

**Session 3.04.** Circular Economy and Sustainable Operations  
and Supply Chain Management  
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# **THE ROLE OF R-STRATEGIES FOR CIRCULAR SUPPLY CHAINS - A SYSTEMATIC LITERATURE REVIEW**

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## THE ROLE OF R-STRATEGIES FOR CIRCULAR SUPPLY CHAINS – A SYSTEMATIC LITERATURE REVIEW

**Abstract:** Circular Economy discusses the replacement of the end-of-life strategy with a closed loop material flow, minimizing raw material consumption by extending the life cycle of materials. Since this approach is expanding from individual organizational actions to supply chain level policies, our objective is to conduct a systematic literature review that presents the role of circular strategies in the development of circular supply chains. This paper contributes to theory and practice by presenting a clear definition of each R Strategy; discussing their role to the development of circular SCs; and identifying how SC actors are involved in the R processes.

**Keywords:** Circular Supply Chain, R-strategies, Circularity framework

# Agenda

**01** Introduction

**02** Theoretical background

**03** Research Method

**04** Results

**05** Main findings

**06** Circular Supply Chain Framework

**07** Conclusions

**08** Future research agenda

# 1. Introduction – SoTecIn Factory

## *Social and Technological Innovation Factory for Low-Carbon and Circular Industrial Value Chains*

- Develop a collaborative environment aimed at connecting industry with society in a community of mission-oriented social innovators;
- Support social entrepreneurs in their drive to increase the circularity of industrial product value chains, and to promote a culture of social innovation in European manufacturing businesses.

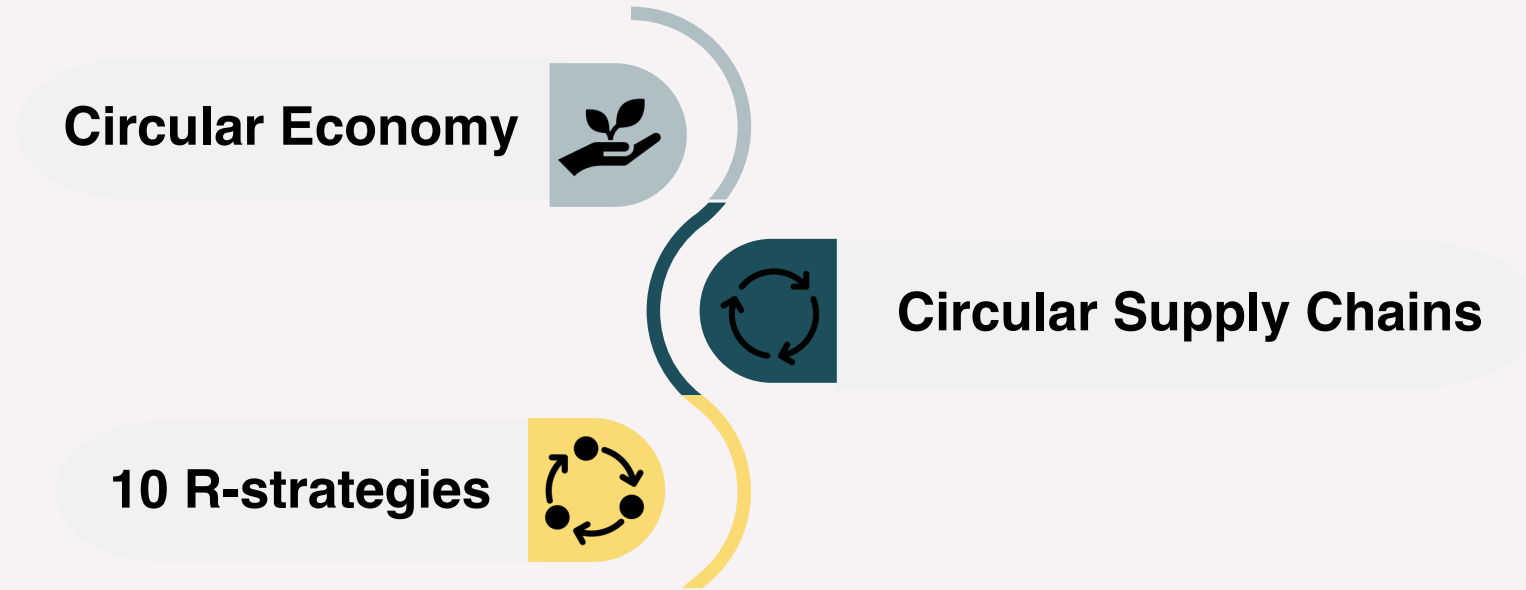
### Target value chains



# 1. Introduction

- Debate about sustainability: from individual organizational actions to **supply chain (SC) policies**;
- **Circular economy (CE)**: model to replace End-of-Life strategy with a closed-loop material flow, which can be achieved through the adoption of the **R-strategies**;
- Lack of consensus regarding the implementation of the R-strategies across the SC;
- **Research question:** *What is the role of each "R" strategy in the development of circular supply chains?*
- Our **systematic literature review** has 3 main objectives:
  - (i) systematize how the R-strategies are being used in different SCs;
  - (ii) develop a circular supply chain framework;
  - (iii) provide directions for future research.

## 2. Theoretical background



## 2. Theoretical background

### Circular Economy



- Alternative model to replace the unsustainability of the current linear economic model;
- Aims to minimize waste through the development of closed-loop systems (Farooque et al., 2019);
- The management of materials in **closed loops** allows the product's return, reuse, refurbishment, remanufacture or recycle (de Angelis et al., 2018).

- Application of CE principles across SC's operations and processes: **Circular Supply Chains** (de Angelis et al., 2018).
- Importance of **collaboration** amongst SC actors and stakeholders, from suppliers to consumers (de Angelis et al., 2018; Farooque et al., 2019)
- The configuration of a CSC implies the implementation of a set of CE strategies, namely the **R-strategies** (de Lima et al., 2021; Geissdoerfer et al., 2017; Kirchherr et al., 2017).



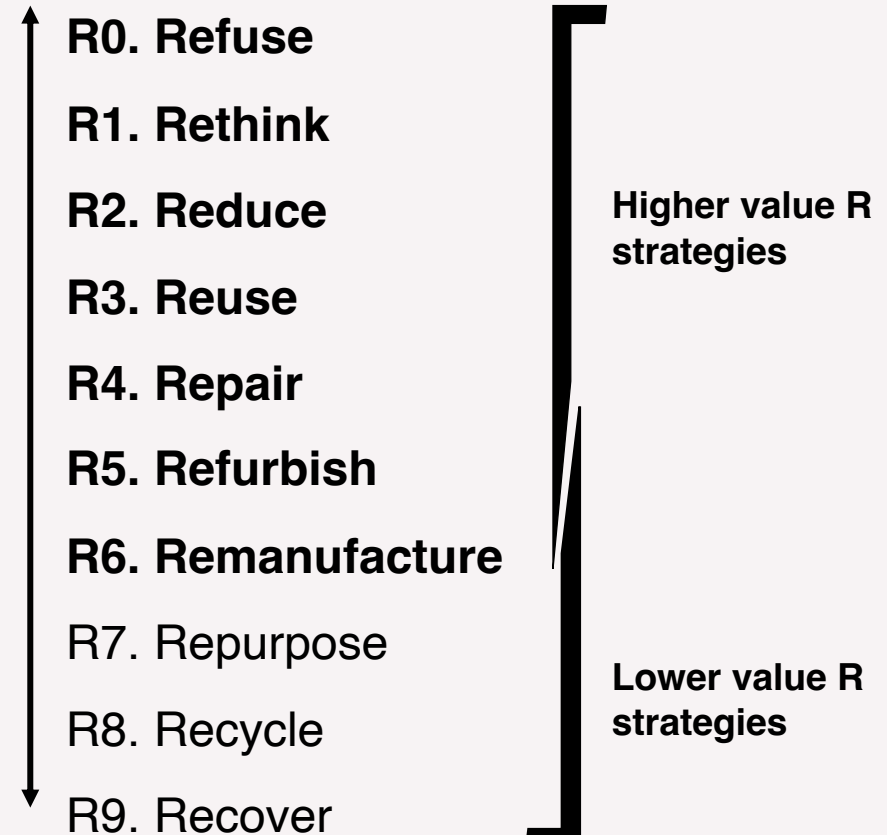
### Circular Supply Chains

## 2. Theoretical background

### 10 R-strategies



- Strategies to help achieve and increase circularity along the SC;
- 10 Rs Framework: from R0 to R9 (according to their level of circularity and priority in a CE);
- **Higher value R strategies:** retain and prolong the economic and material value of the product, requiring fewer resources during production.



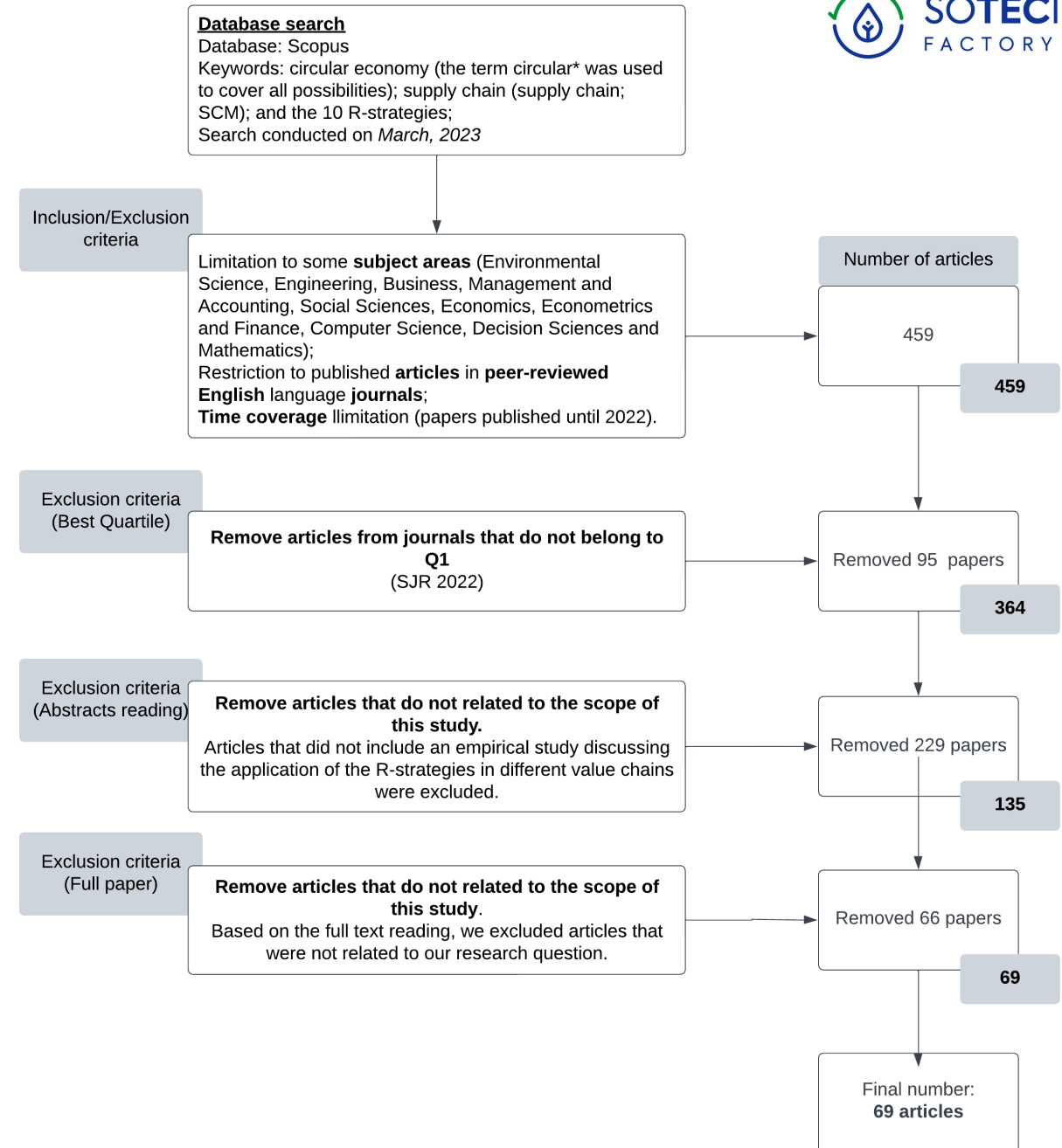
(Potting et al., 2017)



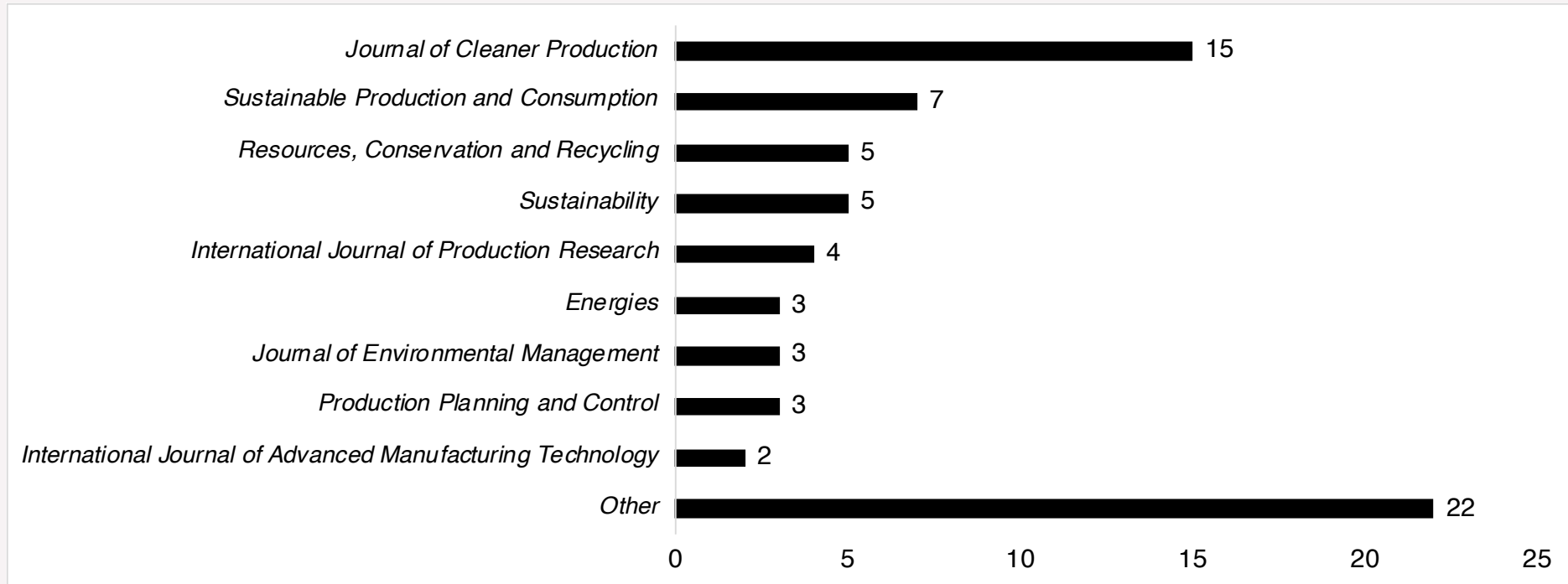
### 3. Research Method

Systematic Literature Review method, following the **five steps** proposed by Denyer and Tranfield (2009):

- (i) definition of the research question;
- (ii) location of studies;
- (iii) selection and evaluation of studies;
- (iv) analysis and synthesis;
- (v) presentation of results.

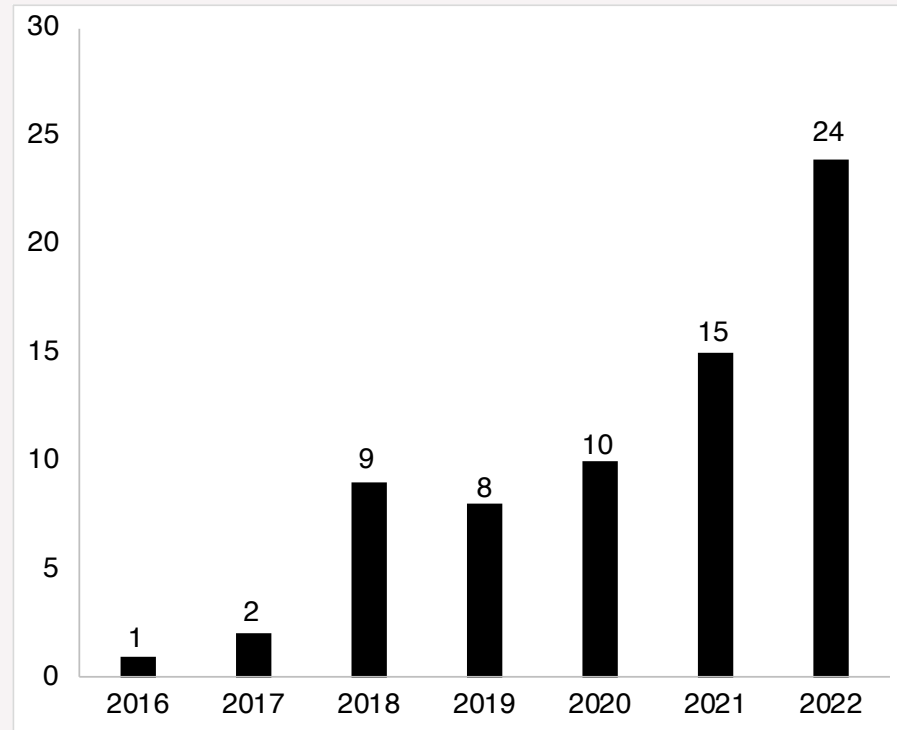


## 4. Results



*Distribution of reviewed papers by journal*

## 4. Results



*Historical publication trend by year*

## 4. Results

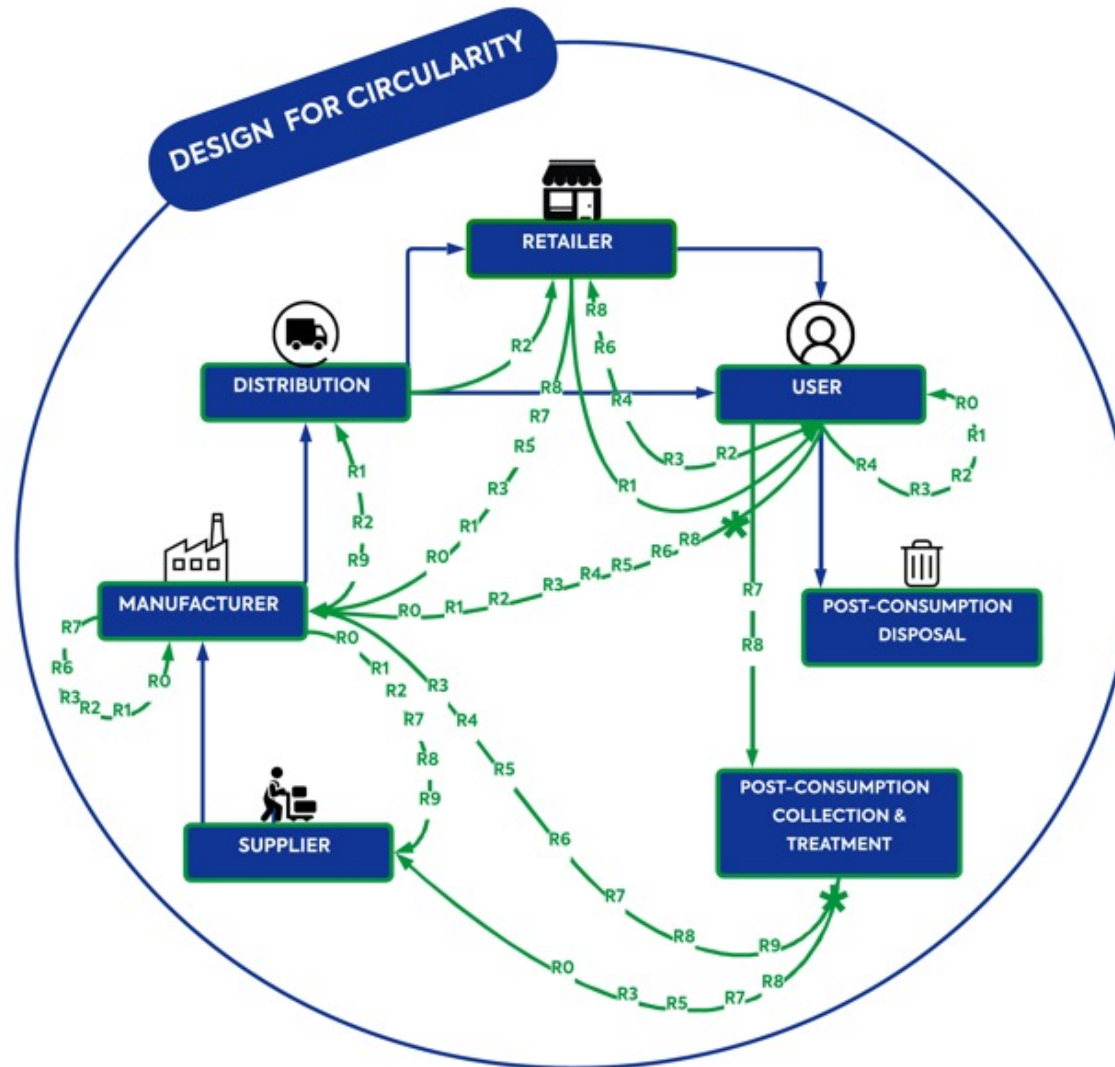
### *Top 5 most cited papers in our review*

<b>Authors</b>	<b>Titles</b>	<b>Journal title</b>	<b>Total Global Citation</b>
Ranta et al. (2018)	Creating value in the circular economy: A structured multiple-case analysis of business models	Journal of Cleaner Production	129
Ghisellini and Ulgiati (2020)	Circular economy transition in Italy. Achievements, perspectives and constraints	Journal of Cleaner Production	124
Goyal et al. (2018)	Circular economy business models in developing economies: Lessons from India on reduce, recycle, and reuse paradigms	Thunderbird International Business Review	113
Hahladakis and Iacovidou (2019)	An overview of the challenges and trade-offs in closing the loop of post-consumer plastic waste (PCPW): Focus on recycling	Journal of Hazardous Materials	112
Yang et al. (2018)	Product-service systems business models for circular supply chains	Production Planning and Control	98

## 5. Main findings

- The role of R-strategies for CSCs is currently being discussed in **several industries** (agri-food, manufacturing, automotive, consumer electronics, packaging, construction);
- More than one R-strategy is discussed in one article, with **recycling** being the most used R-strategy across industries (mentioned a total of 55 times);
- The importance of considering all R-strategies during **design phase**;
- **Digital technologies** are crucial to unveil the full potential of circular SC models (e.g. traceability) and they also help to rethink business models;
- There are some **barriers** to the implementation of circular strategies: uncertainties, technical issues, regulation, costs, culture and workforce qualification;
- The importance of the **interrelationships** and **collaborations** between SC actors (downstream and upstream), which also stresses **Industrial Symbiosis** as one important aspect of CSCs.

# 6. Circular Supply Chain Framework



### 10 R-strategies

- R0 - Refuse
- R1 - Rethink
- R2 - Reduce
- R3 - Reuse
- R4 - Repair
- R5 - Refurbish
- R6 - Remanufacture
- R7 - Repurpose
- R8 - Recycle
- R9 - Recover

- > Flow of information in a circular value chain
- > Flow of materials and information in a circular value chain
- > Flow of materials and information in a linear value chain

\* Depending on the supply chain, these linkages might imply the existence of a platform, a treatment center, or a third party acting as a bridge to deal with the return/ collection process.

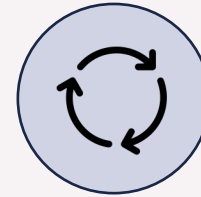
## 7. Conclusions

- There are **different possible circular pathways** when adopting a specific (or several) R-strategies, that imply the establishment of **linkages between the different SC actors**;
- The importance of the role played by **post-consumption and disposal** is stressed by some authors, as this stage allows waste to regain value (recycle, repurpose or for *2nd life applications*);
- **Industrial Symbiosis**, especially related to recycling and repurposing, plays a key role, for instance in the use of end-of-life electric vehicle batteries as energy storage for solar power in households (Alamerew & Brissaud, 2020; Glöser-Chahoud et al., 2021; Olsson et al., 2018); application of food by-products into an input for the construction industry (Bonato et al., 2022; Formentini et al., 2022; La Scalia et al., 2021).

## 8. Future research agenda



Examine the key role played by **collaboration** amongst SC partners and multiple stakeholders to ensure the effective **implementation** of the R-strategies in CSCs.



Explore the impact of **consumer behavior** on the adoption of CE practices, analyzing the active role that customers play in CSCs.



Investigate the role of **Circular Business Models** to enable the transition towards circularity, through the implementation of the R-strategies, together with **industry 4.0**.



Focus on the **social impacts** and benefits of implementing R-strategies across the SC, going beyond the environmental and economic perspective.





**SOTECIN**  
FACTORY

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# Thank you!

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