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BEYOND SMART SUSTAINABLE MANUFACTURING - BSSM
ONLINE TRAINING
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05. SUSTAINABLE AND SMART MANUFACTURING: AN INTEGRATED APPROACH

SECTION - SMART SUSTAINABLE MANUFACTURING

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Overview

- In modern society, manufacturing is connected to all human activities, and it is a source of products and services that are necessary for human health, safety, and well-being.
- Considering that manufacturing processes are responsible for the creation of essential products to the quality of human life and its importance to the global economy, it is vital to analyze it in light of sustainability.
- Therefore, the current study aimed to integrate sustainable smart manufacturing performance by incorporating sustainable manufacturing measures and discussing the current and future challenges that are faced by the manufacturing sector.
- Furthermore, there is a need to establish a framework for both practitioners and scholars when it comes to sustainable manufacturing, and many companies seem to not be mindful of the potential benefits of the sustainable manufacturing approach.
- In this work, a new and comprehensive study was presented and discussed to address and highlight two main aspects: the concepts and benefits/opportunities associated with the proper implementation of sustainable manufacturing and the challenges facing the current industries to establish the SSM approach.
- The integrated smart and sustainable business model should be founded on specific policies that attempt to improve the competence to meet instant facility requirements.

> The necessity for decreasing the negative impact of the manufacturing industry has recently increased. This is getting recognized as a global challenge due to the rapid increase in life quality standards, demand, and the decrease in available resources.



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Therefore, in the present Course work, a new and comprehensive study is presented to discuss and highlight the following points:

1. The concepts and benefits/opportunities associated with the proper implementation of sustainable manufacturing. The accurate identification of these opportunities paves the road for establishing a sustainable smart manufacturing (SSM) approach for different manufacturing industries;

2. The challenges facing the current industries to establish the SSM approach.

Introduction

The “sustainable manufacturing” concept refers to all industrial activities from the factory to the customer including all in-between steps (i.e., resources and services that are connected to the manufacturing chain). In modern society, manufacturing is connected to all human activities, and it is a source of products and services that are necessary for human health, safety and well-being .

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Sustainable Manufacturing: Concepts and Opportunities

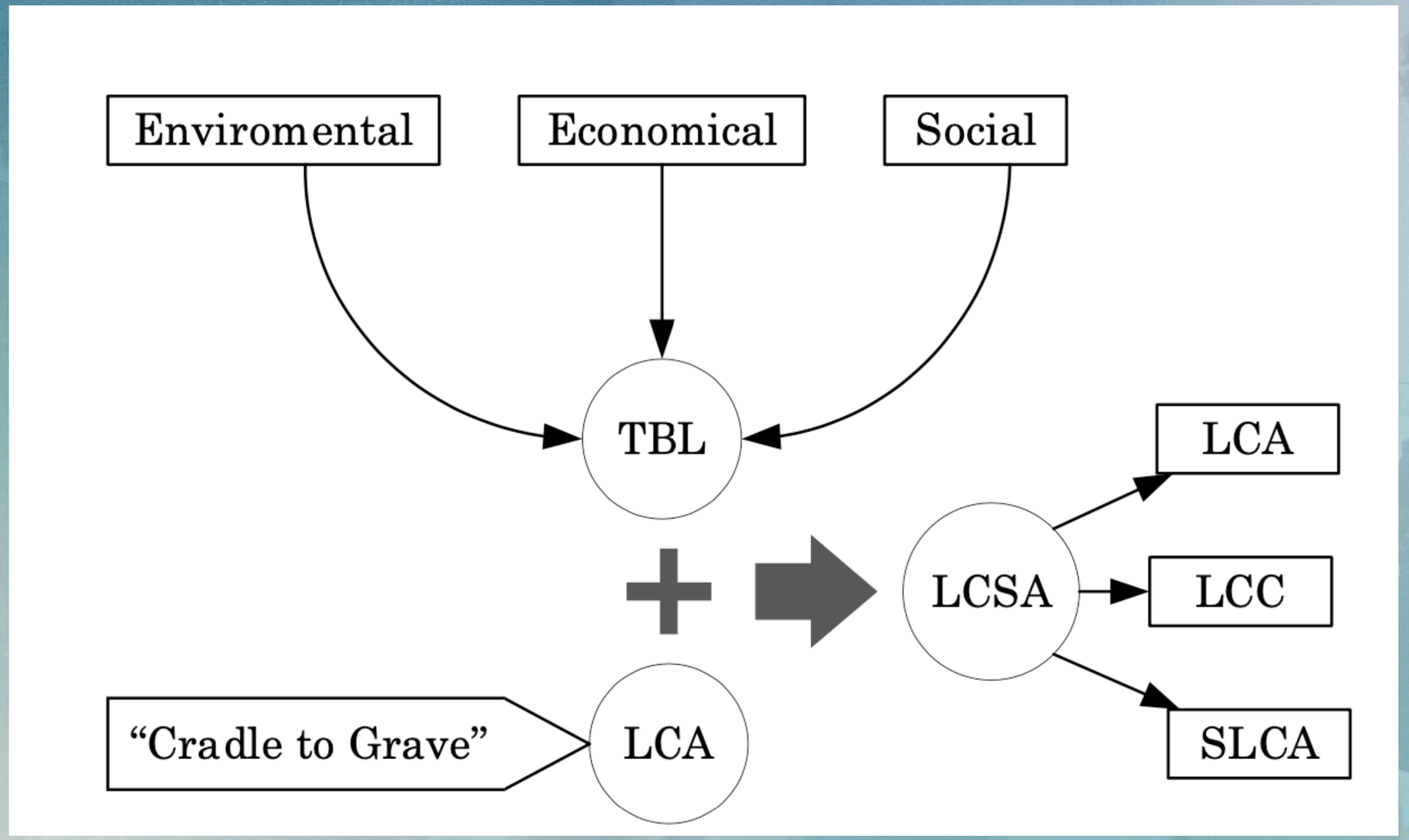
- Sustainable manufacturing is based on the 6R (i.e., reduce, redesign, reuse, recover, remanufacture, and recycle) instead of the 3R approach (i.e., reduce, reuse, and recycle) .
- The "reuse" perspective is connected to the reuse of the products or the previously manufactured parts after its first lifecycle, which contributes to reducing resource consumption.
- "Recycle" is the process of reusing the used materials that are typically considered as waste into new materials or products.
- The act of "Redesign" consists of using methods such as Design for Environment, to redesign the merchandise to make it further maintainable .In terms of the "remanufacture", it includes the reusing of a previously used product, restoring it to initial state through https://quillbot.com/the recycling of as many parts as likely without loss of operation .
- Many efforts have been made to develop models for implementing sustainability in the manufacturing industry.
- New manufacturing technologies are also contributing to achieving reliable, sustainable processes. Additive forming technologies can be used as an example of manufacturing processes that, for many years, have been used only for rapid prototyping.



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- The accurate identification of these opportunities paves the road for establishing a sustainable smart manufacturing (SSM) approach for different manufacturing industries;The challenges facing the current industries to establish the SSM approach.

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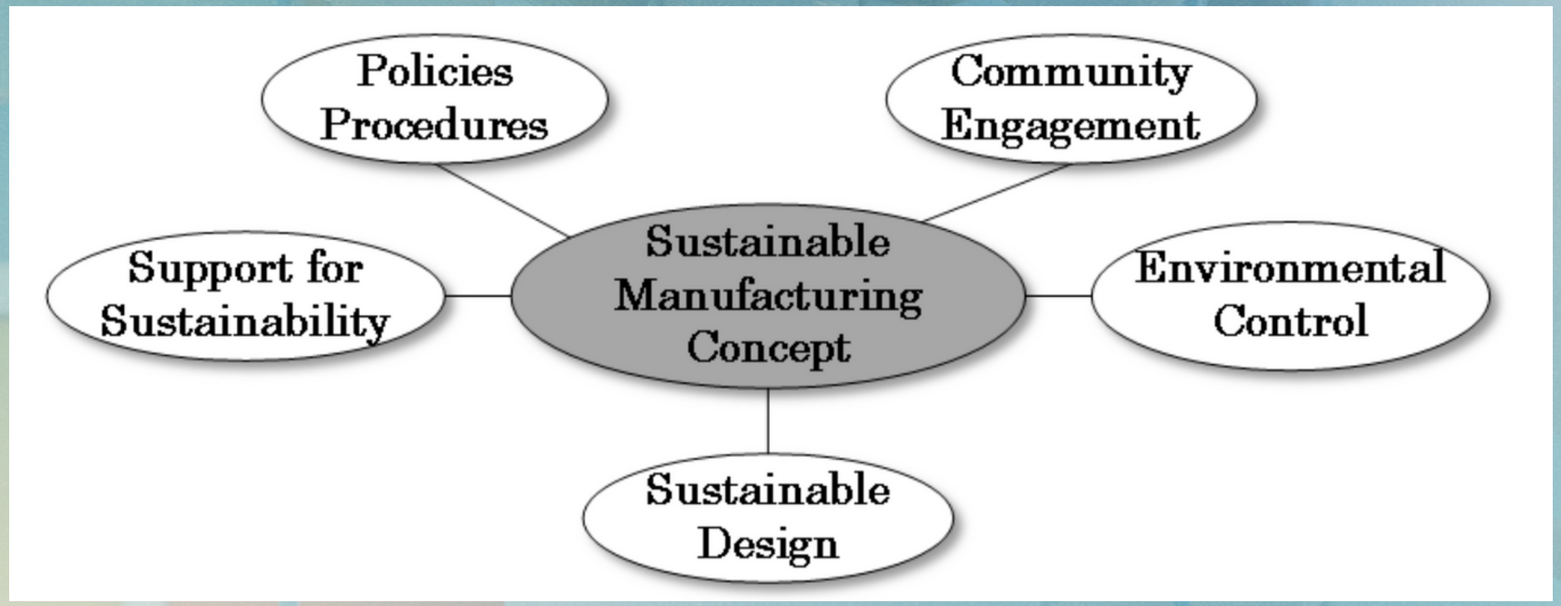
COMBINED LIFE CYCLE SUSTAINABILITY ASSESSMENT



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SUSTAINABLE MANUFACTURING CONCEPTS: KEYS AND ASPECTS

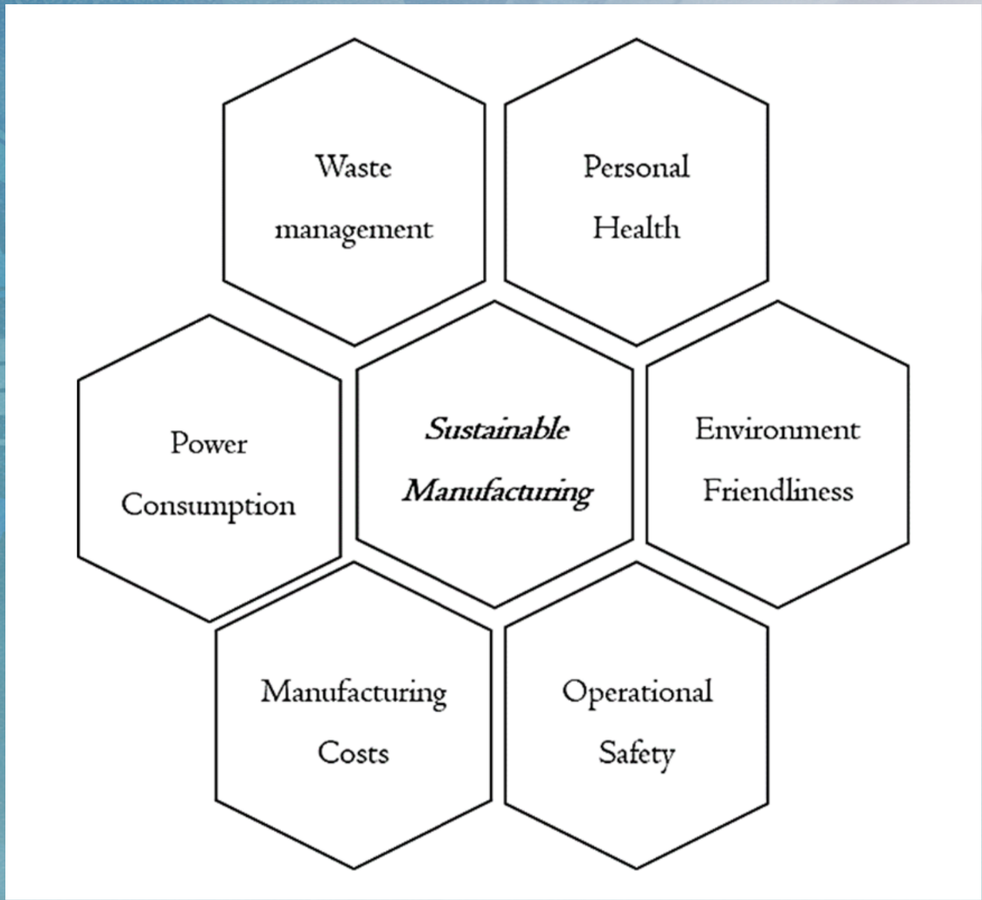
As shown in Figure 1, design, engagement, control, and support are the primary elements for establishing such a concept. Therefore, the challenge in the sustainability assessment is all about finding indicators that can provide an accurate representation of these elements.



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SUSTAINABLE MANUFACTURING ASPECTS.

The opportunities for applying the sustainable manufacturing approach can be reflected in different aspects. These aspects include energy consumption, costs, waste management, environmental impact, health, and safety, as can be seen in Figure 3 .



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THE INTERACTIONAL CONCEPT BETWEEN SOCIAL, ECONOMIC, AND ENVIRONMENTAL DIRECTIONS.

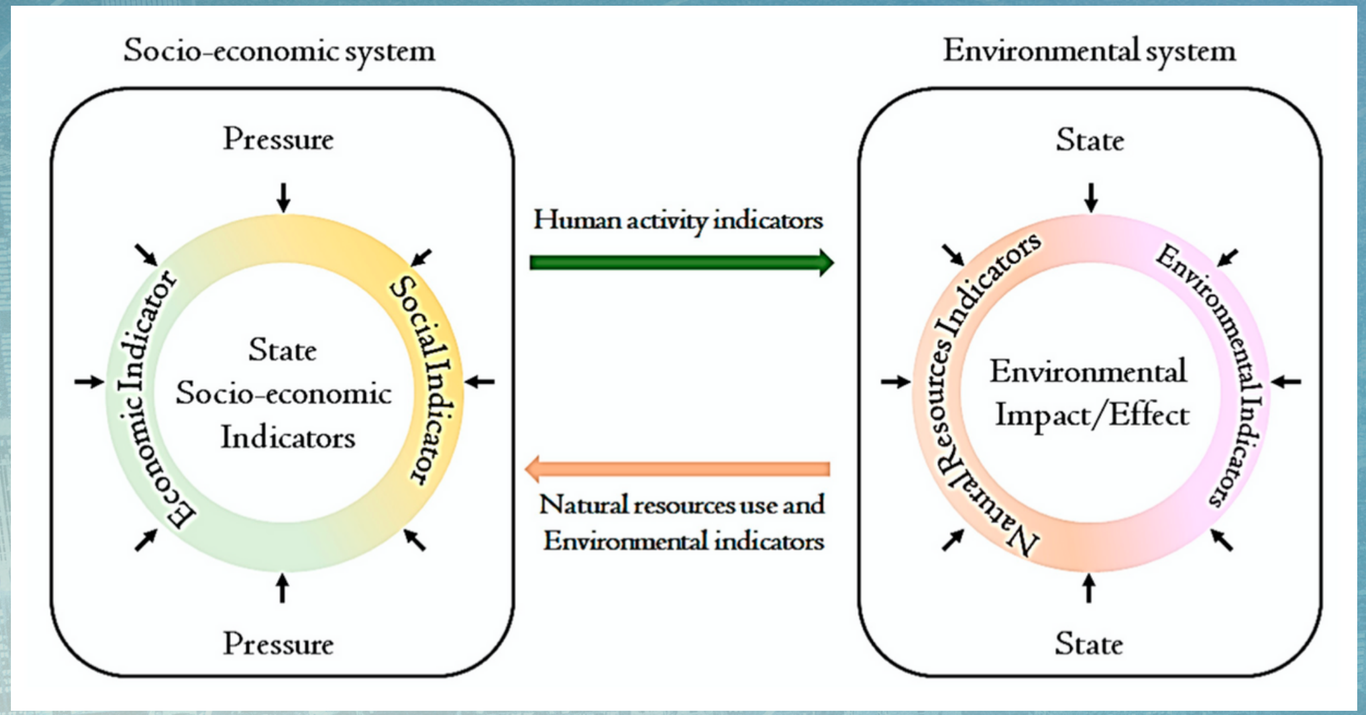


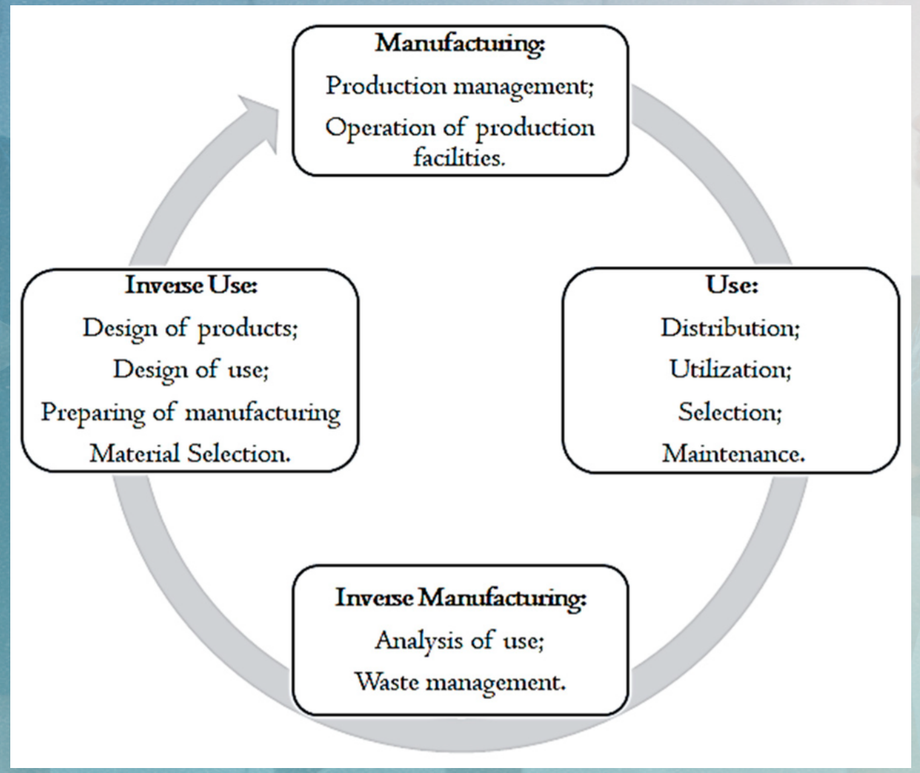
Figure illustrates social, economic, and ecological interactions. The socio-economic system is pressured by society to continuously improveological directions. Society pushes the socio-economic system to improve. However, the community needs to understand how its activities can affect the environmental system. Thus, state rules are fulfilled while minimizing environmental effect. This kind of cooperation may enable tremendous sustainable industrial progress.

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ELEMENTS OF “DESIGN FOR SUSTAINABLE MANUFACTURING” CONCEPT

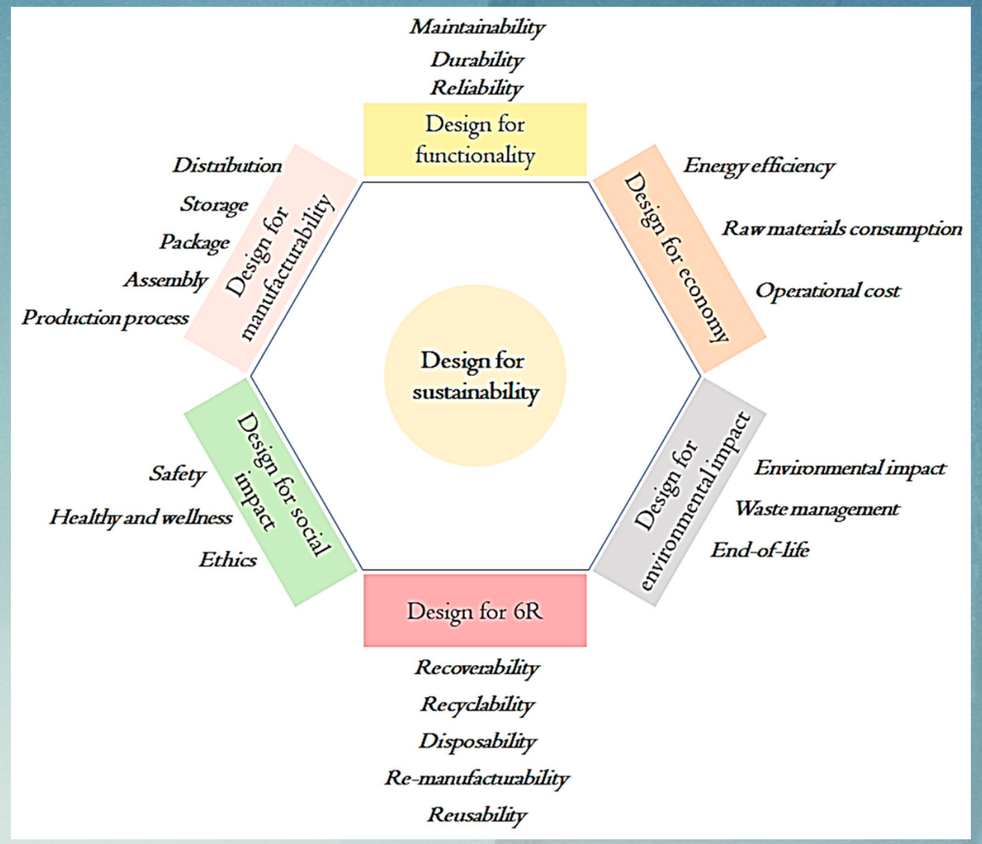
Figure shows a schematic to represent the concept of “design for sustainable manufacturing”.

It should be clarified that the “sustainable manufacturing” concept cannot be realized by focusing solely on the “design for sustainable manufacturing” direction. Thus, constructing an integrated sustainable system that covers the process, product, and system levels are required. The system should include different directions such as design for functionality, design for environmental impact, design for “6R”, design for continuous improvement, design for social impact, and design for the economy.



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DESIGN FOR THE INTEGRATED SUSTAINABLE SYSTEM



Schematic of integrated sustainability in Figure . The proper implementation of such an integrated approach can lead to and accomplish various benefits, for example, reducing energy consumption, developing new and renewable resources, eliminating toxic and severe health issues, improving the durability of products, achieving an effective waste management system, and improving the overall quality of the process. However, a reliable guideline should be defined to implement and design the integrated system in Figure 6. To reach the goal, steps are outlined. These steps include developing smart work practices, improving process optimization capabilities, offering new technologies, and focusing on the "design for sustainable production" approach.

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