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Module 4:
Operational CE in Business

Topic 1:
Operational challenges in industrial symbiosis

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Topic 1 Outline:
Operational challenges in industrial symbiosis

1. Getting started: What is to be considered?
2. Designing IS that fits
3. IS capacity and constraint management
4. Forecasting demand related to IS

In Topic 02: Theory based

5. Waste/Leftovers from the production process?
6. Take back from customer scheme?
7. Feasibility studies – how to realize synergies?
8. What are the risk factors?

In Topic 02: Case based

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Listen to introduction based on the text of this topic:

Listen to discussion on the importance of industrial symbiosis (15 miniutes)

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1. Getting started: What is to be considered?

Imagine

- You are the CEO of a manufacturing company with large bills related to electricity, raw materials and transport services
- The company produces emissions, waste and spill water

Then question arises:

How can IS be relevant in order to reduce your costs and to extend your revenue sources?

WE NEED TO CONSIDER WHAT IS-CATEGORY IS FIT FOR OUR PURPOSE AND OUR CONTEXT =>

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2. Designing an IS that fits (01)

FOUR INDUSTRIAL SYMBIOSIS CHATEGORY CHOICES

1. IS fulfil two purposes (Nordregio report):
   - LEFT-OVERS: Utilising left-overs, residue or waste (products/liquids/energy): Exchange of firm-specific left-over energy, water, or by-products, to substitute delivery from third parties.
   - INFRASTRUCTURE: Utilizing available capacity of the infrastructure: Sharing excess goods, liquids, or gases as an input option or as a waste treatment option, or by capturing emissions.

2. IS may be in the shape of a GEOGRAPHIC REGION (ex. Kalundborg), or installed on a planned ecosystem on a PLATFORM (ex. Sirken)

Link to additional study materials: NORDREGIO publication (2015), Chertow, (2008)

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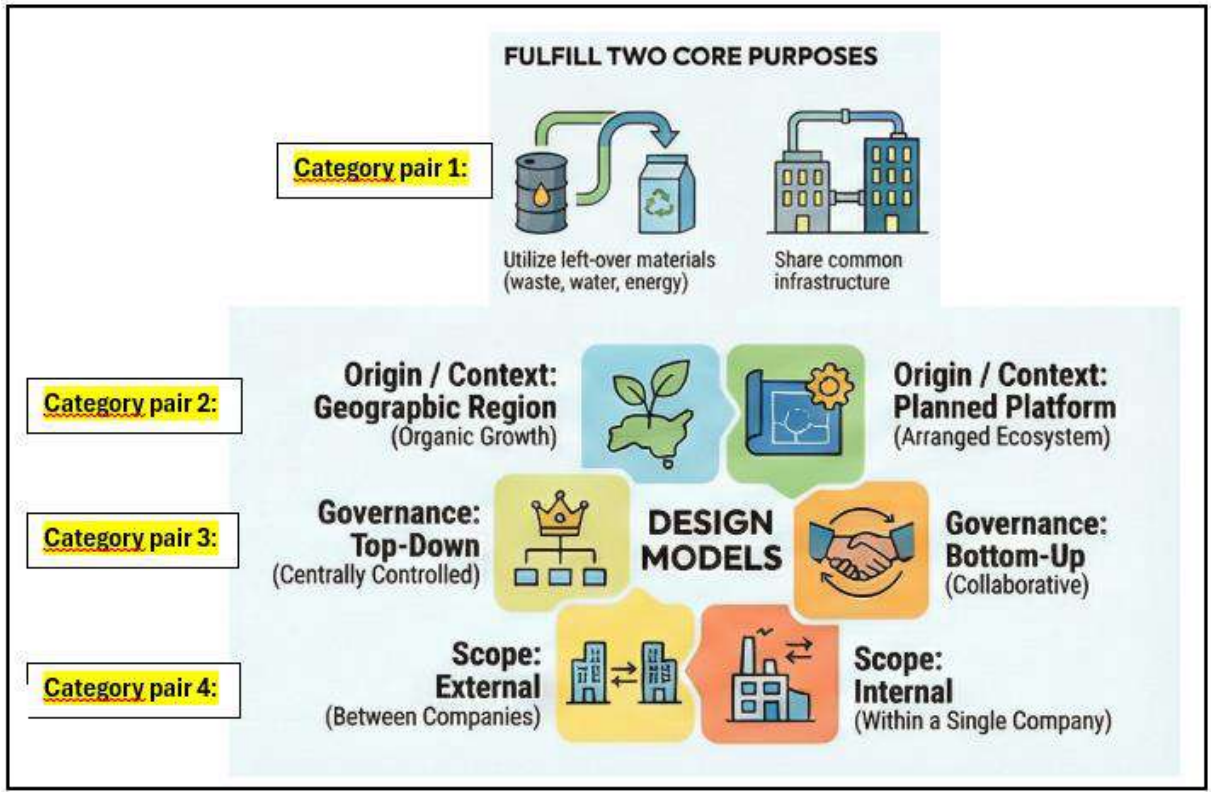
2. Designing an IS that fits (02)

FOUR INDUSTRIAL SYMBIOSIS CHATEGORY CHOICES

3. TOP-DOWN (ex. Derewenda) controlled by central entity, or BOTTOM-UP – governed collaboratively (ex. Tuscan Bull)

4. EXTERNAL EXCHANGES: Between companies, or INTERNAL EXCHANGES: between internal units within a company (ex. Tervete)

Distinguishing IS from SCM and from barter trade. (Source: Chertow, 2008)



Link to additional study materials: NORDREGIO publication (2015), Chertow, (2008)

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2. Designing an IS that fits (03)

REGULATIONS THAT INFLUENCE PRACTICES OF IS

National legislation

- Are there national regulations in place, or in the pipeline, for reuse/recycling resources in your industry? Or for mapping reuse/recycling? Would an IS initiative of som sort benefit your business?
- Are there any changes planned for the national regulation of your waste treatment, discharges of water or other liquids or of emissions to air which will affect your costs?

EU legislation

- Is the industry covered by the Regulation on Ecodesign Requirements for Sustainable Products? (ESRP) (EU Regulation 2024/1781) European Commission introduction here includes also a phased implementation of digital product passports (DPP). See connection between DPP and Circuland here.

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2. Designing an IS that fits (04)

EXERCISE: CONSIDER THE SUITED IS-CATEGORY AND RELEVANT REGULATIONS

Find the website of your local renovation facility responsible for handling household waste.

1. What kind of recycling efforts are they involved in?
   - Distributing district heating based on the incineration of waste?
   - Recycling of glass, paper, batteries and other items? (Other categories?)
   - Compost handling, based on food waste and compost from private households?
   - Other recycling efforts?
2. Decide the most fitting IS category for each of the recycling efforts in this renovation facility (reference to the four IS typologies in Slide 4).
3. Does the website of the renovation facility refer to national or EU legislation? Which?

Answer by using the form: : Link or by using your smartphone:

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3. IS capacity and constraint management

Ensuring capacity for IS

- Preliminary cost assessment of IS: There are costs involved in preparing and processing by-products ready for IS and linked to transport. The price volatility of by-products can be a challenge.

- Knowledge resources: One needs knowledge of alternative treatments and value chains of left-over, residuals, waste, including relevant regulations. IS may require innovation processes.

- Identifying relational resources: IS requires inclusion in confidence-building coordination processes. These processes may reveal available synergies. A third-party facilitator may be deemed necessary. Ex.: Data centres – often rely on green houses for waste-water use.

- Mobilizing relational capacity: Identifying synergies linked to realistic actions among existing or potential partners.

Sources: Europe Economics report (2024:25) (UK. Cavalcanti et al. (2018)

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3. IS capacity and constraint management

Six areas of constraints that must be considered in each case:

- Technical knowledge: Need IS awareness, knowledge of byproducts, and information sharing. By-product delivery risk and uncertainty of quality levels.
- Organisational, social and cultural: Need high levels of trust, top management support, and extensive dialogue. Not aligned business cultures, asymmetric relations, and SC-conservatism.
- Geography: Short/long distances? Increasing cost of logistics? Regulations preventing co-location?
- Scalability: Is the symbiotic exchange scalable? Will economies of scale and liquidity allow us to scale?
- Regulatory and policy-related: IS requires by-product tests? Bureaucracy to issue permits? Linear assumption in regulations? Unpredictability of outcomes and regulatory future?
- Economic and financial: CAPEX for infrastructure/platform? Comparing NPVs? Value of by-products?

Source: Europe Economics report (2024:25) (Chapter 4). (UK).

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4. Forecasting demand related to IS

The IS potential calculated by life cycle assessments (LCA)

IS prolong the lifetime of the residual/waste product involved. Implications are mapped by LCA.

- What LCA accomplishes:
  Performing a LCA on a planned symbiosis exchange can both show how different choices affect different categories, and help mitigate risks of uneven distribution of both costs and emissions.
- LCA in four phases:
  - Goal and scope definition (Needs to be some cut-off of what to include. Assumptions of environmental impact.)
  - Life cycle inventory analysis (Ingoing resources and outgoing emissions are mapped.)
  - Life cycle impact assessment (The impact on the environment (climate and on biodiversity) is assessed.
  - Interpretation Results are evaluated with respect to the goal and scope.
- The potential for industrial symbiosis in different industries:
  You typically use a net present value calculation to evaluate options for industrial symbiosis.
  Study claims that the highest potential for IS *delivery* is among steel mills and waste treatment utilities, while the highest potential for IS *receivers* is among cement producers and those utilizing outputs from waste treatment (EE-report 2024:25).

Sources: Europe Economics report (2024). Witkor & Johansson (2018),

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Case studies:

SELECT ONE OF THE THREE CASES FOR YOU TO WORK ON

1. The Humber region case (England)
   Source: Article by Cervo et al. (2019), Case on pages 10-21.
2. The Kalberg case (Norway)
   Source: Article by Broch et al. (2021)
3. The Circuland case (England)
   Source: Website-01, Website-02, and Google news

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Start working on your case:

- Read the given sources about your IS case.
- First question (answered in at least 50 words):
  How does the case you selected fit into the four IS categories presented above?
- When you have your answers they should be pasted in this form: Link. Or by using your smartphone:

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Write at least 50 word answers to each of the 6+2 questions (A-E):

A. Waste/left-overs from the production process

1. As far as you know, how did the participants in your case become aware of the potential for IS and how did it start?
2. Is the annual volume and value of waste/left-overs calculated? If not available, give your estimates?
3. Is there a balance between the supply and demand in this IS? If not, how do you adjust?

B. Returns from customers (due to the renting out, to take-back systems, or to upgrading routines)

4. In your case, do we see a prolonging of product life and/or reduced resource use, and/or the establishment of circular supply chains?

C. Feasibility analysis: Technical, economic, and environmental assessment of potential synergies

5. Capex: May we calculate the Net Present Value (NPV) for different IS alternatives/participants?
   If available information do not allow for that, describe how one may consider the return on investment in your case?

D. IS risk factors

6. What risk factors are involved in your case? How would you summarize the risks, and their implications, for the design of this IS-case?

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Answer the last two questions:

E. Based on what you now know about your IS-case:

7. What is the most critical task(s) to ensure a profitable and sustainable IS in your case?

8. Summing up your IS case; would you advise “cautiousness”, “continue as before”, or “expand” for the next year? Give reasons.

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Summarising Topic 1: Operational challenges for IS

- We need an overview of the options for IS: Four IS categories…
- And the choice of IS will also depend on the regulatory framework.
  You submitted answers to questions concerning your local renovation facility.
- How do we estimate our capacity and potential for IS? (Constraints)
- IS prolongs the life of business relevant resources: Role of LCA.

SELECTION OF ONE OF THREE CASES:

- Humber region case (UK)
- Kalberg case (Norway)
- Circuland case (UK)

Based on the provided sources to your selection of case, you submitted answers to eight questions.

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Module 4, Topic 1: *Operational challenges for IS*

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