

# ECO-EFFICIENCY AND SUSTAINABILITY INDICATORS OF THE CIRCULAR SUPPLY CHAINS

ÉCONOMIE CIRCULAIRE ET INDUSTRIE DU FUTUR  
SÉMINAIRE SCIENTIFIQUE

Maria Victoria Hernandez Marquina

Research supervisors:

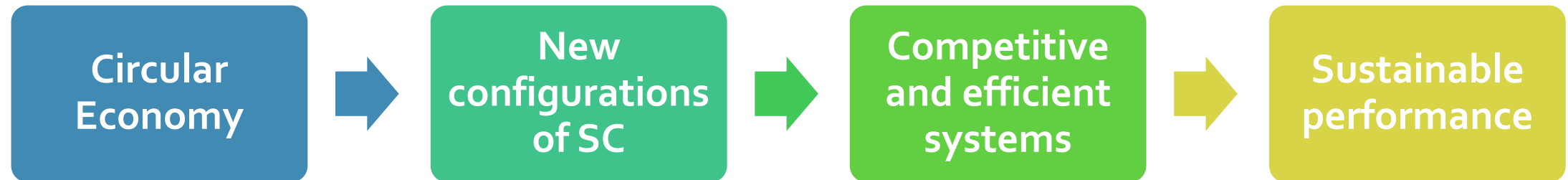
Marie-Anne Le Dain , Iragaël Joly and Peggy Zwolinski

July 5th 2021

# Summary

1. Introduction
2. Research activities
  - Challenges, objectives and contribution
  - Literature review
  - Research model
3. References

# Introduction



# Research Activities

## Objectives

Propose a sustainable performance measurement of CSC

Identify the factors that can influence the sustainable performance of CSC

## Contribution

Support actors in their decision-making processes and the public policy design.

## Challenges

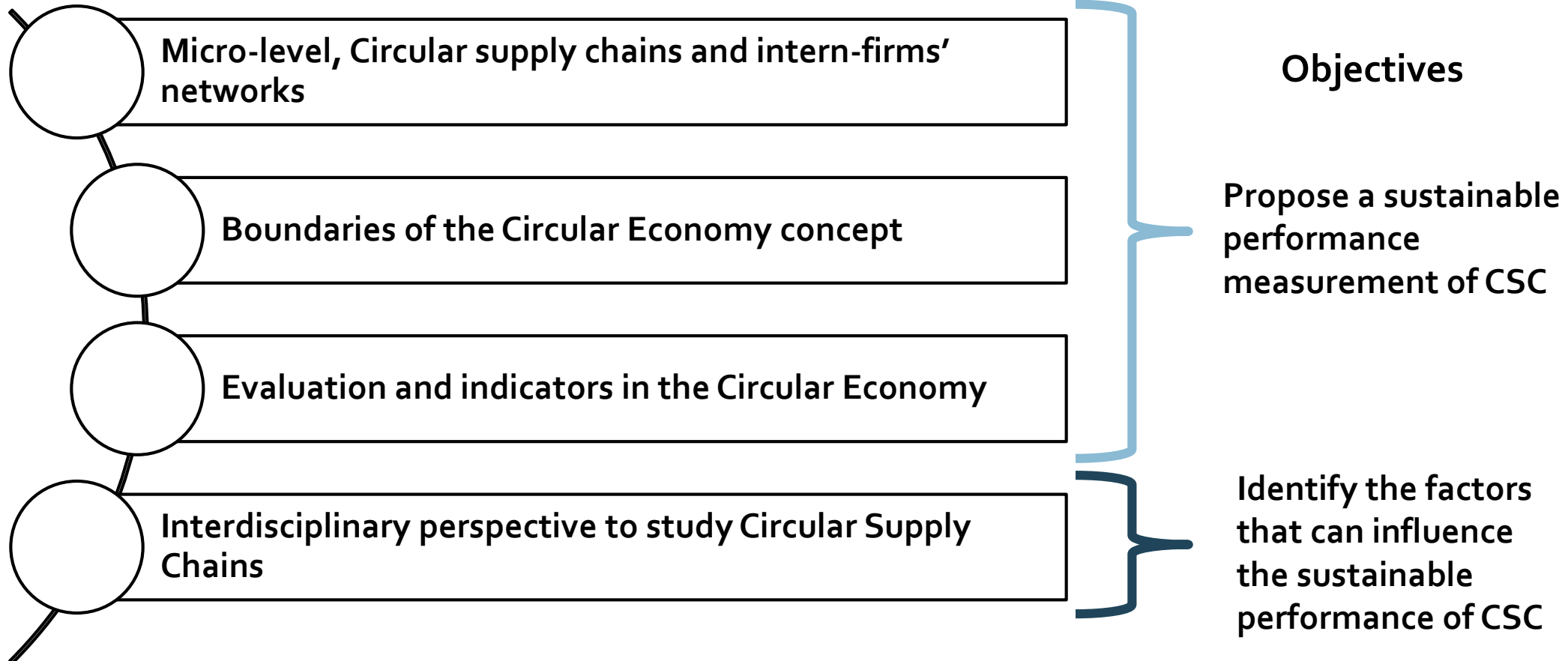
Broad concept of circular economy and sustainability.

Limited success factors in the implementation of the circular economy and sustainability.

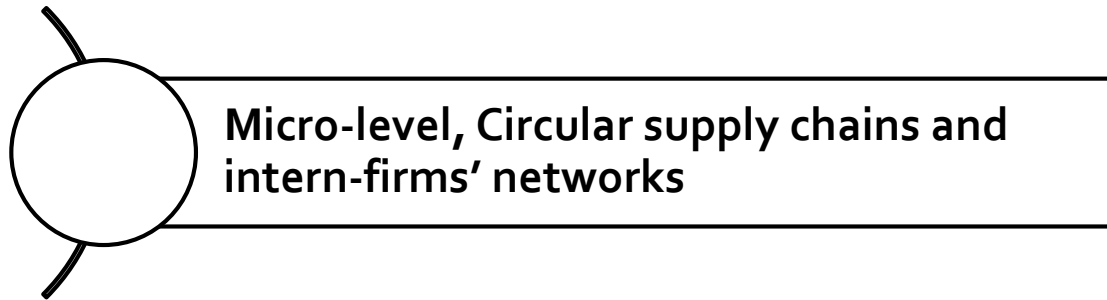
Integration of practitioners and experts in circular supply chains.

# Research Activities

## Literature review



# Research Activities



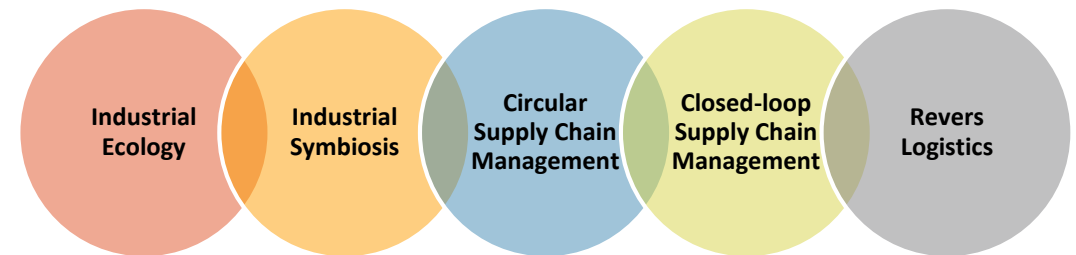
## Circular inter-firm networks

Actors that are connected through open and/or closed supply chains which are de facto circular.

### Micro level



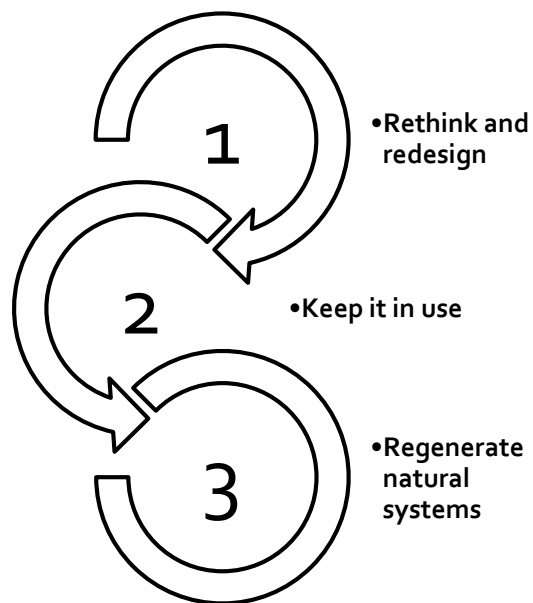
(Lindgreen et al., 2020)



(Walker et al., 2021)

# Research Activities

## Boundaries of the Circular Economy concept



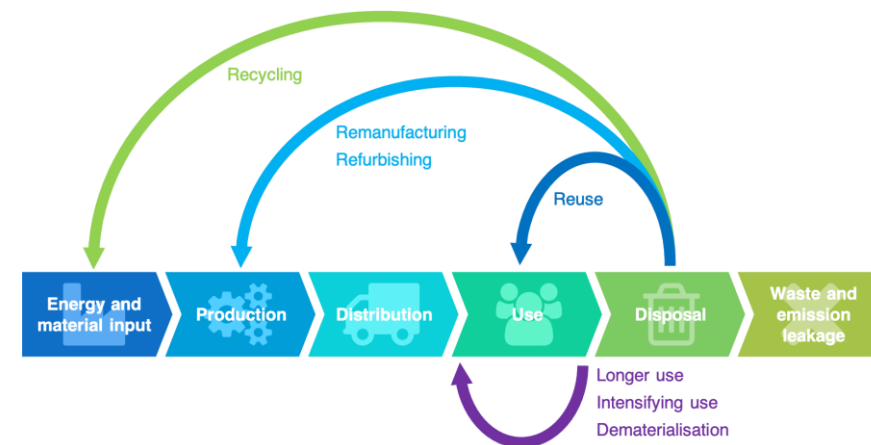
EMF-Ellen MacArthur Foundation, 2013

## ÉCONOMIE CIRCULAIRE 3 domaines, 7 piliers



ADEME, 2014

## R-Principles



(Saidani et al., 2019), (Corona et al., 2019), (Brissaud & Zwolinski, 2017), (Edtmayr et al., 2016), (Uçar et al., 2019), (Pires Do Carmo Neta et al., 2020)

# Research Activities

## Objective 1:

Propose a sustainable performance measurement of CSC

## Proposal for the integration of the principles of circular economy and CSC

H1: The type of R principle on which a circular model is based influences the number of actors and their rolls.

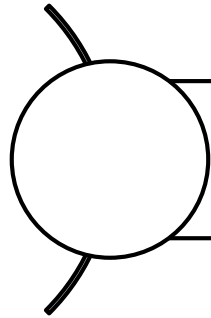
H2: The type of R-principle on which the circular model is based affects the way in which supply chain performance is perceived.

		R-Principle		
		<b>Refuse, Rethink, Reduce</b>		
		(Ellen MacArthur Foundation, 2013)		
		(ADEME, 2014)		
Development of more sustainable product	Stage 0. Design of the product - system	Resell/ Reuse [1] [2] [3]		Repurpose [1] [3]
		Repair [1] [3]		Repair
Extension of lifespan of the products, modules, components (closed and open loops)	Stage 1. Product – system exist and it can be split in modules or components	Refurbishment [1]		
		Remanufacture [1] [3]		
Waste management (closed and open loops)	Stage 2. The product- system it can't be use anymore but it can be transformed in raw materials	Recycle [1] [2] [3]	Recycle	Recycle [1] [2] [3]
				Recover [1][3]
		<b>Original function</b>	<b>Upgrade – Original function</b>	<b>Different function</b>

(Uçar, Ece, Le Dain, Marie-Anne, Joly, 2019)



# Research Activities



Evaluation and indicators in the Circular Economy

**Great diversity**

(Lindgreen et al., 2020) (Corona et al., 2019) (Walker et al., 2021). (Kristensen & Mosgaard, 2020).

**Partial and total sustainable measurements**

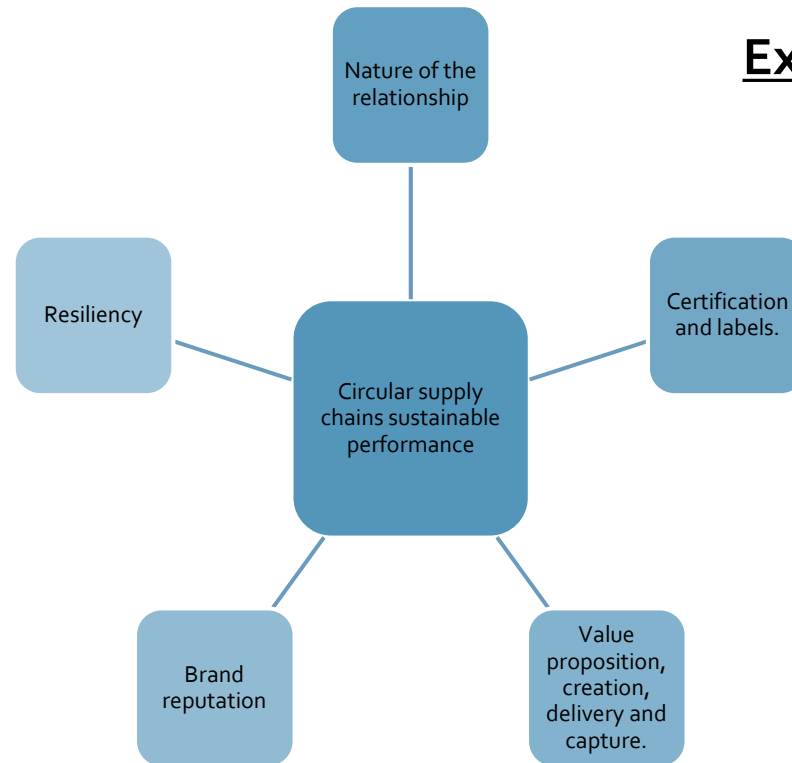
(Kristensen & Mosgaard, 2020) (Corona et al., 2019).

**link to already existing methods, tools and theories**

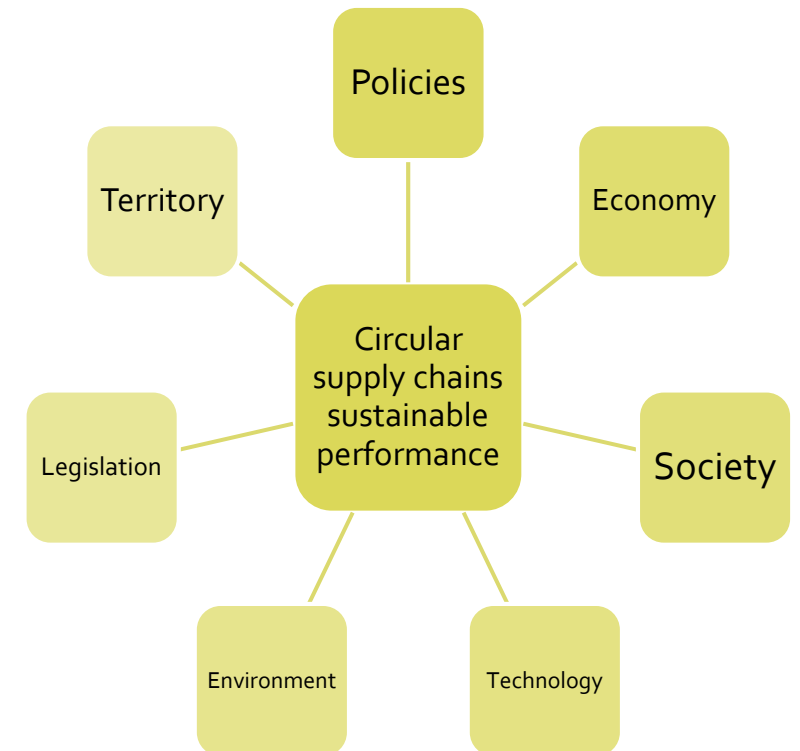
(Lindgreen et al., 2020) (Corona et al., 2019) (Walker et al., 2021). (Rossi et al., 2020) (Uçar, Ece; Le Dain, Marie-Anne; Joly, 2019) (Nußholz, 2018) (Saidani et al., 2019).

# Research Activities

## Internal environment



## External environment



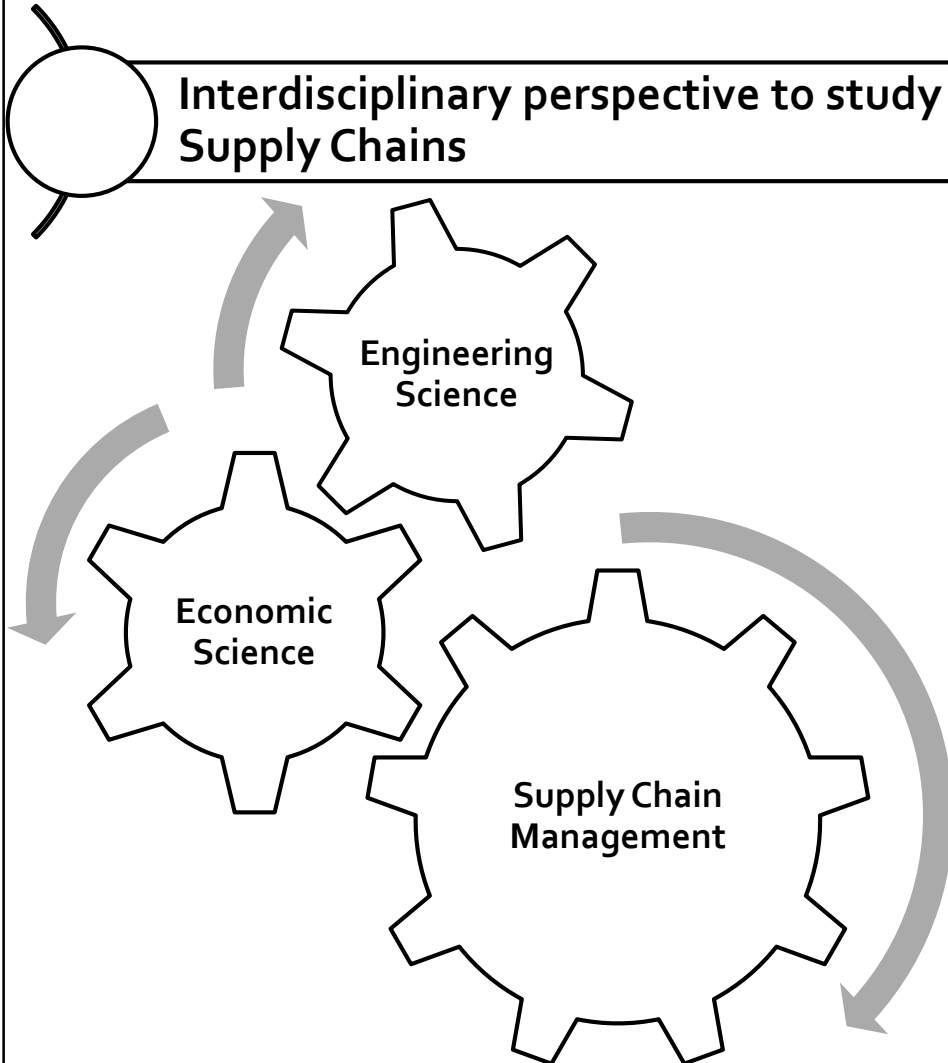
### Objective 2:

Identify the factors that can influence the sustainable performance of CSC

(Masi et al., 2017) (Scheepens et al., 2016). (Saidani et al., 2019) (B. Wang et al., 2020).

# Research Activities

Interdisciplinary perspective to study Circular Supply Chains



## Internal environment

### Relationship and interactions of stakeholders

#### Social Exchange Theory

(Wu et al., 2014)  
 (Santos Dalenogare et al., n.d.)  
 (Y. Wang et al., 2019)  
 (Junjun et al., 2018)

#### Network economy

(Carvalho & Tahbaz-Salehi, 2019)  
 (Graham, 2019)

#### Sharing economy

(Y. Wang et al., 2019)

### Business model and value proposition

#### Canvas Business Model

(Lindgreen et al., 2020)  
 (Corona et al., 2019)  
 (Walker et al., 2021)

#### Functional economy

(ADEME, 2014)

## Engineering

### Eco-design

(Orée, 2015)  
 (ADEME, 2014)  
 (Scheepens et al., 2015)  
 (Zwolinski et al., 2006)

### Digital technologies

(Uçar et al., 2019)  
 (Pires Do Carmo Neta et al., 2020)

### Life Cycle Assessment, Material flow analysis, input output analysis

(Lindgreen et al., 2020)  
 (Corona et al., 2019)  
 (Walker et al., 2021)

## External environment

### Territorial capital

(Allais, 2015)  
 (French Circular Economy Institute, 2018)  
 (Orée, 2015)(ADEME, 2014)  
 (Allais & Gobert, 2016)

### PESTEL analysis

(Walker et al., 2021)

# Research Activities

## Research model (SET)

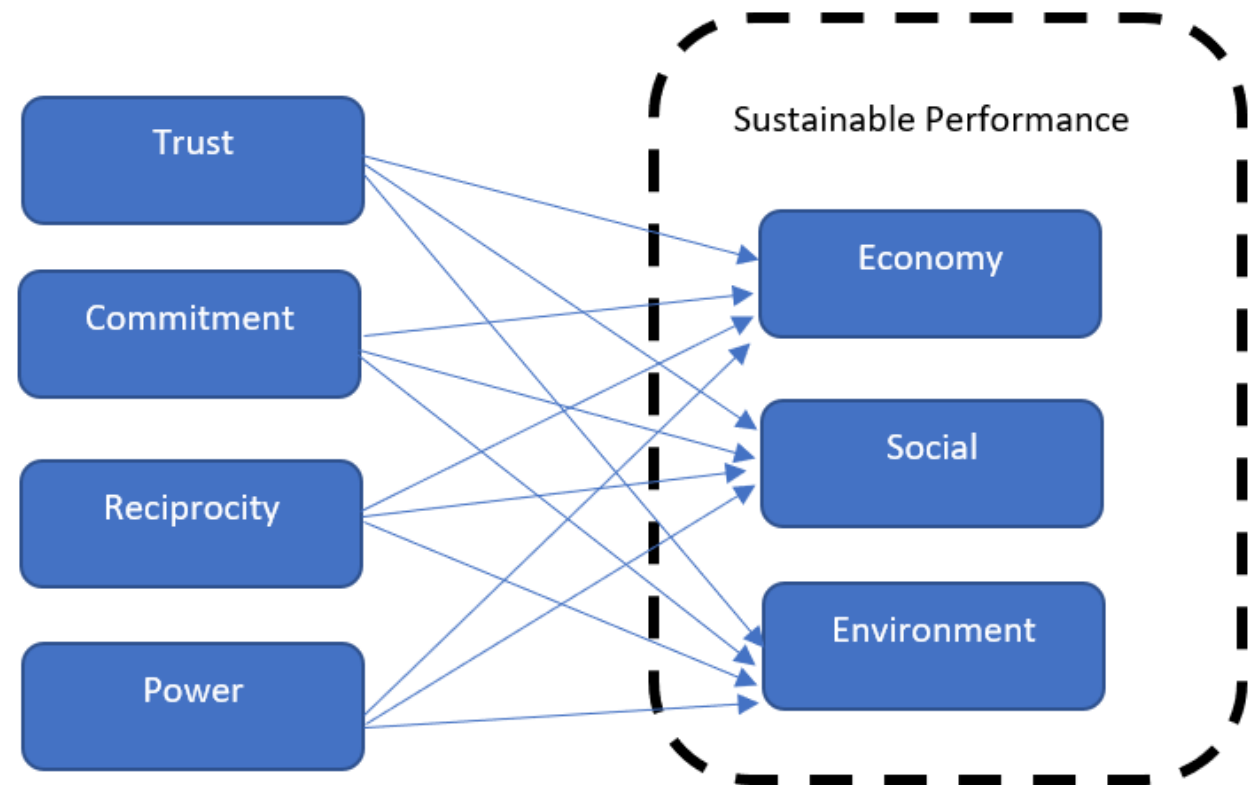
H3: trust among the stakeholders positively affects the environmental (a), economic (b) and social (c) performance of the supply chain.

H4: Commitment among the stakeholders positively affects the environmental (a), economic (b) and social (c) performance of the supply chain.

H5: Reciprocity among the stakeholders positively affects the environmental (a), economic (b) and social (c) performance of the supply chain.

H6: Power among the stakeholders positively affects the environmental (a), economic (b) and social (c) performance of the supply chain.

H7: Each element of the social exchange theory affects to a different degree according to the type of configuration of the supply chain based on the R-Principles.



# REFERENCES

- ADEME. (2014). Economie Circulaire : Notions. In *Fiche Technique - ADEME*. <https://www.ademe.fr/sites/default/files/assets/documents/fiche-technique-economie-circulaire-oct-2014.pdf>
- Allais, R. (2015). *Transition systémique pour un développement durable: entre conception et territoire*. <http://www.theses.fr/2015TROY0024>
- Allais, R., & Gobert, J. (2016). On the use of Intangible Assets Management in PSS Projects. *Procedia CIRP*, 47, 472–477. <https://doi.org/10.1016/j.procir.2016.03.115>
- Brissaud, D., & Zwolinski, P. (2017). The scientific challenges for a sustainable consumption and production scenario : the circular reuse of materials for the upgrading and repurposing of components. *Procedia CIRP*, 61, 663–666. <https://doi.org/10.1016/j.procir.2016.11.148>
- Carvalho, V. M., & Tahbaz-Salehi, A. (2019). Production Networks: A Primer. In *Annual Review of Economics* (Vol. 11, Issue December, pp. 635–663). <https://doi.org/10.1146/annurev-economics-080218-030212>
- Corona, B., Shen, L., Reike, D., Rosales Carreón, J., & Worrell, E. (2019). Towards sustainable development through the circular economy—A review and critical assessment on current circularity metrics. *Resources, Conservation and Recycling*, 151(September), 104498. <https://doi.org/10.1016/j.resconrec.2019.104498>
- Edtmayr, T., Sunk, A., & Sihn, W. (2016). An Approach to Integrate Parameters and Indicators of Sustainability Management into Value Stream Mapping. *Procedia CIRP*, 41, 289–294. <https://doi.org/10.1016/j.procir.2015.08.037>
- EMF-Ellen MacArthur Foundation. (2013). *Towards the Circular Economy: Economic and Business Rationale for an Accelerated Transition. vol.1*. <https://www.ellenmacarthurfoundation.org/assets/downloads/publications/Ellen-MacArthur-Foundation-Towards-the-Circular-Economy-vol.1.pdf>
- French Circular Economy Institute, E. (2018). *Les indicateurs de l' économie circulaire pour les entreprises*.
- Geissdoerfer, M., Savaget, P., Bocken, N. M. P., & Hultink, E. J. (2017). The Circular Economy – A new sustainability paradigm? *Journal of Cleaner Production*, 143, 757–768. <https://doi.org/10.1016/j.jclepro.2016.12.048>
- Graham, B. S. (2019). Network Data. *ArXiv*, 7(June 2017). <https://doi.org/10.1017/9781108644181.011>
- Junjun, L., Yunting, F., Zhu, Q., & Sarkis, J. (2018). *Green supply chain management and the circular economy : Reviewing theory for advancement of both fields International Journal of Physical Distribution & Logistics Article information : April 2019*. <https://doi.org/10.1108/IJPDLM-01-2017-0049>
- Kristensen, H. S., & Mosgaard, M. A. (2020). A review of micro level indicators for a circular economy – moving away from the three dimensions of sustainability? *Journal of Cleaner Production*, 243, 118531. <https://doi.org/10.1016/j.jclepro.2019.118531>
- Lindgreen, E. R., Salomone, R., & Reyes, T. (2020). A critical review of academic approaches, methods and tools to assess circular economy at the micro level. *Sustainability (Switzerland)*, 12(12). <https://doi.org/10.3390/su12124973>

# REFERENCES

- Masi, D., Day, S., & Godsell, J. (2017). Supply chain configurations in the circular economy: A systematic literature review. *Sustainability (Switzerland)*, 9(9), 0–22. <https://doi.org/10.3390/su9091602>
- Nußholz, J. L. K. (2018). A circular business model mapping tool for creating value from prolonged product lifetime and closed material loops. *Journal of Cleaner Production*, 197, 185–194. <https://doi.org/10.1016/j.jclepro.2018.06.112>
- Orée. (2015). *Recueil cartographique des initiatives franciliennes en économie circulaire*.
- Pires Do Carmo Neta, B., Le Dain, M., & Joly, I. (2020). *Digital Technologies supporting Circular economy [Unpublished manuscript]*.
- Rossi, E., Bertassini, A. C., Ferreira, C. dos S., Neves do Amaral, W. A., & Ometto, A. R. (2020). Circular economy indicators for organizations considering sustainability and business models: Plastic, textile and electro-electronic cases. *Journal of Cleaner Production*, 247. <https://doi.org/10.1016/j.jclepro.2019.119137>
- Saidani, M., Yannou, B., Leroy, Y., Cluzel, F., & Kendall, A. (2019). A taxonomy of circular economy indicators. *Journal of Cleaner Production*, 207, 542–559. <https://doi.org/10.1016/j.jclepro.2018.10.014>
- Santos Dalenogare, L., Le Dain, M.-A., Ayala, Néstor, ;, Pezzotta, G., & Frank, A. G. (n.d.). *INTER-FIRM COLLABORATION FOR SMART PRODUCT-SERVICE SYSTEMS: A SOCIAL EXCHANGE THEORY PERSPECTIVE*.
- Scheepens, A. E., Vogtl, J. G., & Brezet, J. C. (2015). *Two life cycle assessment (LCA) based methods to analyse and design complex (regional) circular economy systems. Case: making water tourism more sustainable*. <https://doi.org/10.1016/j.jclepro.2015.05.075>
- Uçar, E., Le Dain, M.-A., & Joly, I. (2019). *Role of Digital Technologies in Circular Economy [Unpublished manuscript]*.
- Walker, A. M., Vermeulen, W. J. V., Simboli, A., & Raggi, A. (2021). Sustainability assessment in circular inter-firm networks: An integrated framework of industrial ecology and circular supply chain management approaches. *Journal of Cleaner Production*, 286, 125457. <https://doi.org/10.1016/j.jclepro.2020.125457>
- Wang, B., Luo, W., Zhang, A., Tian, Z., & Li, Z. (2020). Blockchain-enabled circular supply chain management: A system architecture for fast fashion. *Computers in Industry*, 123. <https://doi.org/10.1016/j.compind.2020.103324>
- Wang, Y., Xiang, D., Yang, Z. Y., & Ma, S. (Sara). (2019). Unraveling customer sustainable consumption behaviors in sharing economy: A socio-economic approach based on social exchange theory. *Journal of Cleaner Production*, 208, 869–879. <https://doi.org/10.1016/j.jclepro.2018.10.139>
- Wu, I. L., Chuang, C. H., & Hsu, C. H. (2014). Information sharing and collaborative behaviors in enabling supply chain performance: A social exchange perspective. *International Journal of Production Economics*, 148, 122–132. <https://doi.org/10.1016/j.ijpe.2013.09.016>
- Zwolinski, P., Lopez-Ontiveros, M. A., & Brissaud, D. (2006). Integrated design of remanufacturable products based on product profiles. *Journal of Cleaner Production*, 14(15–16), 1333–1345. <https://doi.org/10.1016/j.jclepro.2005.11.028>