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Collaboration for circular economy

Managing Circular Economy 20.3.2023

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Outline

Today's session will focus on the role of collaboration for advancing circular business and the types of collaborations for CE.

- **Circularity and collaboration in supply chains**
- **Beyond supply chains – industrial symbiosis**
- **Intermediaries and local collaboration**
- **How to manage collaborative CE systems**

Why do you think businesses might collaborate for sustainability and circularity?

(Discuss in groups)

Circularity and collaboration in supply chains

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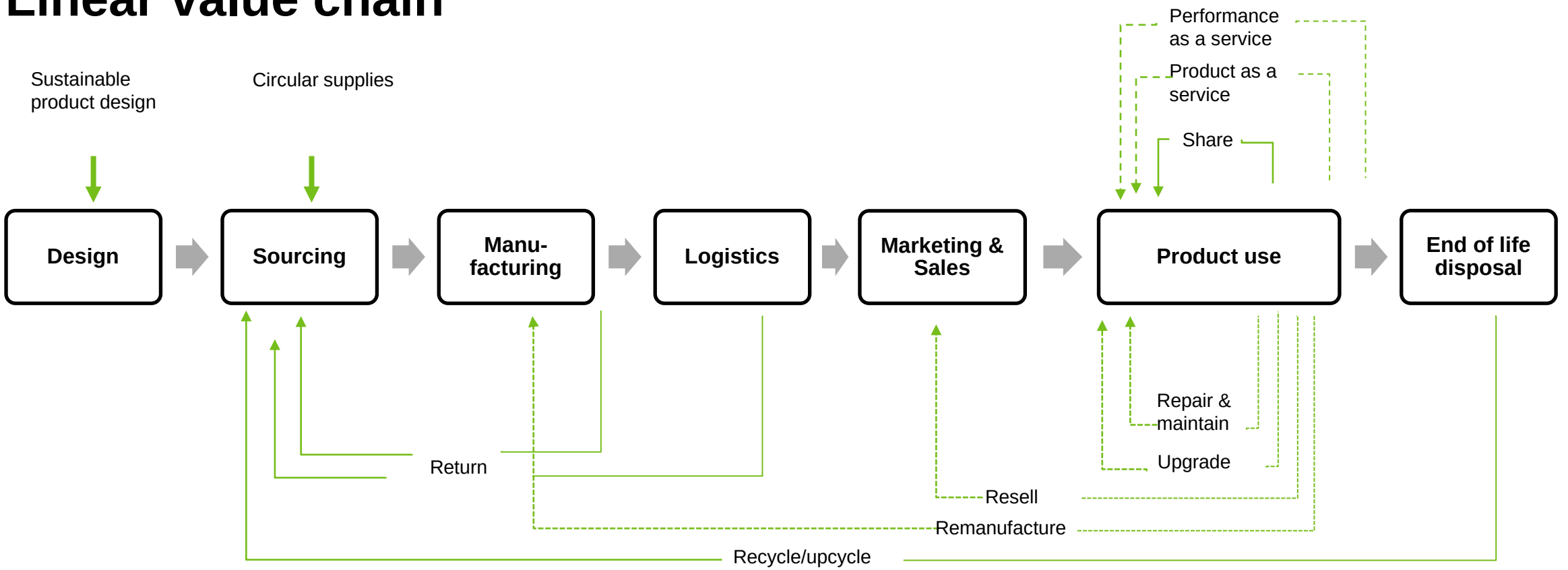
Value chains

Linear value chain



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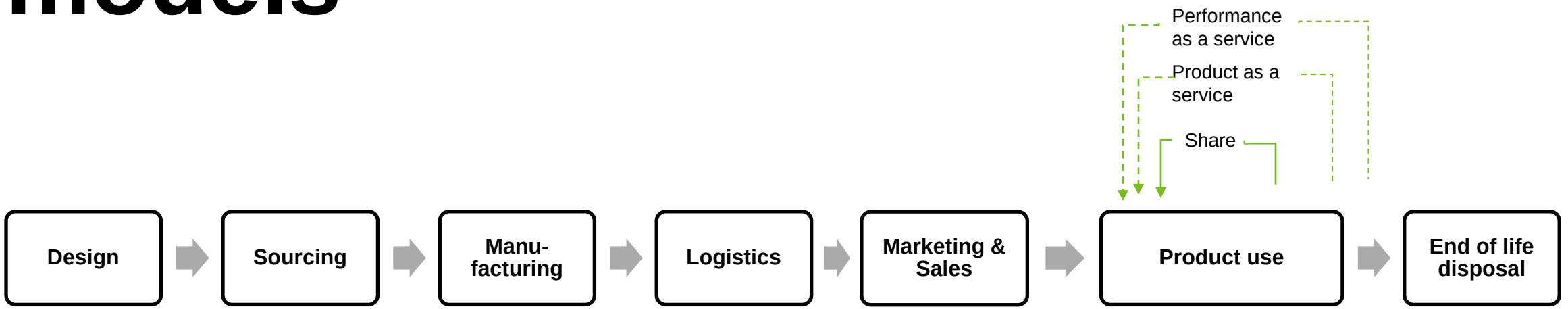
Adapted from Sitra, 2022

Collaboration and service/sharing models



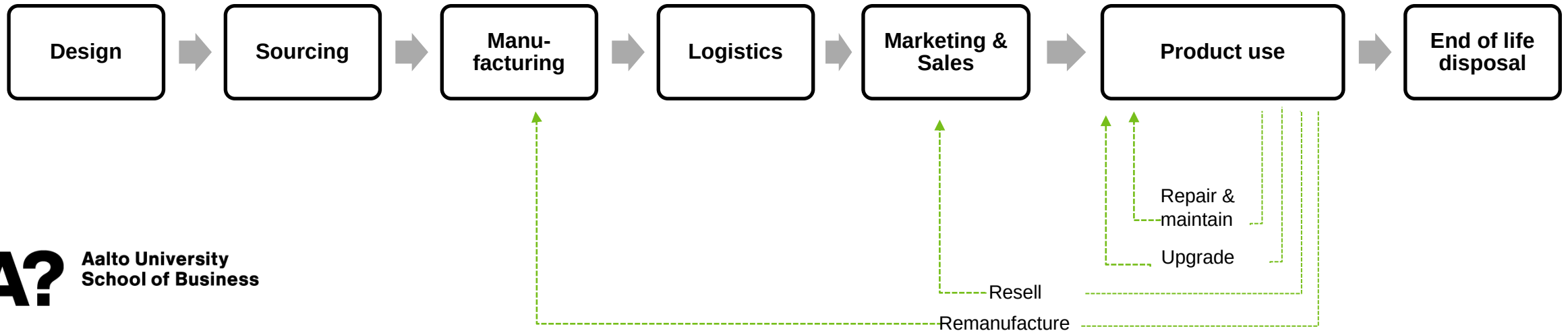
Lindström workwear rental

Partners: laundry and repair services

Collaboration and product life extension

Valtra remanufacturing

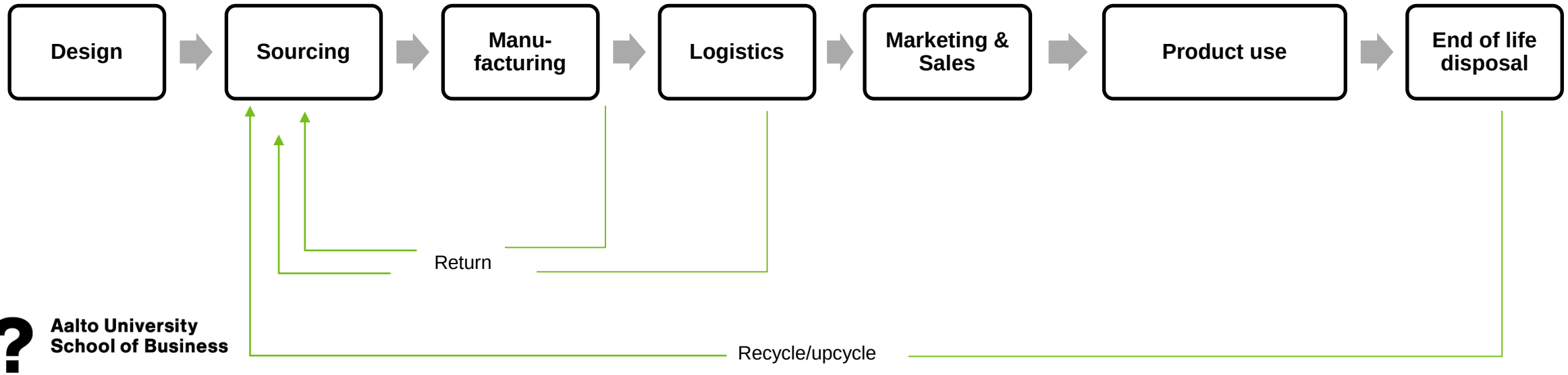
Partners: Product dealers



Collaboration and material life extension

Rester textile recycling

Partners: Waste material producers, texile material users



Industrial symbiosis

Industrial symbiosis – circular economy in industrial firms

The objective of industrial symbiosis is to form closed-loop material cycles among industrial firms

Creating value from wastes and byproducts (Chertow and Ehrenfedd 2012)

- Other activities: Infrastructure, energy and utility sharing among a group of firms

Related terms: industrial ecology, eco-industrial park

Cross-industrial collaboration is common, geographically focused

Case: Kalundborg

Collaboration among several managers of industrial firms in the Kalundborg area of Denmark started in the 1960.

Eventually, a formal association (Kalundborg Symbiosis) was formed to promote and develop the network

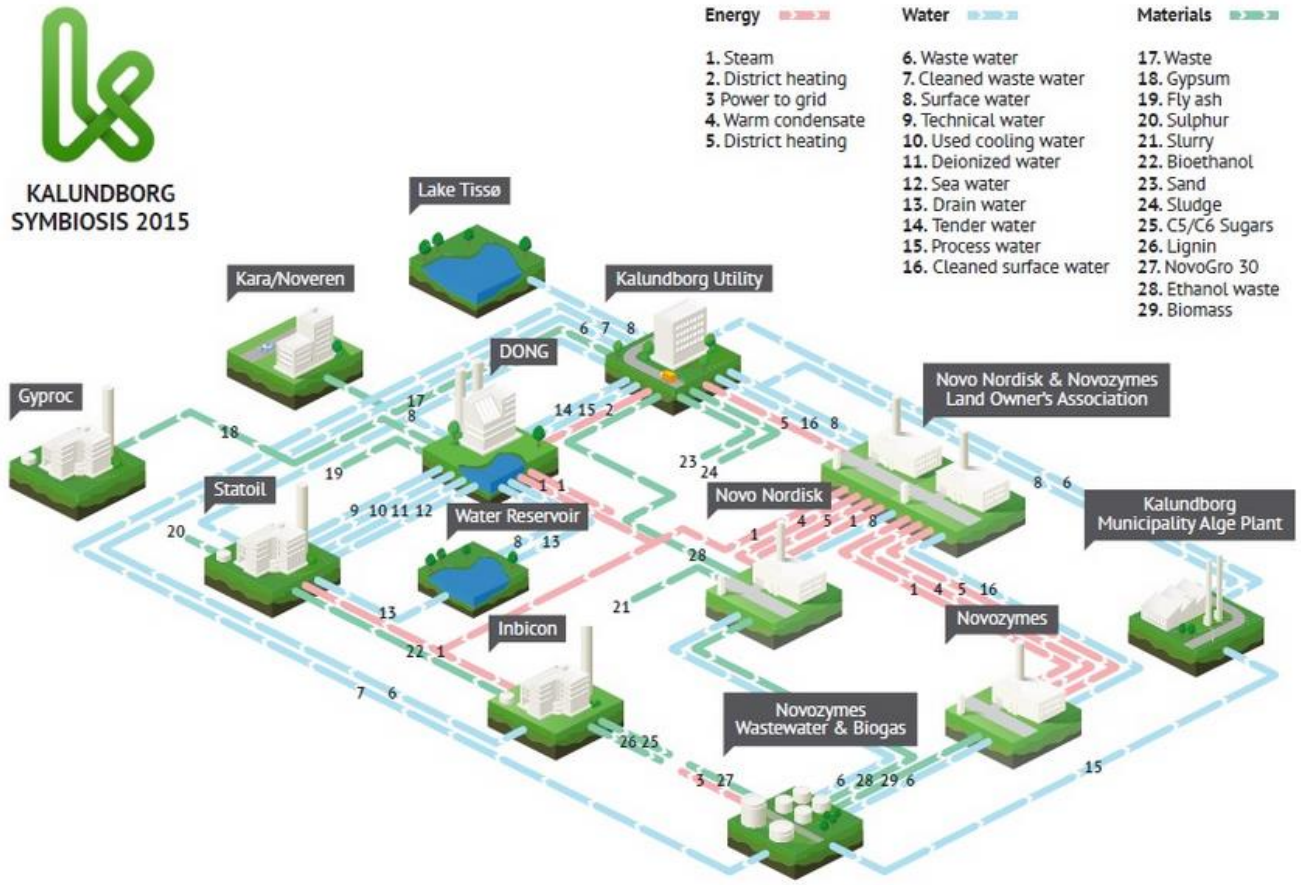
Annual environmental benefits:

- CO_2 emission reduced by 240.000 tons.
- 3 million m3 of water saved through recycling and reuse.
- 30.000 tons of straw converted to 5,4 million litres of ethanol.
- 150.000 tons of yeast replaces 70% of soy protein in traditional feed mix for more than 800.000 pigs.
- Recycling of 150.000 tons of gypsum from desulphurization of flue gas (SO_2) replaces import of natural gypsum ($CaSO_4$).

Case: Kalundborg

https://www.youtube.com/watch?v=ZCdf-TbB0hI

Industrial symbiosis network developed in the Kalundborg area in Denmark over several decades starting from 1960s

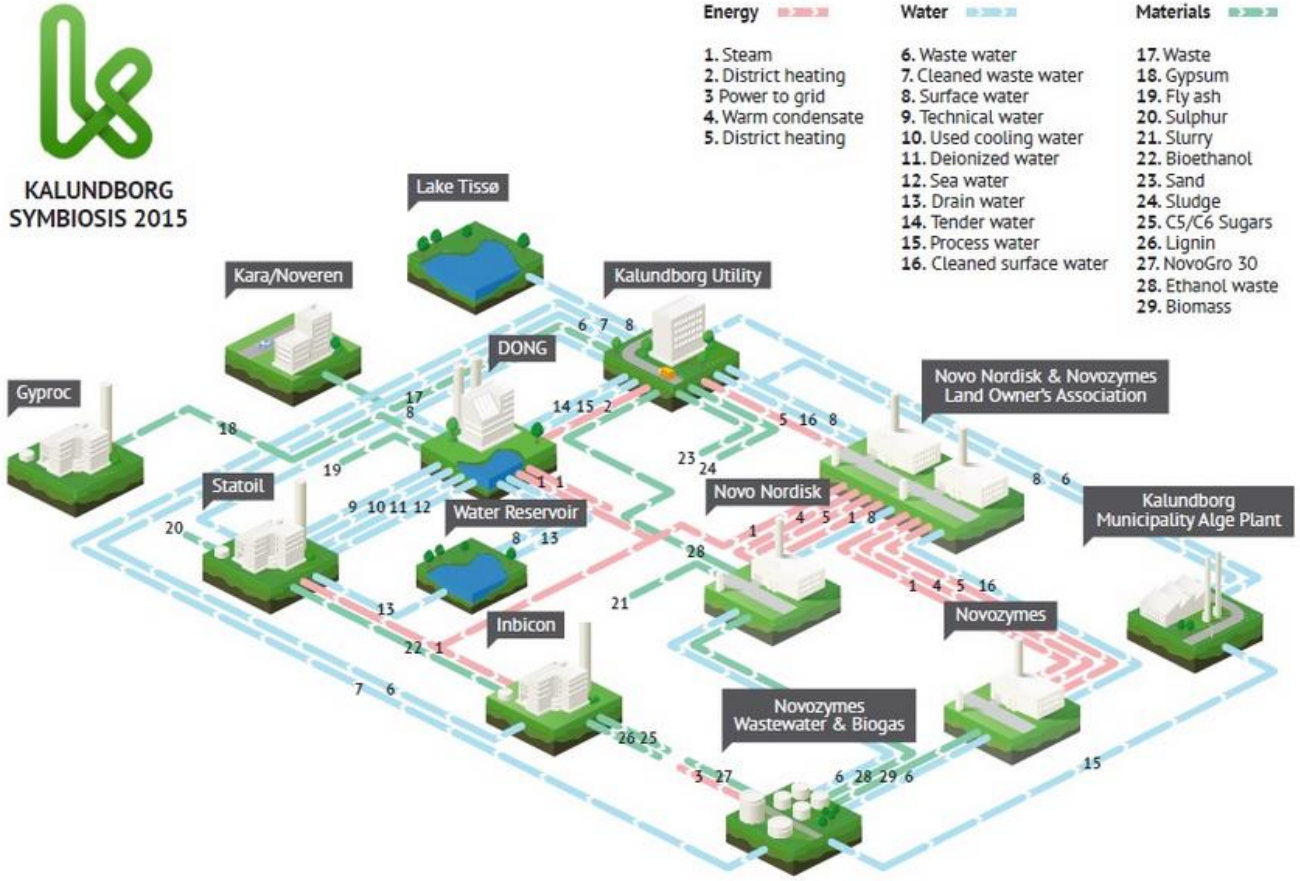


Definitions

Chertow, 2000: “Industrial symbiosis engages traditionally separate industries in a collective approach to competitive advantage involving physical exchange of materials, energy, water and by-products.”

Lombardi & Laybourn, 2012: “IS engages diverse organizations in a network to foster eco-innovation and long-term culture change. Creating and sharing knowledge through the network yields mutually profitable transactions for novel sourcing of required inputs, value-added destinations for non-product outputs, and improved business and technical processes.”

Case: Kalundborg



Case: NISP

- National Industrial Symbiosis Programme (NISP) launched in 2005 in the UK
- First industrial symbiosis programme at national level
- International Synergies organized workshops for potential companies around the country
- Material database helps to discover new symbiosis opportunities
- Coordinators help with the emergence of symbiosis even after the possibility has been identified, e.g. consulting

(Paquin & Howard-Grenville, 2012)

Case: FISS

Officially started in 2014

- The test phase included three resource synergy workshops in different geographical locations, over 600 potential resource synergies recognized

Coordinated by Motiva, Sitra and regional intermediaries

Facilitates industrial symbiosis across Finland

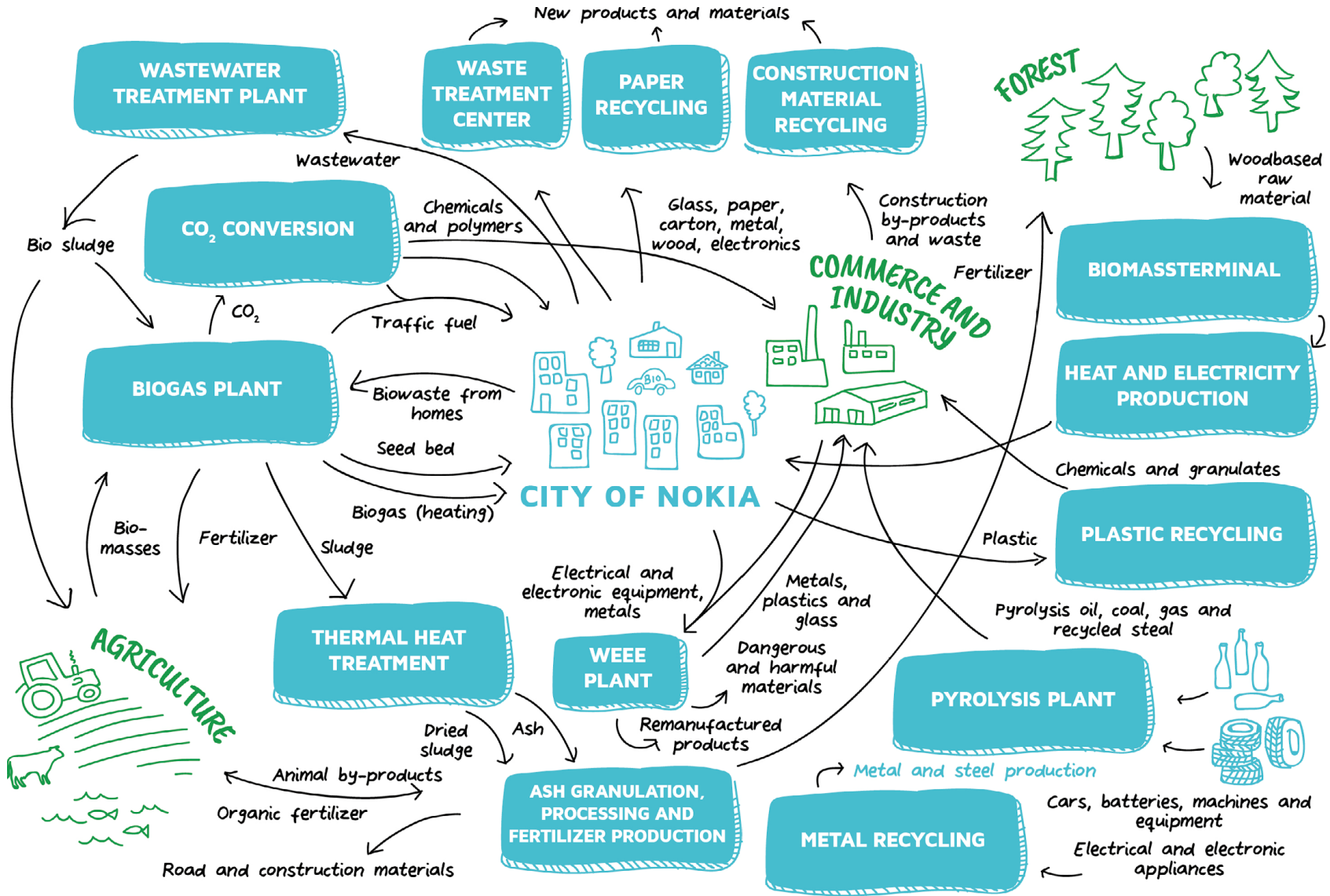
http://www.industrialsymbiosis.fi/

Examples in Finland

- **EnviGrow Park, Forssa**
- **HSY Ekomo**
- **Eco3, Nokia**

https://www.sitra.fi/en/articles/nine-steps-to-establish-an-eco-industrial-park/

Eco3 - Nokia



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Examples globally

(Chertow & Ehrenfeld, 2012)

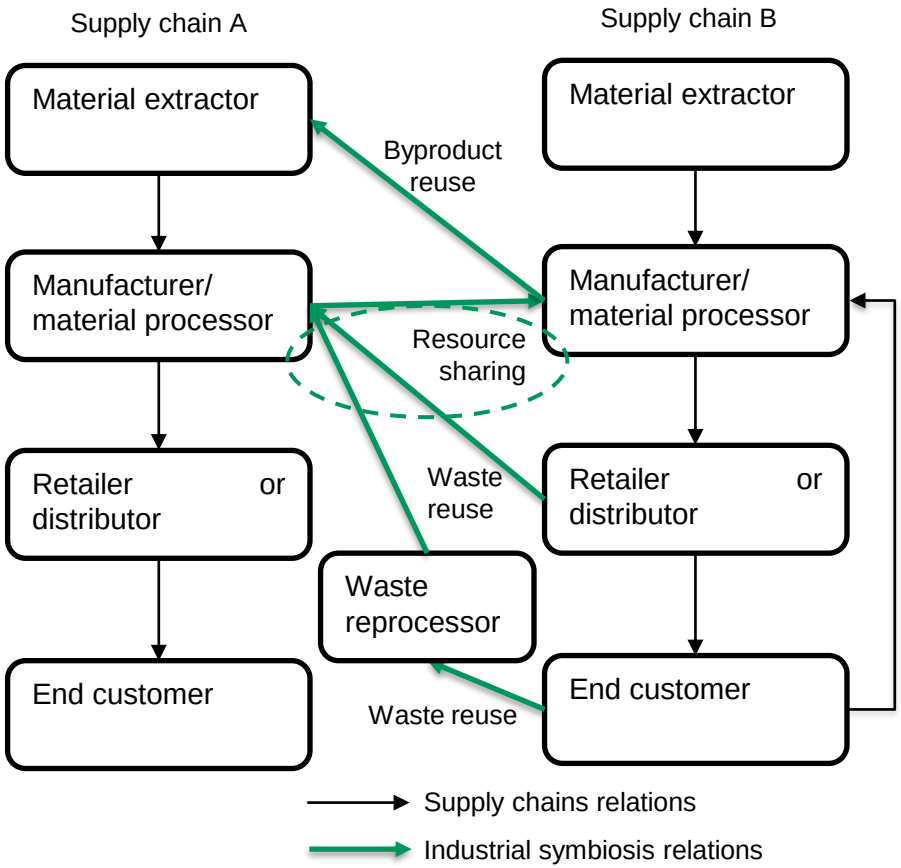
Area	Types of industrial activities involved
Guyama, Puerto Rico	Coal-fired power plant, chemical refining, pharmaceuticals
Shenzen Huaqiang Holdings Ltd., China	Sugar refining, alcohol, pulp and paper mill, cement, alkali recovery, agriculture
Ulsan, Korea	Oil, chemicals, incineration, metal processing, paper mill
Styria, Austria	Sawmills, mining, textiles, chemicals, power plant, board industry, plastic production, ceramic industry, cement plant, material dealers, iron manufacturing, agriculture associations
Tianjin Economic Development Area, China	Pharmaceuticals, food and beverages, electronics, machinery, others
Rotterdam Harbor, Netherlands	Chemicals, cement, oil refining, incinerator

Industrial symbiosis operational logic

Contrasting Industrial Symbiosis with Conventional Supply Chain Approaches

	Industrial Symbiosis	Forward and Reverse Supply Chains
System level		
Coordination	Based on norms of community and cooperation	Often dominated by a large, powerful firm, and/or competitive market mechanisms
Idiosyncratic relationship	Supply chain relationships take advantage of unique fit between firms — i.e., geographic proximity	Supply chain relationships designed based on need — i.e., buys and sells globally
Firm and flow heterogeneity	Cooperating firms are diverse and drawn from multiple industries	Cooperating firms focus on delivering a single type of product
Structure	A dense network structure, with interconnecting ties in many directions	Generally, a linear structure with multiple suppliers and multiple customers
Firm level		
Product identity	Products produced are independent of a firm's identity	Products produced are consistent with a firm's identity
Product manufacturing	Multiple products produced from a set of inputs — sold to multiple industries	Single product produced from a set of inputs — sold to a single industry
Strategic logic	Firms sell products that they have — seeking a higher value use of waste, byproducts and chemical intermediaries. Effectuation logic	Firms design and sell products to meet customer needs. Causation logic
Perception of waste	Waste is seen as feedstock for other production processes	Waste is to be minimized

Bansal & McKnight, 2009



Industrial symbiosis challenges

Cross-industrial CE opportunities can be difficult to uncover

-> need to share resource information between firms

The quality and quantity of byproducts might be difficult to optimize compared to main products

-> Intermediaries might be needed to achieve scale and quality needs

Many diverse actors involved, difficult to govern

-> local collaboration and systemic governance can facilitate this

Drivers and enablers for industrial symbiosis

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Drivers for industrial symbiosis

	Kalundborg	NISP
Emergence conditions	Shortage of fresh water as input material Stringent environmental regulatory framework Geographical concentration of companies producing high volume of a wide variety of waste flows Extended macroculture of cooperation, past experience of cooperation Multiplexity increases the importance of collective sanctions and reputation	Landfill space scarcity Growing importance to environmental issues in regulatory framework The large size of the network limits the potential development of social mechanisms such as macroculture of cooperation, reputation or collective sanctions The existence of a coordinator might offers some guarantees of 'fair play' and contribute to the learning process

Domenech and Davies, 2011

Intermediaries and industrial symbiosis

Intermediaries are organizations that facilitate industrial symbiosis without directly being involved in the exchanges

Roles: (Zaoual & Lecocq, 2018)

- Revealing value in industrial symbiosis
- Generating trust
- Activating industrial symbiosis
- Institutionalizing the practices

Intermediary challenges

(Patala et al. 2020):

- Openness dilemma
- Value creation dilemma

Motiva

International Synergies
industrial ecology solutions

Patala, S.; Salmi, A.; Bocken, N. 2020. Intermediation dilemmas in facilitated industrial symbiosis. *Journal of Cleaner Production,* forthcoming.

Importance of local collaboration

- **Close mental distance** (Ashton, 2008)
- **Informal relations**
- **Opportunities for deeper collaboration**
- **Champions** (Kokoulina et al. 2019)
  - Institutional
  - Network
  - Power
  - Expertise

Kokoulina, L., Ermolaeva, L., Patala, S, Ritala, P. 2019. The role of champions in developing industrial symbiosis. *Regional Studies, 53(4), pp.528-539*

System-level governance in circular economy

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Need for system-level governance in CE

Challenges with industrial circular economy:

- Lacking information: e.g. firms may have deep knowledge of their supply chain, but CE business often requires new, cross-industry relations
- Economies of scale: material flows may be too small for viable business
- A diverse set of actors involved (firms from various supply chains, public sector, non profits) with various governance mechanisms. No one party has clear authority over others.

-> system-level, polycentric governance of resources is needed for effective CE!

Research approach

- Aqualitative multiple case study of three circular economy systems in
  - Finland (FISS, Finnish Industrial Symbiosis System)
  - Spain (Basque Circular Economy, BCE)
  - USA (Devens eco-industrial park)
- 90+ interviews, archival data and observations

Case: Devens Eco-Industrial Park

- **Started as a Redevelopment project of an army base, located close to Boston, MA**
- **Close to 100 organizations in the area have been involved**
- **Coordinated by Devens Eco-Efficiency Center and Devens Enterprise Commision**

Devens Eco-Efficiency Center
Helping firms protect resources.

Case: Basque Circular Economy

Self-organized group of organizations undertaking projects and other collective activities for CE

Started in 2013

150 organizations have been involved

Findings

Mutual adjustments

- Role adjustments
- Governance logic adjustments
- Temporal frame adjustments

Practices for collective agency

- Protocols and shared strategies
- Building and sharing systemic knowledge

Structures for sharing

- Platforms for sharing resources
- Master plan for the systemic optimization of resources

Conclusions

Advancing CE can be facilitated by collective governance mechanisms, where residual resources have some elements of commons

- Resource ownership remains private but knowledge on how to use them can be shared
- Some resources (e.g. shared facilities) may even be collectively owned

Recommendations for businesses:

1. Openness and adaptation to new forms of collaboration
2. Building inter-organizational coordination processes

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Blogi: https://nbs.net/p/how-to-accelerate-the-circular-economy-nbsp-c8143695-20a1-4c98-87b6-

How could new technologies facilitate CE collaboration?

(Discuss in groups)

Summary

- **CE business can involve collaboration within and outside supply chains**
- **Industrial symbiosis is a systemic form of collaborating for inter-industry CE opportunities**
  - Can involve different operational logic compared to supply chains, and may need deep local networks and intermediaries
- **Building systemic governance models can help overcome the challenges related to CE collaboration**

Further information

Kalundborg: http://www.symbiosis.dk/en/

FISS: https://teollisetsymbioosit.fi/finnish-industrial-symbiosis-system-fiss/

Devens: https://devensecoefficiencycenter.wordpress.com/

Eco3: https://eco3.fi/en/

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