

## THE BENEFITS OF INTEGRATION OF CIRCULAR ECONOMY IN SUPPLY CHAIN MANAGEMENT

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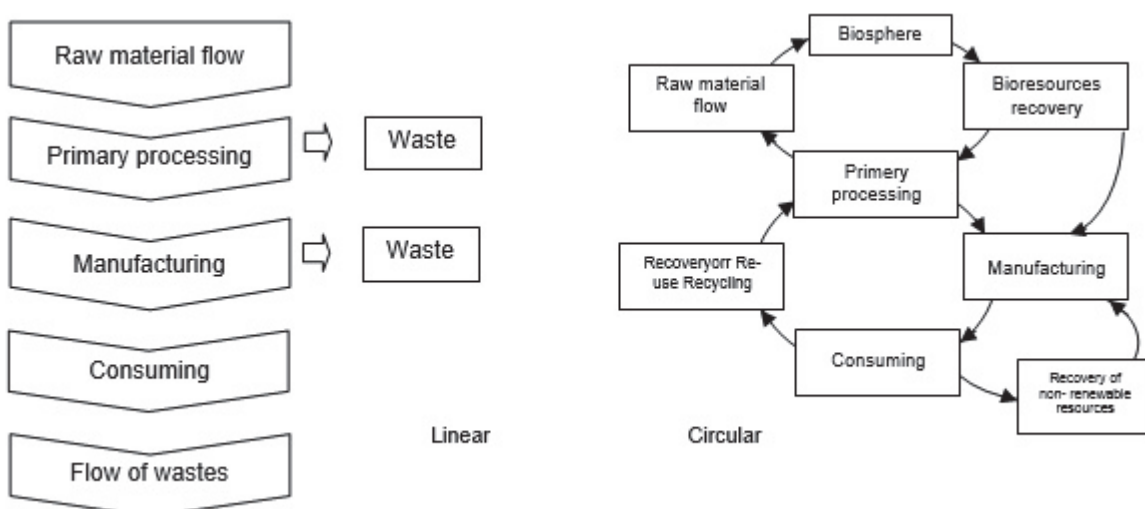
### Abstract

This paper presents importance and the benefits of integration of circular economy in supply chain management. The main aim of the paper is to implicate of circular economy principles across the supply chain. It was shown the overview of the current status of circular model for a new perspective in supply chain management. Sustainable supply chain management has become a strategic process enabling organizations to create competitive advantage. Cradle-to-cradle approach and holistic view at the supply chain is a fundamental step for establishing more sustainable production systems. The circular economy is designed as a circular model for a new perspective of the linkage between resource flow and economic issues in contrast to the existing open-ended models of classic production processes.

**Keywords:** Circular economy, sustainable supply chain management, life cycle management

### 1. INTRODUCTION

The circular supply chain is opposite of a linear supply chain. The linear model is still dominant in the most industries. A circular model refers to a supply chain restorative by nature. In the linear supply chain, raw materials are extracted and manufactured into end products which are, landfills or incineration plants at the end of life stage [1]. The linear concept is based on the premise of take, make and use, which generates waste that must be disposed. The circular model is optimising system. Three major trends support the shift towards adopting a circular economy: a new era of resource scarcity, a new age of innovation as seen by clean technology advancements in the energy sector, and the emergence of a bio-age to replace the oil age [2]. Difference between linear system and circular economy are shown in **Fig. 1**.



**Fig. 1** Difference between linear system and circular economy

## 2. IMPORTANCE OF A CIRCULAR ECONOMY

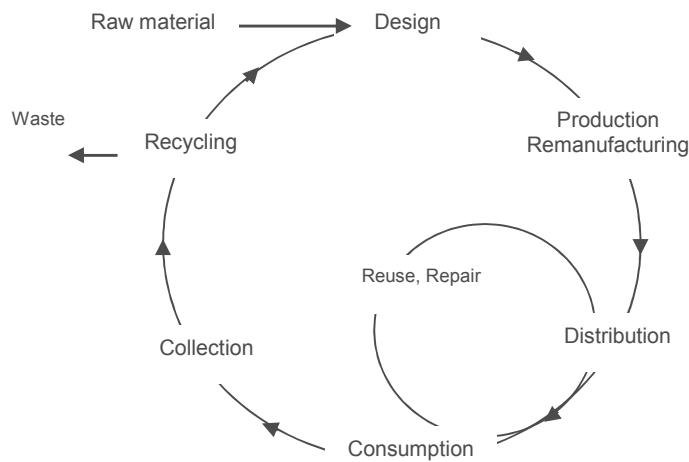
The Circular Economy (CE) was first mentioned in 1990 by Pearce and Turner [3]. According to Pearce and Turner the CE is model for a new innovative perspective of the linkage between economic issues and resource flow in contrast to the open-ended models (linear concept) of classic production processes. The principles of the model of CE are connected with industrial ecology [4]. Industrial ecology is multidisciplinary discourse seeks to understand emergent behavior of complex integrated human and natural systems and focuses on the residual waste recycling in the life cycle [5, 6]. The circular economy [3] represents a model with life cycle approach that focuses on waste recycling in the product life cycle, distinguishes between durable and consumable products, and indicates that the energy required for economy cycle should be from renewable resources [7]. Schrödl and Simkin presented the circular economy (CE) into an economic system and its importance in develop of supply chain management [8]. The Ellen MacArthur Foundation commissioned a report called "Towards the Circular Economy". It was the first report, which consider the economic, business and organization opportunity for the transition from linear to a circular economy concept [9] The circular economy is based on the industrial ecology, the biomimicry and cradle to cradle.

The CE framework is associated with eco-effectiveness concept. Eco-effectiveness and eco-efficiency importance in management of supply chain was shown by Burchart-Korol et al. (2012) [10]. Eco-efficiency integrates economic analysis with environmental considerations to improve sustainability of products in life cycle [11]. Eco-effectiveness is the newest concept connected with Cradle to Cradle (C2C) model. Eco-effectiveness is an innovation concept used in order to design products which are beneficial in environmental, economic and health terms [10]. A circular economy is a core of sustainable growth [12, 13]. Higher improvements of efficiency performance of resource could give main economic benefits. Circular economy systems eliminate waste and bring added value in supply chain management. Transition from linear model to circular economy model requires changes of value chains and business and market models. This requires whole systemic changes in products, organisation, technologies, society and policies.

The high-level European Resource Efficiency Platform [14], suggest transition to circular economy, which relies more on high quality recycling and much less on raw materials. According to the Roadmap to a Resource Efficient Europe in 2011 [13] waste prevention, ecodesign and reuse could bring savings for businesses in the European Union, and reducing emissions of greenhouse gases. Reverse logistics enables the realization of the idea of a circular economy, which is a departure from the linear model of raw material flow, to a model of closed material-energy cycles [14].

## 3. THE FRAMEWORK AND PRINCIPLES OF CIRCULAR ECONOMY

The conceptual model (see Figure 2) shows the main stages of a circular economy model. The CE framework contain many opportunities and challenges to reduce costs and limit harmful emissions to the environment and waste.

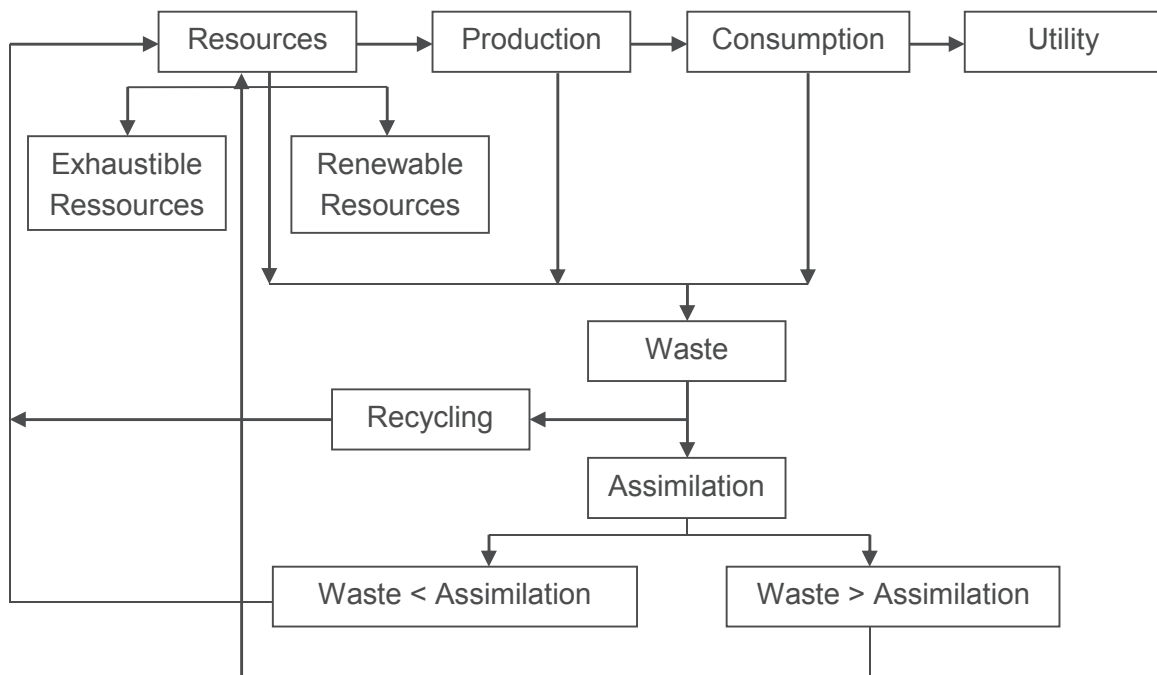


**Fig. 2** Stages of circular economy

To ensure the alignment of all activities, a shift is made from the view of a consumer of a product towards the view of the user for a product. This means that, in Circular Economy, products are not sold to a customer, but users use products on a leased, rented, or shared basis whenever possible. A circular economy is based on a few simple principles [9]:

- A circular economy aims to design out waste. Waste does not exist: products are designed and optimized for a cycle of disassembly and reuse. These tight component and product cycles define the circular economy and set it apart from disposal and even recycling, where large amounts of embedded energy and labour are lost.
- Circularity introduces a strict differentiation between consumable and durable components of a product. Unlike today, consumables in the circular economy are largely made of biological ingredients or ‘nutrients’ that are at least non-toxic and possibly even beneficial, and can safely be returned to the biosphere, either directly or in a cascade of consecutive uses. Durables such as engines or computers, on the other hand, are made of technical nutrients unsuitable for the biosphere, such as metals and most plastics. These are designed from the start for reuse, and products subject to rapid technological advance are designed for upgrade.
- The energy required to fuel this cycle should be renewable by nature, again to decrease resource dependence and increase systems resilience. For technical nutrients, the circular economy largely replaces the concept of a consumer with that of a user. This calls for a new contract between businesses and their customers based on product performance.

Pearce and Turner [3] proposed a conceptual model for the Circular Economy which is shown in Figure 3.



**Fig. 3** Conceptual model for the Circular Economy [3]

A circular economy is an industrial restorative or regenerative system. The CE model replaces the end-of-life concept with restoration, shifts towards the use of renewable energy, which impair reuse and return to the biosphere, and aims for the elimination of waste through the superior design of products and business models [16].

#### 4. INNOVATION IN A CIRCULAR ECONOMY

Circular economy approaches involve innovation throughout the value chain and whole life cycle design. Innovation in a circular economy can include such elements as:

- lightweighting - reducing the quantity of raw materials
- durability - lengthening products' useful life
- efficiency - reducing the use of materials/energy in all stages of life cycle
- substitution - reducing the use of raw materials that are hazardous or difficult to recycle in products and processes, creating markets for secondary raw materials (recyclates)
- ecodesign - designing products that are easier to maintain, upgrade, repair, remanufacture or recycle
- maintenance - developing the necessary services for clients in the regard incentivizing and supporting waste reduction and high-quality separation by consumers, incentivizing separation, collection systems that minimise the costs of recycling, and reuse
- industrial symbiosis - facilitating the clustering of activities to prevent by-products from becoming wastes, and encouraging wider and better consumer choice

Business and consumers remain the key actors in the transition to a more circular economy. The European Resource Efficiency Platform has identified [17] significant opportunities for business and consumers at different stages in the “loop” feeding materials back into the production process or various segments of the supply chain. The opportunities include:

- in the production stage:
  - sustainable sourcing standards
  - industrial symbiosis to provide markets for by-products
  - voluntary schemes led by industry and retailers
- in the distribution stage:
  - to develop information how the resources can be repaired or recycled
  - improving information on the resources contained in products
- in the consumption stage:
  - collaborative consumption models based on swapping products and service systems to get more value out of underutilized resources or assets

## 5. CONCLUSION

The circular economy has new opportunities for business management of goods and services. In this paper new perspectives of circular economy development in supply chain management were presented. This paper concluded that circular economy model has significant potential for improving efficiency in supply chain. The important priorities of waste management in circular economy are waste prevention, critical raw materials recycling and energy from renewable resources. Further research will be focused on development circular economy model for improving sustainable supply chain.

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