SESSION 3A:

DISCUSSION AT THE LEADING EDGE – MECHANISMS TO ADVANCE INDUSTRIAL SYMBIOSIS

Despite the wry observation of the practitioner-moderator Mr. Christensen that he'd always found it much easier to find mechanisms to stop IS than to advance it, the three speakers spanning the academic to practitioner spectrum identified the same mechanisms central to advancing IS: at least as critical as presenting IS as a business opportunity is developing a robust network.

In discussing the NISP engagement model, Dr. Murphy described using the business case to get the companies’ attention, then offering value through facilitating cross sector exchanges, and political and regulatory situations that many companies do not know how to approach. The resulting NISP networks underpin Dr. Jennifer Howard-Granville’s work; she and colleague Ray Paquin have been studying the existing networks in 4 of NISP’s regions, making explicit the characteristics of the networks and providing possible explanations of how social ties come about and their role in the development of robust IS systems.

In presenting on IS work in Austria, Dr. Hasler further made the point that the network of companies, once established, essentially becomes a structure unto itself – through trust and cooperation, and the companies’ self-identification with the network. Professor Hasler sees IS as balancing the longer term perspective of the environment with the short term economic perspective through the shared goal of increased efficiency.
Facilitated Industrial Symbiosis: 
Network Forms and Evolution in NISP

Professor Jennifer A. Howard-Grenville and Ray Paquin, Boston University School of Management, USA

This presentation looked at the early promise of using social network analysis to examine existing NISP’s industrial symbiosis networks. The study includes comparative analysis of two regions and highlights both potential strengths and weaknesses thus opening up possibilities for IS practitioners to make IS networks more robust.

SOCIAL NETWORK ANALYSIS

Social network analysis is a social science technique used for mapping and comparing the structures of social systems, whether they are made up of organizations, groups, individuals, or combinations of these. Social network analysis represents “ties” (affiliations or relationships) between members of a network. Prior work on industrial symbiosis (IS) suggests that pre-existing social ties between organizations or individuals enable the development of IS, as do more broadly shared norms (Ehrenfeld and Gertler, 1997; Baas and Boons, 2004; Chertow and Lombardi, 2005), demonstrating the value of understanding IS as a social, and material, economic, ecological, and geographic phenomenon.

Social network theory provides possible explanations for how social ties come about and why. First, the theory suggests that formal ties between organizations often grow out of informal ties between their members, that they are developed through repeated interaction, and that they may be facilitated by a third party (Gulati, 1999; Smith-Doerr and Powell, 2005). Further, the theory suggests a number of benefits to social network ties, including access to information and opportunities, shared norms and trust, sources of motivation, learning and resources, and smoother and more timely interactions (Smith-Doerr and Powell, 2005). However, there are a number of challenges associated with developing such ties in an IS system: new types of interactions, or the development or use of new technologies, by companies who have no prior dealings with each other; or the degree of uncertainty surrounding IS
arrangements. In sum, while there may be significant benefits to establishing social network ties as a way of progressing towards IS, there are also significant obstacles.

**PRELIMINARY RESULTS FOR NISP REGIONS**

This talk introduced early social network analysis results based on a comparison of two NISP (National Industrial Symbiosis Programme) regions. NISP operates from a unique position as it is facilitating the formation and evolution of IS networks on a large (national and regional) scale. We focus on four of NISP’s ten regions, and in this presentation gave early network structure results on only two of the four focal regions. Social network analysis was performed using NISP’s synergy grids (documentation of all existing and potential IS relationships, by stage of the relationship) for the West Midlands and the North East, two of the regions in the program with the longest history of engagement.

Results show some interesting commonalities and differences between the network structures of the two regions. The West Midlands network (see Figure 1) is characterized by a core “ring” of industry members who all have at least one exchange with each other and also have a number of exchanges or relationships with others (seen as a number of “sub networks” off the main ring). There are also a large number of one-to-one exchanges between members who are not connected at all to the main ring. The West Midlands networks appear to be anchored around several key industries that are prevalent in the region, but are more highly geographically dispersed and do not have a history of interaction.

The evolution of the core ring is uncertain, but as the main members of this ring are among the most active in the program it is likely that they will see further growth and development of their symbiosis ties. Whether this occurs by the growth of larger and more complex sub networks or by the development of connections “across” the ring between its main members depends in part on the nature of the potential exchanges and the types of opportunities seen by NISP (as facilitator) and/or the members themselves. The latter type of development would lead to greater ties between diverse firms and greater “cross linking” of the network, which could lead to a more robust network in which novel information flows. One potential disadvantage of the growth of sub networks alone is that it could be focused on a certain industry or industrial facility’s waste, and therefore limit the opportunities for truly novel, perhaps three-party symbiosis arrangements.

The North East network structure (see Figure 2) also shows a core network with higher density ties and a number of unconnected dyads. However, in the North East the core network does not appear as a ring of main players who are connected to each other through only one or two primary ties. In contrast, it appears as a “multi-connected” system where each main member is connected to a number of other main members. The growth and development of this network could lead it to become even denser among these main members, perhaps limiting the potential for new ideas and opportunities to enter in. However, a dense, multi-connected system is quite robust, at least theoretically, as the removal of one main member would not fundamentally break apart the system.
While the analysis is preliminary and much more must be understood about the nature of the ties, how they came about, their directionality, etc. in order to explain the current structure and predict further development, there is great promise for using social network analysis to map and compare different industrial symbiosis systems. In this case, hints about the current structures can be found in looking at the history and industrial make-up of each region. The North East industrial symbiosis networks may be heavily centred on the petrochemicals industry that has been historically dominant in the region, is geographically co-located, and has processes conducive to resource exchange. The West Midlands industrial symbiosis networks appear to be anchored around several key industries that are prevalent in the region, but are more highly geographically dispersed and do not have a history of interaction.
ROLE OF FACILITATOR

In both cases, a facilitator (NISP) can serve a critical role in introducing companies to each other, helping to build the network either from the main players (by encouraging sub-networks), or across them (by encouraging cross-industry exchanges), or both. Any targeted facilitation approach (e.g. by industry sector, or by geography sector) has potential trade-offs with the diversity and density of the emerging network. For example, growth around sub networks may be a natural course because it tracks materials from one industry but it may reduce the diversity of the network overall, having implications for its capacity to renew itself (through new information flows and new members) over time.

Network analysis can help facilitators to visualize patterns in the network structure, understanding them better through their in-depth knowledge of the individual members, and actively managing their implications. Network analysis is also an important tool for use by scholars seeking to better understand industrial symbiosis emergence and development. Critical to the use of the quantitative modelling techniques is complementary qualitative understanding of the nature of the ties and the conditions surrounding their development. Only through this qualitative analysis can the logics of the structures (how they form and why the look as they do) be understood. Key questions facing scholars interested in this area include:

- How do we adequately measure truly “social” ties in an industrial symbiosis network? Ties of acquaintance or friendship between individuals may be important in the development of ties between companies in the emergence of industrial symbiosis, so social network analysis ideally needs to capture both. A challenge is that these ties are very hard to measure systematically in a large network, and also must be followed over a long period of time to understand their effect.

- How do we construct and compare to a “base case” industrial symbiosis network? In other words, what might have happened under different conditions, or with different pre-existing social ties? This question relates to understanding just how important each of a number of factors (e.g., social ties, regulatory incentives, environmental impacts, economic factors, etc.) is in influencing the development of industrial symbiosis.
REFERENCES


Focus Engagement Models

Dr. Adrian Murphy, NISP- West Midlands Regional Director, UK

In his presentation, Dr. Murphy discussed NISP’s focus on maintaining a close relationship with businesses and understanding of their issues in order to best facilitate cross-sector IS business opportunities, key to their engagement strategy of “working with the willing.” Also central to the facilitation model is a close relationship with the regulator.

FACILITATOR OF BUSINESS OPPORTUNITIES

Dr. Murphy began by describing NISP’s philosophy of engagement as “working with the willing;” in his experience, presenting a company with an IS opportunity does not, by and large, get the company engaged; an opportunity to improve environmental performance receives some interest, but engagement is still unlikely. The entry line must be a business opportunity. NISP has demonstrated ability to reduce costs and emissions, increase sales and asset utilization, create jobs and attract inward investment through IS. To assure a strong connection to its local business community, NISP partners with industry associations, and each NISP region has an advisory group composed of local businesses (ranging from multi-nationals to micro-industries and individual entrepreneurs). The majority of NISP regional coordinators (leaders of the regional teams of practitioners) and practitioners have a background in industry that facilitates their understanding the companies’ business drivers.

The facilitation role was central to connecting Maxell, electronic component manufacturer, and JBR Recovery, a precious metals recovery facility 5 miles away. Each year, Maxell sells of order 60 million slim-line silver oxide batteries to the automotive industry across Europe. The batteries have a limited shelf life, resulting in 2 tons per year of waste batteries being land-filled as hazardous waste – an avenue closed by a change in legislation in 2005. The neighbouring JBR Recovery had excess capacity, and was looking for anything that contains silver. The batteries contain over 40% silver with a current market value £100k/year – once recovered. The silver recovery hadn’t thought to pursue batteries; the battery seller hadn’t thought about the silver. It took someone working cross sector to make the connection, and the introduction.
STRATEGY FOR ENGAGEMENT

NISP-WM is involved with companies of all sizes in a number of industrial sectors: their strategy of engagement is “wide and deep”. Many of the current 4000+ members are at the early stages of interaction, engaged in preliminary conversations about IS and its benefits. If NISP can provide them some easy wins, the companies become more engaged. The next step might be to hold a workshop with a number of companies at the same time. At the workshops, NISP gathers data on the companies; simultaneously, the companies make their own connections with other attendees. In the early stages of engagement there are no predefined boundaries or expectations on what kinds of exchanges may be identified. The resulting engagements are with those self-selecting – thus willing – companies (see Figure 1).

One member company, an animal renderer, processes about 300,000 tons each year of food waste from food companies, supermarkets, and abattoirs. Prior to Animal By-Product Regulations, waste food could be sent to landfill; this process is no longer permitted. Through use of what is essentially a giant pressure cooker, the foods are broken down into component parts: solids, liquid, and fats. Working cross-sector, NISP helped the company identify opportunities for the reuse of these outputs. The company has since installed a £1M system to process the solids containing minerals and carbon value; they now displace fossil fuel use for a cement manufacturer. Four hundred thousand (400,000) tons of water each year were purchased by the business, put through effluent treatment after use, then thrown away; the company is now cleaning the water and reusing it in the process. The fats are now going into bio-diesel. This company is not just engaged in the program; they are using IS to shape the future of their business.

Figure 1 NISP-facilitated IS network developing in the West Midlands regions.

Source: Murphy
PARTNERSHIPS WITH GOVERNMENT — REDUCING RISK

Legislation can sometimes be a barrier to IS exchanges, either de facto or through misinterpretation by the regulator or by the companies themselves. Where this misinterpretation occurs, NISP can leverage its relationship with the regulating bodies – the Environment Agency and the Department of Environment, Food and Rural Affairs – to clarify the intent of the policy and occasionally to work with the regulator to change the policy. Sometimes NISP’s role is to facilitate the companies accessing government agencies and resources which small companies in particular have difficulty doing as they lack the appropriate knowledge. For example, a small recycler needed significant investment to grow its business, and then increased input supply (in this case, cans) to match. The recycler had been pursuing alternative sources of funding, but had not thought to approach the regional development agency, which, facilitated by NISP personnel, awarded them a capital grant; NISP also identified through its network additional sources of cans as input.

In conclusion, the NISP early network growth has been predominantly self selecting i.e. those willing companies who have gone beyond initial engagement. The presentation of a business opportunity brings them in: being open minded and reactive to the challenges faced by industry effectively engages them in IS, leading to the facilitation of many IS exchanges across all resource types and all sectors.
Inter-Firm Coordination

Dr. Arnulf Hasler, EU Regional Management of Upper Styria West, Austria

Reiterating the centrality of the business case – that IS is always driving the business competitiveness of the economy – Dr. Hasler emphasized the need for people to work together to create the win-win situation. Creating a long-lasting sustainable situation for companies requires balancing the short-term economic perspective and the long-term ecological perspective; the common aim is increased efficiency.

Dr. Hasler identified three stages to the growth of the company networks, resulting in the creation of something larger than the sum of its parts; that is, the network created takes on a life of its own. The process is iterative. In stage 1, companies meet to explore the potential for working together: information exchange is central. In stage 2, they are forming the network, that is there is the consciousness of being part of the total structure: identity with the network and confidence in it are central. In the final stage, the strategic management of the central structure is key to the network becoming self-sustained. As the companies interact more and more frequently, they find out more about one another, creating mutual understanding and strengthening the network, and the companies’ own self-definition as part of the network.

Trust between companies and confidence in the system are the basis for new cooperation. Few people (if any?) ask to see the captain’s pilot’s license when boarding an airplane; the stewardess in her uniform is the public face of that system, and passengers trust in that system. Similarly, for IS, the networking managers are the face of the IS system. As part of the network, one trusts the whole system; it is not necessary to meet everyone and question their trustworthiness; the only commitment is to work together with the system. Short mental distance helps to build trust and cooperation.

The IS work in Styria, Austria, is part of a regional development package of programs that focus on economic growth. The regional structure supporting the IS network was not created by the government, but rather supported and financed by the 72 communities in the region through a regional association. Its focus is primarily on information exchange, building up transparency in the region. Feeding local data into a benchmarking system enables the creation of benchmarks for regional policy, supporting programs for regional planning.

By creating ecological competence, the companies of Styria are becoming more competitive. Innovation is promoted by creating centres, building networks and
clusters. For example, the wood cluster is working toward creating a sustainable business based on regional resources; when the raw materials are sourced regionally, more of the value generated remains in the region.
Session 3A – Discussion and Research Questions

- Initial discussion centred around the relative merits of mechanistic approaches (more complex/sophisticated data driven modelling) and humanistic/social approaches (use what we know about humans and relationships). Mr. Christensen observed that there are various ways to proceed, depending on culture, all related to human interactions, and that even if we strengthen the modelling tools, people have to talk to each other. Picking up on the phrase ‘working with the willing,’ can a theoretical model be used to identify ‘willing’ and then bring them together thus shortening the ‘dating’ period?

- Dr. Hasler described IS as unifying the short term economic perspective with the longer term environmental perspective through increased efficiency; one participant asked ‘what if economic [benefit] comes at cost of the environment?’ Although this is a possibility (see e.g. Chertow and Lombardi 2005) it was suggested that to date most of the evidence pointed towards dual economic and environmental gain, and that the rigorous application of measurement and metrics can identify any negative environmental costs at an early stage. Under what conditions does economic gain outweigh environmental benefits? Is it a systemic problem such that the IS approach should be re-examined?

- Engagement precedes facilitation: engagement is the entry into the network – once engaged, specific exchanges can be facilitated. Regarding engagement, what are the tradeoffs between a targeted industry sector approach versus a targeted geographic approach? Under what conditions, and to what extent are they mutually supportive?

- The ecological metaphor was raised regarding the social network analysis, in that more diverse connections (may) make for a more robust system. The remodelled industrial system has been likened to a more complex natural system with increasing number of interactions. How robust is the metaphor? At the strategic level, do we want particular connections? Regarding facilitation, one might do some targeted exchanges for significant outputs – at what cost to the wider system/network? Are more connections always better? Is there such a thing as ‘too big’ a network?
• Society acts to discourage certain flows (e.g. toxins) in part through economic and regulatory burdens. IS allows companies to lessen these burdens, for example, through avoiding disposal. Would a more sustainable outcome result if the burdens were left intact to incentivize innovation? For example, does being able to recapture the silver from batteries prolong the reliance on a system that uses disposable batteries? Or as one participant put it, ‘is there such a thing as a bad connection?’ Does it hinder or prevent the system from evolving to a more sustainable form? IS interventions have resulted in culture change within companies that may accelerate more sustainable forms – is that as effective a path to a more sustainable outcome?

• The ultimate impact of IS on consumption has not been disaggregated. Do economic savings accrue to investors, or propagate through to consumers in the form of lower prices, or both? Is the net impact of IS to make industry more efficient at producing more throwaway goods?