINABILITY THROUGH CRADLE–TO–CRADLE APPROACH

Before describing the cradle-to-cradle approach, you are requested to go through the following famous quotes from William McDonough:

a) "The Stone Age did not end because humans ran out of stones. It ended because it was time for a re-think about how we live."
b) ''Waste equal food, whether it's food for earth or for closed industrial cycle. We manufacture products that go from cradle to grave. We want to manufacture them from cradle to cradle."
c) "If we think about things having multiple lives, cradle to cradle, we could design things that can go back to either nature or back to industry forever."

These quotes compel the designer and professionals to favour design based on cradle to cradle approach.

When a designer opts for ***cradle-to-grave*** approach, then the life span of material or product starts with its birth/creation and ends up to the point of disposal. The problem faced with this design is if the product is not biodegradable then heaps of disposable products are created. Many of the Indian cities are facing disposable problem for such products.

"File:Electrical and electronic waste Cluj-Napoca 1.jpg" by FlickreviewR is licensed under CC BY 2.0

"File:Ewaste.jpg" by Txopi is licensed under CC0 1.0

Figure 3 Cradle-to-grave design

In contrast to this, cradle-to-cradle approach ensures environment sustainability. *'cradle-to-cradle'* ***design ensures*** that material flows cyclically in appropriate, continuous **biological** or **technical nutrient** cycles. All waste materials are productively re-incorporated into new production cycle, fulfilling the concept "waste = food" as proposed by McDonough &

Braungart [2002]. For better understanding about waste=food watch the video available on YouTube at https://www.youtube.com/watch?v=EyiweCa_0yU.

Cradle-to-cradle design approach is depicted diagrammatically in Figure 4. The *biological nutrients* return to the organic cycle and are consumed by micro-organisms and other creatures in the soil, whereas *technical nutrients* referred to those materials that are considered as waste after their use, also becomes food for new and better material/product, which is the basic principle on which nature works. This means the material, product or system after completing its useful life-cycle turn into new products the value of which is equal, if not greater than the old product. In other words, waste does not exist when the biological and technical components of a product are designed by intention to fit within a biological or technical cycle for re–marketing, re–manufacture, dismantling or re–purposing. This can be explained with the help of an example.

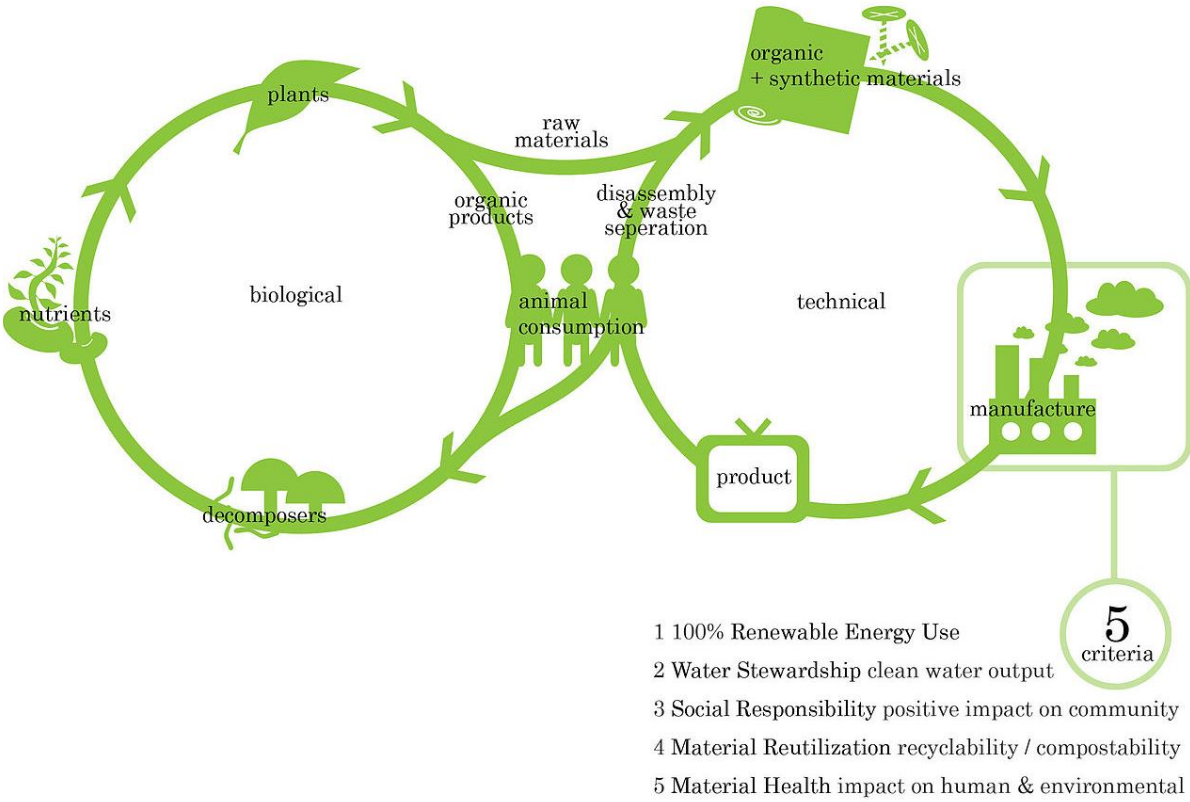

Figure 4 Cradle-to-Cradle Design Approach

Example 1

Consider the product – the plastic bottle used for packaging of water, cold drinks, oils and other liquids. Heaps and heaps of these used bottles are collected as waste material. This is one of the major sources of environment pollution today. Instead of using one-time-use plastics, there are other type of bottles that are made of bio-degradable materials that can fully enter a new life cycle either back to nature or back into the design process as a new product. These options need to be explored.

6.0 CRADLE–TO–CRADLE APPROACH VIS-À-VIS TECHNICAL EDUCATION SYSTEMS

For the cause of sustainability, it is high time that curriculum designers and teachers in the technical education systems start thinking and guiding students to develop attitudes and habits that limit consumption, minimise materialistic purchase (buy less and spend less), and share resources (as discussed in the next lesson on 5Rs), when they are working on variety of tasks in classroom, laboratory, during 'Tech-Fests', while undertaking various types of projects and internships. Such sacrifices save the planet earth and make available the resources which otherwise may go extinct.

The students should be continuously reminded and motivated to incorporate the 'cradle-to-cradle' approach in the small and large projects or have some flavour of it in everything that they do, not only in the institute, but at home and everywhere they go in order to render the earth a safe place to live for the future generations to come.

Case of Designtex

A fabric that helps strawberries grow, with production methods that clean water

(Courtesy https://www.greenbiz.com/blog/2014/03/20/4-cradle-cradle-certified-product-breakthroughs)

There is more concern lately about fashion and its impact on human health, the environment and workers. Susan Lyons of the New York-based design firm Designtex was ahead of the curve. In 1993, she decided to develop a collection of ecological fabrics. At that time, no one knew exactly what a *'green fabric'* should be.

A partnership then emerged among Designtex; William McDonough and his colleague, Michael Braungart; and the Swiss textile mill Rohner to develop upholstery with remnants that would not be considered hazardous waste. Braungart analysed more than 8,000 chemical formulations commonly used in textile production, then selected a mere 38 that he deemed safe for human and environmental health. These were the dyes and process chemicals allowed to be used in the production of Climatex upholstery.

According to Designtex, optimising this chemistry changed the mill's water release, which became cleaner than the incoming water. By producing new fabrics designed to decompose safely, the mill saved scraps and turned them into felt, avoiding costly disposal fees. Local strawberry farmers used this felt as ground cover for their crops. Designtex has expanded its Climatex offering to some 20 styles and Climatex was awarded Gold level C2C certification.

7.0 SUMMARY

It is seen in the above sections and also after watching the associated videos, that in the 'cradle-to-cradle' approach, the *biological nutrients* return to the organic cycle and are consumed by microorganisms and other creatures in the soil, whereas *technical nutrients* referred to those materials that are considered as waste after their use, also become food for new and better material/products, which is the basic principle, on which nature works. In educational and training institutions your role is to integrate the concept of sustainability across courses and programmes in such a way that students are forced to think of sustainable solutions, whenever they are involved in any activity related to curricular, co-curricular or extra-curricular. This will help in changing the behaviour and attitudes of individuals including those of colleagues, peers, teachers, staff and also that of producer and consumer of products and services for exploring and accepting sustainable solutions.

ACTIVITY

View the video programme Cradle–to–Cradle by Michael Braungart and William McDonough on YouTube link https://www.youtube.com/watch?v=EyiweCa_0yU. After viewing the video programme list the ways in which as a technical teacher you can promote 'waste = food' in your professional work and the variety of tasks/projects that you may give your students in order to promote the concept of *cradle-to-cradle* in the technical education system.

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[2] McDonough, W., & Braungart, M. (2002). *Cradle to Cradle - Remaking the Way We Make Things.* New York: North Point Press.

[3] https://en.wikipedia.org/wiki/Triple_bottom_line

[4] https://www.greenbiz.com/blog/2014/03/20/4-cradle-cradle-certified-product-breakthroughs

L 18 DISCUSSION FORUM

Start a discussion on social media on some examples of ‘cradle-to-cradle’ approach.

APPENDIX A

Sustainability Principles

Anastas and Warner (1998) articulated the following principles and methodologies to accomplish the goals of environmentally friendly and cost-effective designs. These principles are powerful enablers for sustainable futures because on one-hand they address optimization at molecular level and on other-hand the principles address system level reengineering. In other words, the key to achieving sustainability lies in the design of molecules, systems, processes and product levels through logical integration of the 12 green engineering principles (Gopichandran, Asolekar, Jani, & Kumar, 2016).

Principle 1. Designers need to strive to ensure that all materials and energy inputs and outputs are as inherently Non-hazardous as possible.

Principle 2. It is better to prevent waste than to treat or clean up waste after it is formed.

Principle 3. Separation and purification operations should be designed to minimize energy consumption and materials use.

Principle 4. Products, processes, and systems should be designed to maximize mass, energy, space, and time efficiency.

Principle 5. Products, processes, and systems should be “output pulled” rather than “input pushed” through the use of energy and materials.

Principle 6. Embedded entropy and complexity must be viewed as an investment when making design choices on recycle, reuse, or beneficial disposition.

Principle 7. Targeted durability, not immortality, should be a design goal for products. After useful use of a product to disintegrate under natural conditions.

Principle 8. Design for unnecessary capacity or capability (e.g., “one size fits all”) solutions should be considered a design flaw.

Principle 9. Material diversity in multi component products should be minimized to promote disassembly and value retention.

Principle 10. Design of products, processes, and systems must include integration and interconnectivity with available energy and materials flows.

Principle 11. Products, processes, and systems should be designed for performance in a commercial “afterlife”.

Principle 12. Material and energy inputs should be renewable rather than depleting.