Designing the Future: Lean and Circular Strategies for Next-Gen Supply Chains

Neelima Singh
Mechanical Department, National Institute of Technology, Raipur, Chhattisgarh, India

Dr. Suraj Kumar Mukti
Mechanical Department, National Institute of Technology, Raipur, Chhattisgarh, India

Abstract

The traditional linear "take-make-waste" model of production and consumption has led to unsustainable levels of resource depletion, environmental degradation, and waste generation. As industries face increasing pressure to adopt more sustainable practices, the concept of circular supply chains has emerged as a promising solution. By emphasizing resource recovery, reuse, remanufacturing, and closed-loop systems, circular supply chains aim to maximize resource efficiency and minimize environmental impact. This paper explores the integration of Lean principles originally developed to reduce waste and enhance process efficiency, with circular supply chain strategies to create a synergistic approach to sustainability. The literature review covers both international and national contexts. It also contains impacts of the circular supply chain, lean principles and digitalization. Lean methodologies, including just-in-time production, value stream mapping, and continuous improvement, provide a strong operational foundation to support circularity. Additionally, the adoption of digital technologies such as the Internet of Things (IoT), artificial intelligence (AI), blockchain, and digital twins enables real-time visibility, predictive analytics, traceability, and lifecycle optimization within circular supply networks. This paper presents a conceptual framework that combines Lean principles. The "Lean and Green" approach to circular supply chains (CSCs), therefore, involves applying the principles of lean management to the processes of a circular economy. A circular economy aims to keep resources in use for as long as possible by designing out waste and pollution, keeping products and materials in circulation, and regenerating natural systems. This framework focuses on three core pillars, each with specific objectives and practical applications. First Pillar deals with Designing for Circularity and Efficiency (Upstream), second pillar Optimizing the Supply Chain Network (Operational), and third Pillar contains Measuring and Continuous Improvement (Managerial).

Keywords

Digitalization, Lean principles CSC, Lean and Green framework, Muda, Waste Management.