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A REVIEW ON NETWORKING AND INNOVATION: THE POTENTIAL ROLE OF INNOVATION POLES

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ABSTRACT

There is considerable discussion in the literature about how to make Industrial Symbiosis (IS) effective, as well as the variables that may influence its implementation, such as networking and creativity. They've found little room for study thus far, preferring to focus on other technical and economic problems including the nature of the processes involved, regulatory difficulties, economic feasibility, and stakeholder engagement. They may, however, become important in certain situations, particularly when examined collectively and in their synergistic interplay. The Innovation Poles (IPs), which are government-sponsored consortia created within EU programs with the goal of stimulating innovation within networks of organizations and promoting competitiveness in specific industries or value chains at a local or regional level, are an interesting context to consider in this regard. In this article, we first describe how these issues have been handled in IS research so far, and then we examine the key characteristics of the IP model in order to determine if and how it may help to the growth and spread of IS. The study's knowledge base was built on a review of the literature through desktop analysis and direct investigation, with an emphasis on Italian patents. The findings indicate the beneficial role that the IP model may play, both in terms of its institutional activity of knowledge creation and distribution and, more importantly, as an applicative framework for IS.

KEYWORDS: *Clusters; Industrial Ecology, Industrial Symbiosis, Innovation, Innovation Poles, Networks.*

1. INTRODUCTION

Industrial Ecology (IE) is concerned with the effect of industry and technology on the biophysical environment, as well as the societal and economic changes that accompany them. To emphasize the possible reduction of environmental burdens, local, regional, and worldwide uses and flows of materials and energy in goods, processes, industrial sectors, and economies are examined. Industrial Symbiosis (IS) is a strategy within IE that encourages communities of businesses to collaborate to improve their economic and environmental performance. There is still a lot of discussion in the literature regarding how to make the IS effective and what variables influence its implementation, such as technical and organizational features, regulatory problems, company and stakeholder participation, and economic viability. The importance of networking and innovation is also acknowledged. Companies' networks are seen to be one of the most potential settings for IS because of their physical closeness and learned propensity for cooperation among the organizations concerned, particularly in the operational forms of industrial clusters or districts. Innovation is often seen as an important element of IS development, for example, in terms of offering new supporting technologies. Despite the fact that these topics are often addressed together, particularly in organizational studies, this seldom occurs in the context of IS development[1]–[4].

The Innovation Poles concept is an intriguing approach to explore in order to close this gap (IPs). They are government-sponsored consortia formed under EU initiatives with the goal of promoting local or regional competitiveness in particular sectors or value chains by encouraging innovation within networks of companies. Moving on from the fundamental characteristics of industrial networking and innovation, we look at the role that IPs may play in the creation and diffusion of IS in this article. The Italian territory is utilized as a source of regulatory and technical information on the IP model, which has spread rapidly and widely in this nation[5]–[8]. The study's findings will aid in the exploration of new spaces and possibilities for the development of IS in existing contexts, an area of research in which the authors have been involved for years, and they have conducted research on various forms of territorial agglomerations of companies, such as clusters, local supply networks, districts, and environmentally equipped industrial areas[9], [10].

The next sections detail the study methodologies utilized, and the existing areas for creativity and networking within the IS studies are explained to explain why these variables are deemed important. The idea of IP and its major characteristics are defined and explored in the second half of the essay to emphasize its potential and limits, as well as the roles that this model may play in relation to IS. At the end of the process, conclusions are made[2].

1.1. Networking and Innovation:

Industrial networks are hybrid patterns of economic activity coordination that incorporate the benefits of conventional governance methods such as vertical integration and market exchanges; they may take many different shapes and function at varied geographical scales. Innovation, according to the literature, refers to changes made by businesses to their goods, processes, and organizational structures in order to enhance their own operational or market performance. Organizational studies show that these two ideas are inextricably linked, and that their interplay may result in system changes. Many writers believe that businesses that are part of networks are

more creative than companies that are not; this is due to the existence of relationships that allow for learning and information exchange. Geographical closeness is often important in creating and enabling information transfers among network members, which increases the probability of innovation creation. Furthermore, it is a great tool for companies to communicate with one another. Economic geographers have also contributed to this discussion, pointing out that, in addition to physical closeness, cognitive and organizational dimensions are important factors in interactive learning and innovation within industrial networks.

1.2. Industrial Symbiosis:

IS networks are referred to as "complex adaptive systems" because they may emerge in a variety of ways and develop over time because to their resilience. An IS may include a variety of solutions (e.g., supply chain synergies, shared utility synergies, local use of by-products, energy, or wastes); it can depend on new or existing organizations; and it can develop in a planned, assisted, or spontaneous manner. Exchange connections are often facilitated by social relationships that are based on trust and cultural factors. Some of the participants (individuals or organizations) have a critical role (as external facilitators) in determining the IS's effectiveness. Participants gradually incorporate certain kinds of interaction, as well as other cultural aspects and values, over time, increasing their understanding of the program's original goals. IS has the potential to enhance the socioeconomic and environmental performance of the communities of businesses engaged, as well as the territory where it is created, in the long run. Despite its obvious promise, IS has had trouble spreading operationally. We can see from the dissemination rates that nations where it was able to design their development from the ground up (e.g., China) grew more quicker; in others, where development is based on existing industrial settings, cultural issues and resistance to change may emerge.

1.3. Industrial Ecology, Industrial Symbiosis and Innovation:

The book "Industrial Ecology and Spaces for Innovation" highlighted the possibilities for collaboration between innovation and IE research. According to the authors, innovation studies should examine how innovations alter socio-economic systems (including changes that affect the natural environment), while IE should shape socio-economic systems “metaphorically” as ecological systems (through a set of concepts and techniques that includes technological and organizational innovations). They also recognize that the two areas have a lot in common and that innovation is critical to attaining sustainable production and consumption, despite the fact that at the time, research on innovation were not being conducted in a systematic way in the IE community.

During the 2000s, the integration process has progressively developed, thanks to certain important contributions, such as the IHDP-IT Science Plan, which specified some realistic trajectories of technical and organizational change in terms of the environment, dubbed "Industrial transformation." In terms of methodology, significant progress has been made in the co-evolution of the perspectives of innovation studies (from individual initiatives to innovations within companies and sectors, up to systems of innovation) and IE studies (from individual initiatives to innovations within companies and sectors, up to systems of innovation) (from products, to processes, supply chains and whole economic systems). The incorporation of elements of policy and governance of socio-economic development under common research

topics resulted from this holistic and systemic approach that currently defines the two fields of study. Some writers have recently concentrated their attention on figuring out how technology innovation might help with IE. SWIT (Sustainable Wealth Creation based on Innovation Systems and Enabling Technologies) is a comprehensive framework and model that incorporates the utilization of suitable technologies and their integration into innovative supply chains. Other writers stress the importance of open innovation and business model innovation in putting recycling at the forefront of strategic business management[8].

There are just a few scholarly papers that explicitly examine the connection between innovation studies and information systems, and they all take various approaches to the subject. From an innovation standpoint, researchers developed a conceptual framework for evaluating sustainable supply network strategies. He stresses the importance of the "focal" business and suggests several methods. External orientation, transparency, learning capacity, leadership, autonomy, and results orientation are among the characteristics that characterize the strength of the business, according to him. Trust, clear plans, and an efficient information system all help to facilitate the exchange of these methods throughout the network. Other research examines the application of cutting-edge ICT techniques and tools in the context of IS, including modeling, mapping, and optimization of symbiotic networks.

1.4. Industrial Networking and Symbiosis:

Many scholars have emphasized the significance of industrial network studies in connection to eco-industrial systems. In the implementation of sustainable development methods within local and regional networks, the interconnections of economic, social, and environmental factors. He emphasized the need of multidimensional methods that include economic geography and regional economics research into certain "untreated interdependencies" (based on trust, cooperation norms, and routines) that constitute the foundation of local unique assets. The relationship between IS and the so-called "agglomeration economies," or positive externalities resulting from co-located businesses. It is discussed how various kinds of IS are adapted to different industrial setups. During the same time period, the significance of the linkages between the techno-sphere and the social system aspects in the study of IS was investigated by the IS program in Rotterdam. Several research on the emergence of IS in existing settings have focused on networking, both social and material. Some have explored the importance of tacit and explicit knowledge, as well as ICT technologies, in enhancing cooperation, while others have concentrated on embeddedness, which is linked to the notion of trust or closeness, in the application of Social Network Analysis (SNA). Several writers have recognized the potential of information systems (IS) to provide new possibilities and add value to local production systems, which is best shown by the industrial clusters or districts concept. In this way, networking may be seen not just as a precondition or an enabler of IS, but also as a result. Studies performed inside long-standing IS, such as symbiotic networks, have shown that they are capable of self-modifying, resulting in new areas for cooperation and relationships among the businesses involved[1].

1.5. Innovation Systems and Other Territorial Innovation Models:

The topics of innovation and networking are closely linked to the ideas of Innovation Systems (or System of Innovation) and, even more so, Regional Systems of Innovation in research on

local and regional economies. Innovation Systems are a collection of interconnected components (local actors, institutions, business networks, and technical variables) that work together to generate, exchange, and distribute innovation, knowledge, and technological development in a given region. They can have various spatial scales (national, regional, and local) or spheres of interest (sectoral dynamics, technological, or organizational), and they can include individuals from various contexts (public or private bodies, companies, research centers) or formalization levels (national, regional, and local) (spontaneous, planned). Their innovation activity may be assessed in a variety of ways, including the number of registered patents, the number of active initiatives, and R&D expenditures. Different variations of the idea of Innovation System may be found in the literature. They are sometimes referred to as Territorial Innovation Models by certain writers (TIM). A variety of new ideas have emerged as the conventional model of industrial districts or clusters has evolved into territorial organizations with significant scientific and technical implications. One that has gained popularity in recent decades is the Regional System of Innovation (RSI). The spatial size is the distinguishing characteristic of these systems. They are the result of the interplay of a number of variables linked to regional industrial growth (economy, technology, districts, research, learning, knowledge, and governance). Companies, institutions, infrastructure, knowledge, and a policy aimed at regional innovation are usually their building elements, and they are characterized by interactive learning (cross-fertilization), knowledge creation, proximity (geographical closeness), and social embeddedness (in terms of role of social relations)[7].

Other operational models based on networks of businesses, a territory, and innovation activities, such as Technological Districts and Science/Technology Parks, have expanded throughout EU areas in recent decades. Technological Districts are conglomerations of expertise in certain high-tech industries that have been designated as priority for a specific region. They are methods for transferring and connecting information about the circumstances that occur in a certain area. The Science/Technology Parks (STP) are a technical offshoot of the IDs, with the main goal of promoting the culture of innovation and competitiveness of businesses and organizations that produce knowledge. STPs facilitate the development of creative businesses by encouraging the flow of knowledge and technology among universities, R&D institutions, companies, and markets.

3. DISCUSSION

The research shows that partnerships (assured by the network) and changes (i.e., innovations) have been important in IS studies; it also shows that these two components have been positioned based on EU territorial innovation models, and therefore IPs. For these reasons, we think that IPs are attractive settings in which to study IS. A variety of factors have surfaced in favor of this, which are discussed.

It's worth noting that the environmental variable has been identified as a significant factor in almost 15 instances among Italian IPs. Some of them are in regions that have already begun to develop territorial solutions for environmental sustainability (for example, Tuscany's CLOSED project (Closed Loop System with Eco-Industrial Districts); Piedmont's development of the Environment Park Scientific and Technological Park; and Emilia Romagna's promotion of the

so-called Ecologically Equipped Industries). However, there are no clear allusions to the idea of IS in relation to IP initiatives.

Specialization by industry: By definition, IPs are made up of businesses and entities that are part of the same supply chain or industry, implying a degree of homogeneity in terms of the processes, resources, and products produced in the network (as emerging in the Italian context). This feature, when viewed in light of the potential for IS growth, identifies both good and negative topics for consideration. Internal homogeneity means that resources beneficial to IS (such as by-products and trash) are available in greater quantities and from a greater number of businesses, which may assist overcome certain "scaling" constraints. Other beneficial aspects include the ability to share expertise and the creation of shared management solutions for two or more businesses. On the other hand, because the involved organizations in the IS have similar flows, a high level of internal homogeneity in the network can reduce the chances of input/output matching; indeed, in some cases, a certain level of diversity among the involved firms is essential to allow symbiotic exchanges. Some of the barriers to sectoral homogeneity may be overcome by encouraging inter-IP synergy. In this scenario, the involvement of a coordinating organization (or knowledge-sharing among IP managers) would be required to enable the start of contacts between the businesses concerned.

Spatial scale: Scientific research and practical examples indicate that businesses in an IS do not have to be co-located. Long-distance transfers, however, may result in additional costs and environmental effects since IS is built on exchanges of low-value-added flows (e.g., trash). As a consequence, proximity, in general, favors high IS exchange efficiency; nevertheless, some findings indicate that, when dealing with recovery and recycling problems, it is impossible to assign any specific geographical scale a priori, since economic transaction motives often dominate. Other research suggests that a "local" scale may compensate for certain trade-offs (such as those between "technical and organizational skills" and "degree of personal affectedness"). IPs may have a varied geographic size, according on the data gathered. They may overlap existing industrial clusters or districts (as in some cases in the Tuscany region), or they may involve companies from the same region or even beyond regional boundaries (as in some cases in the Abruzzo region), and then operate transversely to existing industrial sites (as in some cases in the Tuscany region).

3. CONCLUSION

The potential synergies and critical issues between the two models of local development of Industrial Symbiosis (IS) networks and Innovation Poles (IPs) have been investigated in this article, which moves from the common features of industrial networking and innovation to the potential synergies and critical issues between the two models of local development of Industrial Symbiosis (IS) networks and Innovation Poles (IPs). The study's knowledge base was built on a review of the literature and firsthand investigation. The Italian territory has been utilized as a source of regulatory and technical information on the IP model, which has seen fast and widespread adoption in this nation. To begin, it was discovered that networking and innovation are two important elements in IS research; it was also verified that they have been underutilized as a common foundation for IS development, but are at the heart of EU territorial innovation models, including IPs. The positive role that IPs can play in the development and diffusion of IS

in a given territory can be attributed to their institutional activity of knowledge and innovation production and dissemination, and, more importantly (if considered as applicative contexts for IS), to their promotion of the establishment of symbiotic relationships among their members. Some factors, such as sectoral specialization, geographical scales, the presence of social connections and trust, the involvement of stakeholders, and regulatory problems, have emerged as important in this regard. There were also a number of policy and management implications for local development that were discussed. To begin with, the potential advantages to the area from the spread of the IS model are many, and this should be carefully examined by regions and local officials. Second, since IPs were not designed with this goal in mind, important synergies between the IP model and other methods and instruments for local sustainable development may emerge. Concerning the study's limitations, it should be noted that they are related to the study's scope (the sample is limited to Italian IPs) and the availability of data, as the IP model is still understudied, and examples of its practical application are too recent to provide a meaningful picture of how they work. Our future efforts will be focused on identifying new operational scenarios in which we may further develop and test our findings.

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