

Industrial Symbiosis

Industrial Ecology in support of building a Circular Economy

Circular economy and industrial ecology mark different concepts that both support the transition to a sustainable society. Industrial symbiosis, one of the main tools in the field of industrial ecology, can support a successful circular economy, because of its focus on industrial networks and clusters.

By Gijsbert Korevaar

In many academic discussions about sustainability, the attention is drawn towards either the ecological impacts and how they have to be monitored, or towards new materials and technologies that can lower the ecological impact. In this paper, the aim is to show how both circular economy and industrial ecology can support the transition to a sustainable society. And especially how industrial symbiosis, one of the main tools in the field of industrial ecology, can be a stepping stone to a successful circular economy.

Industrial symbiosis (IS) is a collective approach in which separate industries create a cooperative network to exchange materials, energy, water and/or by-products. It is not only about the technical elements, but also about the softer elements like skilled labour, sustainable strategies, or business data, that are exchanged as well. Circular economy (CE) refers to the concept that stimulates the circularity of materials, working towards a

transition of a linear economy to a circular one. Also, circular economy is important for sustainable development, mostly because it emphasizes the material side of industrial production as an addition to the climate impact and climate adaptation research and it emphasizes the importance of the business perspective. In practice, circular economy is an important concept for companies, municipalities and nations, because its profound notion of economic development in combination with a sustainable transition to closed loops of materials.

Modified from Baldassarre et al. (2019), Figure 1 summarizes the main components of both industrial ecology and circular economy. In both cases it is about a nested structure that goes from the main concept to the practical side. In the rest of this paper, first the nested structure for industrial ecology is discussed, then the nested structure for circular economy is discussed, after which the two structures are combined and observations are given on how the two fields can learn from each other.

Industrial Ecology and Industrial Symbiosis

From the start of the industrial ecology (IE) field, after the idea of “industrial ecosystems” was launched by Robert Frosch and Nicholas Gallopoulos in 1989 (Frosch/Gallopoulos 1989), quite some attention has been given to eco-industrial parks (Yu/Davis/Dijkema 2014). Industrial Ecology research and education always has had a strong emphasize on the analytical side of “metabolism of society”, working on tools like Life Cycle Assessment or Material Flow Accounting (Ayres/1994). However,

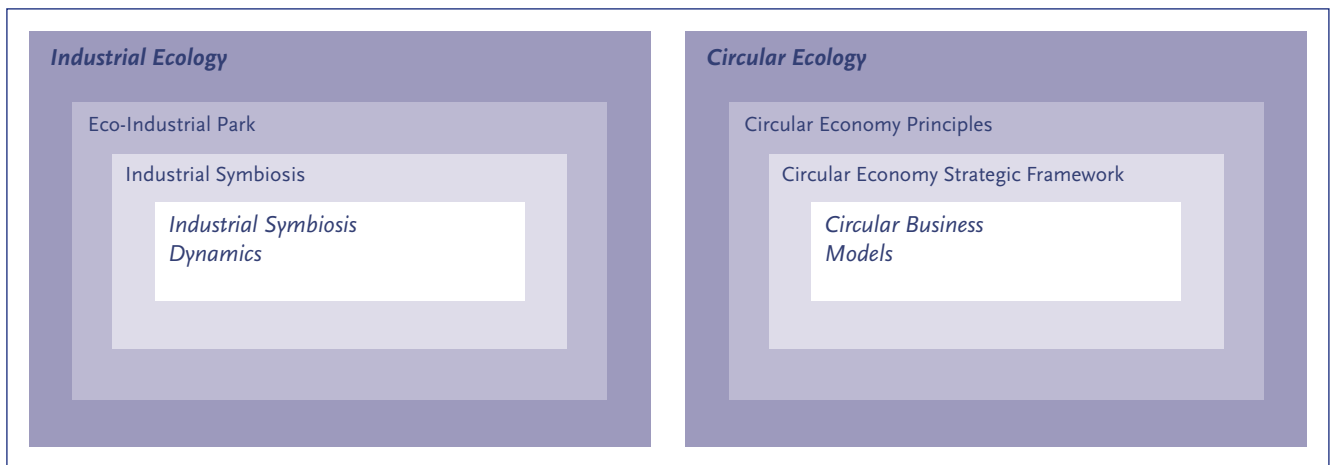


Figure 1: Nested structures of industrial ecology (A) and circular economy (B).

Modified from Baldassarre et al. (2019)

also from the start the design of industrial parks or industrial clusters with an exclusive focus on sustainability have received quite some recognition. This focus on the exchange of materials, energy, and information in industrial locations, has been labelled industrial symbiosis (Jacobsen 2008). In order to achieve industrial symbiosis, several types of dynamics are considered (Boons/Chertow/Park/Spekink/Shi 2016 and Sun/Spekink/Cuppen/Korevaar 2017). These industrial dynamics support the way in which industrial symbiosis can be understood and applied for the establishment of eco-industrial parks. Not only in a technical way (e. g., exchange of materials, energy etc.), but also in an institutional way (e. g., legislation, contracts, business models, etc.) (Lange/Korevaar/Oskam/Nikolic/Herder 2021).

Circular Economy

Circular economy (CE) is a concept that has become quite popular recently in policy, business and academia. CE advocates a transition from a linear “take-make-dispose” model, with raw materials on the one end and wastes at the other, towards a circular model, in which waste is a resource that is valorised through recycling and reuse. Since IE can be considered as one of the main roots of CE (Lüdeke-Freund/Gold/Bocken 2018), a large overlap exists between the CE and IE literature. Both IE and CE are based on the idea of closing material loops in order to make an affordable and profitable reduction of the environmental impact of industries. This also means that the circular economy principles overlap with the principles of industrial ecology. As derived from these principles, circular economy has a strong focus on the development of a strategic framework both for the identification of potential closing of the loops as well for business support for companies. This has been introduced extensively in the volume series of the Ellen MacArthur Foundation that started with number 1 in 2013 (Ellen MacArthur Foundation 2013). Central in the CE concept are the circular business models (Lange/Korevaar/Oskam/Nikolic/Herder 2021).

Conclusion

Based on our comparative analysis of IE and CE, we argue that their differences in nature, features and relevance should be leveraged in combination to get a more thorough understanding of both IS dynamics and CE business models. By using both perspectives it is possible, for example, to get a full picture about the role and aims of the local government for industrial symbiosis development (Baldassarre et al. 2019). The IE perspective can tell us that the strategy of a local government should not be only the creation of an industrial cluster, but rather using different modes of industrial exchange to bring down the environmental impacts. The CE perspective can tell us how the local government could intervene financially or which insights it could share with companies in the industrial cluster in order to create value. IE and CE perspec-

tives are different, but also complimentary. The CE perspective is more suitable to start or create a sustainable business operation, the IS perspective is more suitable to study a business development over time and its impacts on the environment, the economy and society.

Circular economy is a rather new topic that can take advantage from the insights and research in the field of industrial ecology. Both approaches are important concepts to reach a sustainable development of society. In this short paper, it is not discussed in detail how the methods and tools work, but more than sufficient references are provided that can help the readers find the main sources of information about IE, IS, and CE.

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