

ORCHESTRATING NET ENVIRONMENTAL GAINS: PROCESSES AND CONSEQUENCES OF INDUSTRIAL SYMBIOSIS NETWORK ORCHESTRATION

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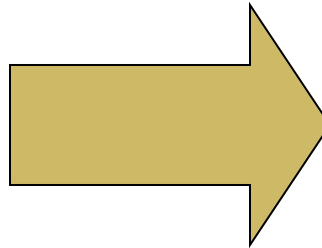
Industrial Symbiosis Defined

- Exchange, sharing and/or reprocessing of waste from one firm into feedstock for another (Chertow, 2000)
 - Ecosystem metaphor
 - Economic and environmental motivations
- *Transforming “wastes” into resources*



Industrial Symbiosis Example

Potential economic &/or environmental gains



Spent brewer's
yeast into...

Marmite!

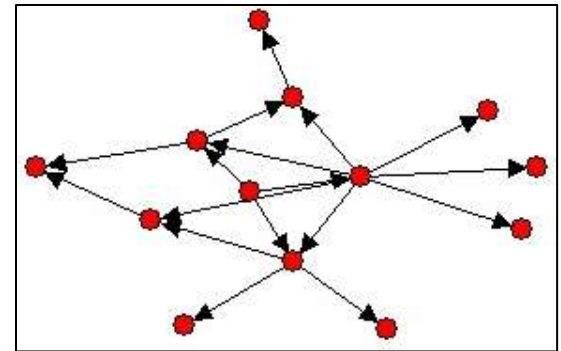
Industrial Symbiosis Network

Orchestration: *Empirical motivation*

- Self-organizing approach very slow to mature

- Ex: Kalundborg, DK

- 40+ years
- 20-30 firms
- 15-25 projects



- Top-down approach often fails

- **Facilitated network a 'third way'?**

Industrial Symbiosis Network

Orchestration: *Theoretical motivation*

- Intentionally assembled networks understudied relative to those that arise ‘serendipitously’
 - ▣ Yet numerous examples: *supply chain networks, research consortia, business support organizations* (Capaldo, 2007; Dhanaraj & Parkhe, 2006; Doz, et al, 2000; Dyer & Nobeoka, 2000; Human & Provan, 2000; Lorenzoni & Lipparini, 1999)

- Network ‘orchestrators’ play critical role – *bring dispersed actors and resources together for individual and collective gain*
 - ▣ Recruit network members
 - ▣ Develop rules & norms for network engagement
 - ▣ Support network-level value creation
(Doz, et al, 2000; Dyer & Nobeoka, 2000; Human & Provan, 2000; Powell, et al, Forthcoming)

- Limited understanding of **how** network orchestrators act, and with what effect on the network?

Special Considerations for Industrial Symbiosis Network Assembly

- Economic & environmental benefits unevenly distributed (Chertow & Lombardi, 2005)
- Opportunity for IS rarely apparent to firms
 - “[NISP is] able to come up with **ideas that we wouldn’t have thought of**”
- Limited managerial awareness of potential partners
 - “[NISP] **introduces us to companies that we might never have crossed swords with.**”
 - “They [NISP] have the time and energy to get around and **talk to a huge cross section of companies within the region** ...as a business we wouldn’t be that outwardly looking”

Research Questions

Q1: What actions does a network orchestrator undertake to develop a new network aimed at generating collective (and individual) gains?

Q2: How do the actions of a network orchestrator early in a network's formation influence the network itself, and its subsequent actions as the network grows?

National Industrial Symbiosis Programme, UK

Launched
Nationally '05

Regional teams
facilitate
development of
IS projects



West Midlands

• *Early pilot
program*

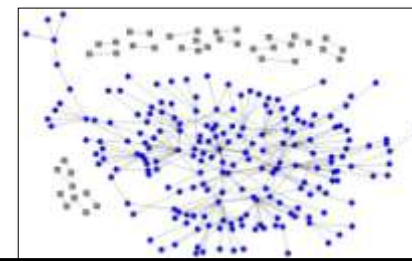
Impacts of NISP

- West Midlands Industrial Symbiosis Network
 - *6 years, 243 firms, 307 IS projects*

 - Economic Benefit
 - Increased sales, reduced costs, new businesses / jobs, etc

 - Environmental Benefit
 - 388K tonnes of industrial landfill waste diverted
 - 342K tonnes of industrial carbon emissions reduced

(NISP & Databuild, 2006)



Our Approach

- Longitudinal Case Study: Dec 2005 – May 2008
 - ▣ Inductive Analysis

- Qualitative Data
 - ▣ 4 NISP Regions – Staff, plus HQ
 - ▣ 24 firms in 2 regions
 - Interviews, Observations, Archival documents

- Network Data: *West Midlands Region*
 - ▣ Archival proj mgt data on all IS projects in region
 - ▣ Used to construct evolving IS network

What We Found

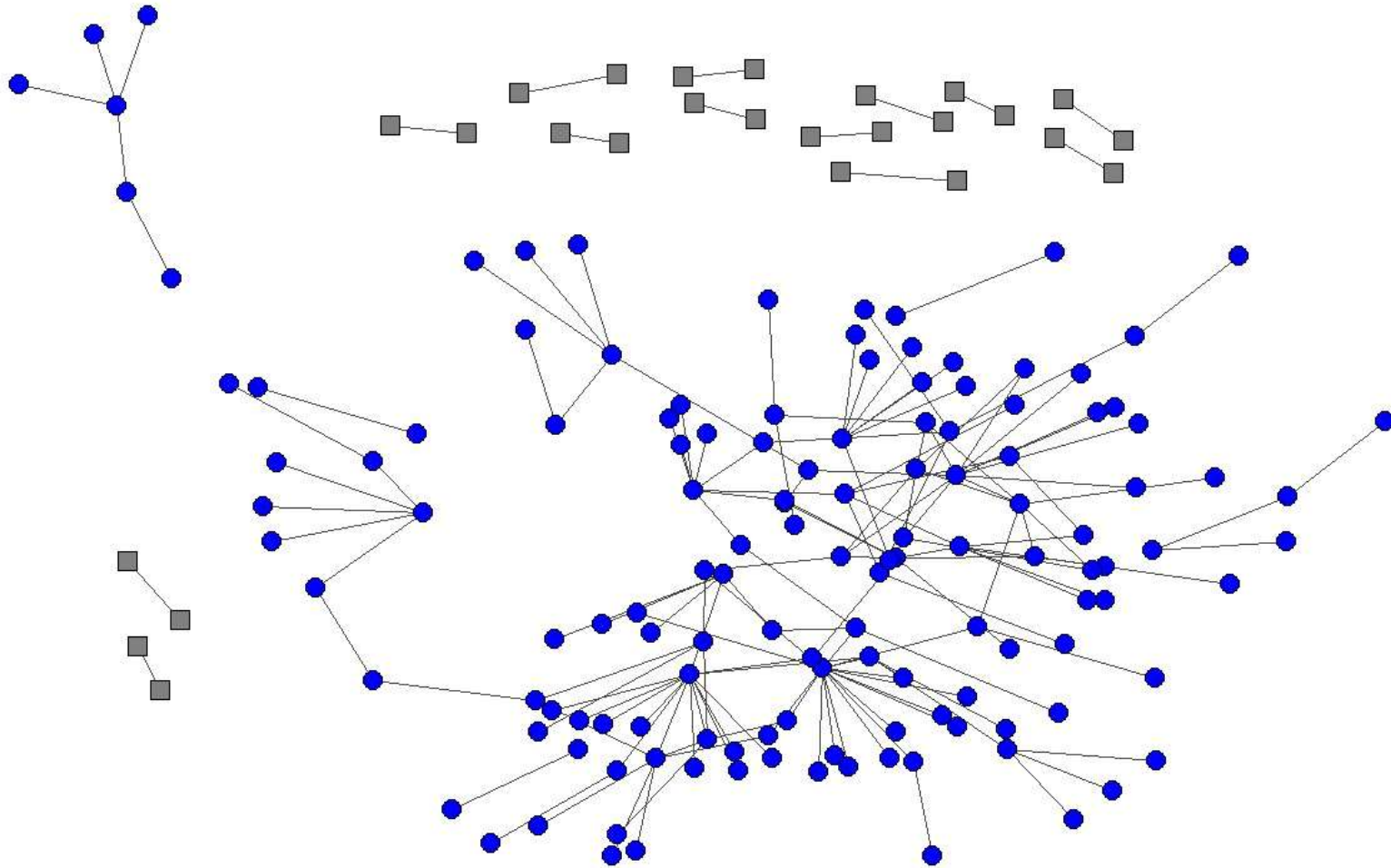
The Growing Network

West Midlands Regional IS Network

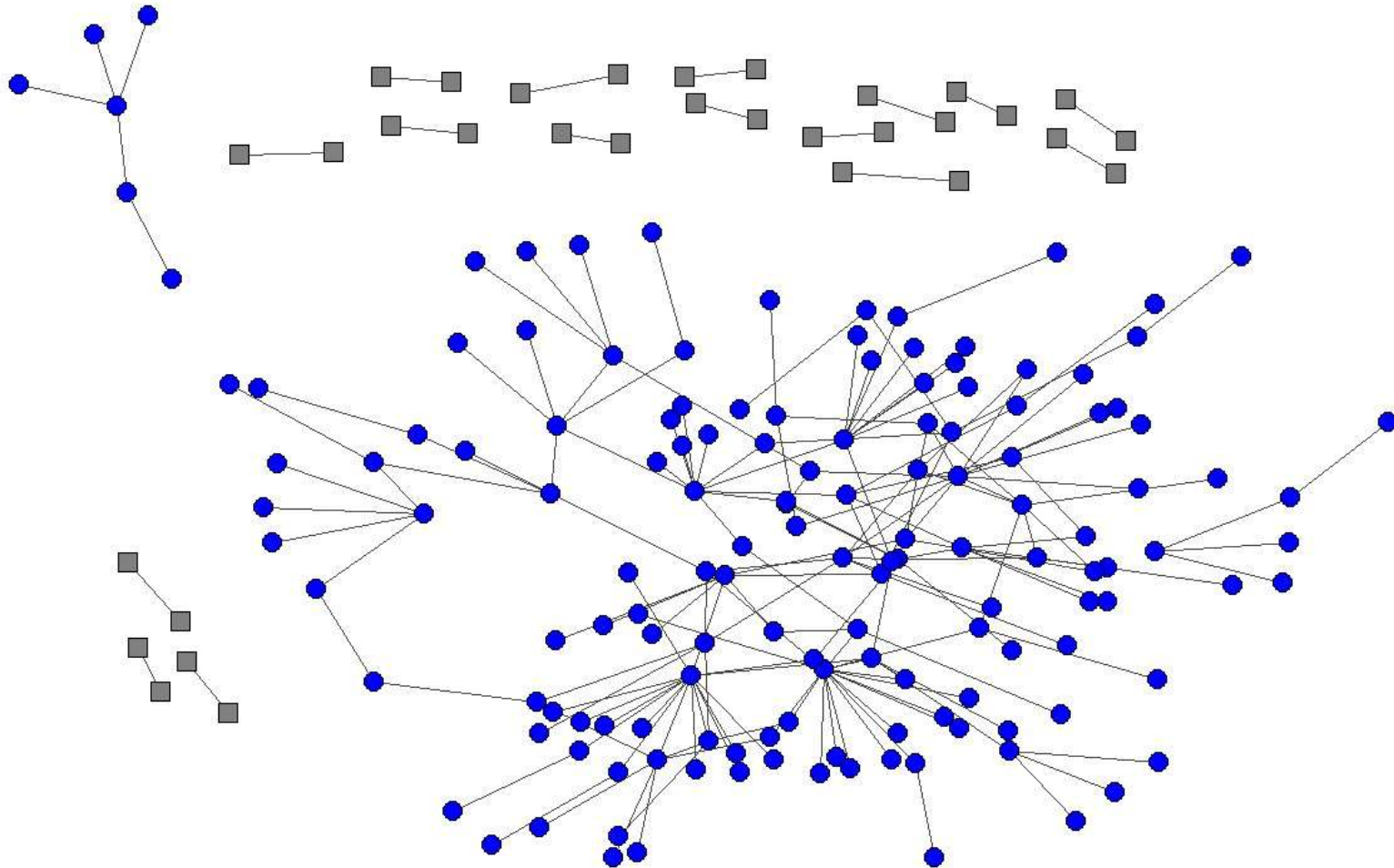
▣ Network Descriptives:

	2005	2006	2007	
# Firms:	162	180	243	} <i>Network growing</i>
# Projects:	175	208	307	
Mean Projects/Firm	2.2	2.39	2.53	} <i>Engagement increasing</i>

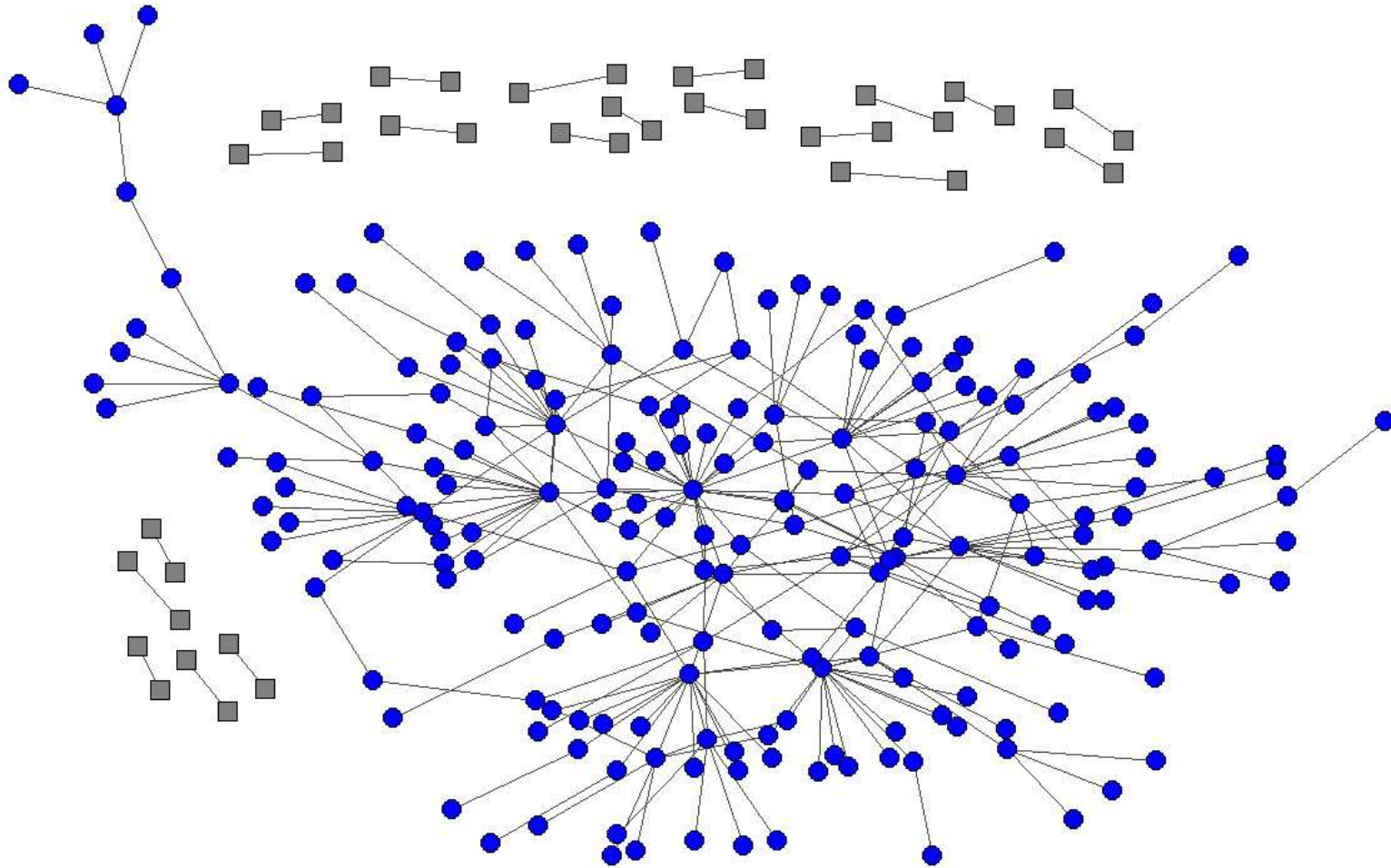
2005



2006



2007



Conversation

Generate initial awareness; create opportunities for engagement

- Strategic view of region to identify members
 - “[There have been a] number of **changes with the environmental legislation** over the last 6-9 months...so you start looking at those legislative drivers and **see who is going to be affected** ... companies that don’t realize that they are going to be affected but they will be.”
- Used others’ networks to make contact
- Target ‘high-value’ members to build legitimacy
- Cast wide recruiting ‘net’

- Quick Wins workshops – *‘industry speed dating’*

Effect of Conversation

Created very high demand

- ▣ Necessary 'pre-network' activity
- ▣ A lot of interest quickly
 - Could not meet demand

Demanded adjustments in NISP's approach

- ▣ *Fewer workshops* – left interested firms on their own
- ▣ *Relied on referrals* – Supply chain partners, Enviro Agency

Connection

Deepen relationships; bring firms together around projects

- Developed in-depth relationships
- Strategically introduced firms to develop projects
- Supported projects as they developed

*“Often what [firms] are giving you on the paper may not match what is really going on. So the other thing is to **gain confidence of the people you are talking to**, for them to give you an accurate description rather than the ‘corporate’ view.”*

Effect of Connection

Challenged NISP's internal resources to match demand for 'hands-on' project support

- ▣ Simply connecting firms not enough
- ▣ Ongoing support to firms as project develops
- ▣ Even 'simple' projects are not simple

*the project “appeared at the outset to be **very simple**, but the technicalities of it and the commercial issues did not go well between the two companies... start[ed] getting into issues of continuity of supply, ... they are **actually making a simple opportunity much more problematic.**”*

Effect of Connection - 2

NISP's own IS development experience increased

- Affected choices of projects / firms

Regional IS Network

- Network-level: Became less stratified, but 'stable'

	2005	2006	2007	
Mean EigenCen	4.66	3.76	4.66	} Became less stratified
SD	(12.59)	(11.53)	(8.76)	
Ntwk Centralization	103%	95%	91%	

- Firm-level: High churn within network

- 18 of 20 top firms in 2005, are **not** in top 20 in 2007
 - Mann-Whitney test of network's centrality measures ($p=0.00$)

Co-Creation

Develop underlying 'infrastructures' for future projects

- ▣ Customized by project, firm
- ▣ Individualized, leveraged NISP's internal expertise
- ▣ Larger potential scale

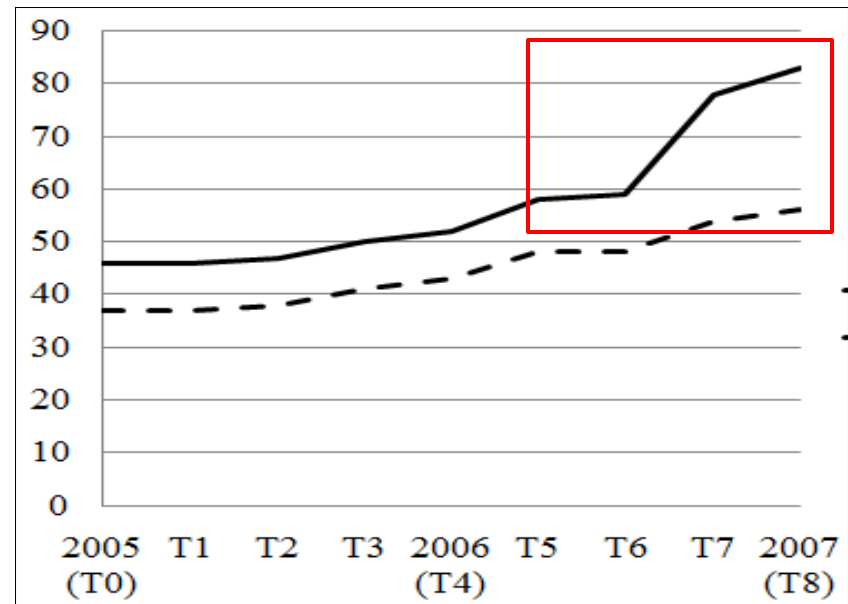
Effect of Co-Creation

- ▣ Developed new techniques for problematic wastes
- ▣ Expanded firms' capacity for prominent wastes

Effect of Co-Creation - 2

NISP co-creation action increased over time

- Selectively took leadership role in projects
- *Not only organization in network to do so*



Effect of Co-Creation - 3

NISP's co-creation differentially influenced network beyond connection

Network	Actual Network <i>With NISP's Co-creation projects</i>		Constructed Network <i>W/o NISP's co-creation projects</i>	
	<i>2005</i>	<i>2007</i>	<i>2005</i>	<i>2007</i>
Year				
# firms	162	243	159	235
# projects	175	307	167	281
Eigen Centrality (SD)	4.66 (12.59)	4.66 (8.76)	4.88 (12.84)	2.82 (9.76)
<u>Ntwk</u> Centralization	102.8%	91.5%	102.9%	95.3%

Implications: Empirical

- Industrial symbiosis networks can be ‘orchestrated’
 - ▣ Large #'s projects & large #'s of firms
 - ▣ Contrasts with prior IS research

- Network orchestrator’s actions have distinct influence on network’s development
 - ▣ ‘Connection’ – Network- & firm-level effects
 - ▣ ‘Co-creation’ - Qualitatively different nature of ties;
 - Additive and differential influence on path of network’s growth

Implications: Theoretical

- Combined qualitative & network analyses yield insight into **how** networks develop through orchestration
 - ▣ Lack of initial power/position as a 'hub' can be overcome
- Orchestration is beyond brokerage
 - ▣ Involves developing and exploiting specialized expertise
 - ▣ Building legitimacy of orchestrator & network's core activities simultaneously
 - Analogous with other collective efforts to introduce new environmental practices or standards

Some Questions Raised

- How can we more deeply understand the influence of individual gains (firm economic or environmental benefits) and collective gains (overall waste or CO₂ reductions) in shaping IS networks and other collective environmental practices?
- How do we better understand how legitimacy of new practices (and their orchestrators) is built and leveraged over time?
- As IS networks develop, what additional benefits accrue to participating firms (e.g., innovation)?

Questions?

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