Business Networking For Sustainable Development

COMPETITIVE PAPER FOR 32ND ANNUAL IMP CONFERENCE

Joanna Wiśniewska-Paluszak and Grzegorz Paluszak
Department of Economics, Poznan University of Life Sciences
Department of Money and Banking, Poznan University of Economics and Business

Abstract

The main research question of the paper is: what are the motivations for business to network for sustainable development. In order to answer this question two kinds of studies have been done. Firstly, the review of the literature has been done. Two sets of theories have been considered as suitable to answer the question – the theory of industrial ecology and the theory of industrial networks – because both of them define business as a systematic network of related modes which is characterised by interrelation between nodes and flows. The review of the theories let to the assumption that the incentives for business to network for sustainable development are exogenous. The exogenous incentives may come from NGO's like in the IKEA case (Håkansson and Waluszewski, 2002). The exogenous incentives may come also from public policy towards sustainable development like public initiatives fostering the development of eco-industrial parks and eco-industrial networks (Desrochers, 2001). Nevertheless, the Kalundborg Industrial Park was never planned for industrial symbiosis, and was spontaneously developed over a period of 20 years (Ehrenfeld and Gertler, 1997). Secondly, in order to answer the research question the case study has been conducted. For the case study the network of the Polish green bank has been selected. The assumption has been made that the green bank provides the exogenous incentives in form of investments and finance to network for sustainable development. A green bank is a linkage between the industrial networks and industrial ecology, because its mission is to combine business and ecology for the benefit of customers. A green bank is a state chartered and state capitalized lending institution designed to fill gaps in private market finance for clean energy generation and energy efficiency. It is a public or quasi-public financing institution that provides low-cost, long-term financing support to clean, low-carbon projects by leveraging public funds through the use of various financial mechanisms to attract private investment so that public money supports multiple moneys of private investment (Coalition for Green Capital, 2014).

This paper results in providing confirmation that there are different exogenous incentives for business to network for sustainable development like NGO's, public policy or even public investments and finance. But the network for sustainable development depends finally on links which are negotiated as an independent business deal, and are established only if they are expected to be economically beneficial. The results of this paper contribute to IMP Group theory contributes by showing the role of the eco-financier in the organising the sustainable industrial network.

Keywords: sustainable industrial network, industrial ecology, industrial networks, green banking, green bank stakeholders.

Acknowledgements: The research has been possible to conduct under the financial support of the National Science Centre Poland contracted on the decision number DEC-2013/09/B/HS4/01494.

INTRODUCTION

The sustainable development is the most important challenge for each economic unit of the modern economy. There are two notions of sustainability – the narrow one and the broad one. The first one is about the sustainable growth, which means long-lasting competitive advantage of the economic unit. The second one is about the sustainable development, which means preventing ecosystems like ecological and human health from

which derives the long-lasting company, as well as intergenerational and inter-societal equity which enables the continuity of economic unit. Namely, economic systems and ecosystems are interrelated. Sustainable development has been defined in many ways. But the most frequently quoted definition is the one proposed in 1987 by the World Commission on Environment and Development:

"*Sustainable development is development that meets the needs of the present without compromising the ability of future generations to meet their own needs." (Brundtland Commission 1987).*

This definition contains two key concepts. The first concept is about the needs, in particular the essential needs of the world's poor, to which overriding priority should be given. The second concept is about limitations imposed by the state of technology and social organization on environment's ability to meet present and future needs. For businesses, the notion of sustainability necessity means stepping out of narrow confines of what a business does, and thinking beyond economic considerations. The concept of sustainability adopted for business has generally the four features:

- recognition of the widespread interdependence of species and ecosystems,
- it always involves systems beyond the immediate focal organization,
- understanding the presence of longer-term effects in addition to immediate short-term gains,
- multiple dimensions of performance beyond simple economic profits, e.g. social performance and cultural sustainability (Porter and Derry, 2012).

This perspective clearly shows that sustainable development of firm requires that economic dimensions are being considered at the same time as social and ecological dimensions. It acknowledges the interdependency of three dimensions on a firm's strategy. Therefore, it highlights transformation of the correct understanding of firm's sustainable development from a one-dimensional "making profit for the shareholder" approach to an integrating three-dimensional sustainability that requires the development "from shareholder to stakeholder" approach (Kakabadse, Rozuel, and Lee-Davies, 2005, p. 279).

According to the sustainability, firms can survive only when their activities meet the expectations of stakeholders and social norms (Lee and Carroll, 2011, p. 117). Indeed, stakeholders are commonly treated as a link between the organization's goals and the society's expectations (Iivonen and Moisander, 2014). According to R.E. Freeman, a stakeholder is "any group or individual who can affect, or is affected by, the achievement of a corporation's purpose" (Freeman, 1984, p. 53). A general definition of stakeholders refers to shareholders, customers, partners, employees, unions, local community, society, government, non-governmental organizations, associations, competitors, investors and suppliers. The sustainable development can only be realized by demanded a new way of thinking not only for firms, but also for contract inter-firms relationships and noncontract relationships with all of the stakeholders (Baraldi, Gregori, Perna, 2010).

The main research question of the paper is: what are the motivations for business to network for sustainable development.

In order to answer this question two kinds of studies have been done. Firstly, the review of the literature has been done. The idea of the paper comes from the industrial ecology as a background for organizing sustainable industry ecosystem and from industrial networks as a background for organizing sustainable industry network. Both of the background concepts are based on the substance understanding of the industry as an inter-firm relationship. Secondly, in order to answer the research question the case study has been conducted. For the case study the network of the Polish green bank has been selected. The

assumption has been made that the green bank provides the exogenous incentives in form of investments and finance to network for sustainable development.

The paper aims at analyzing the role of green banking in organizing sustainable industrial network.

The main hypothesis of the paper is that the green bank works to mobilize other industrial actors to undertake activities and devote resources to implement network strategies of sustainable development.

The main contribution of the paper is the proposition of integrating network analysis into the complex structure of green banking system interactions and relationships with industrial system which aim at eco-development into the coherent industrial ecosystem. The conceptualization of green banking network using the close loop model of industrial ecology and ARA model of industrial network is configured to address explicit environmental issues. The main assumption of the sustainability network model is that the relationships of banks with stakeholders (i.e. suppliers, employers and customers) are based on mutual benefit and sustainability outcomes.

The paper is organized as follows. In the first part of the paper the research background has been presented, i.e. the insight into concepts, theories and methods applied within the areas of industrial ecology and industrial networks. In this part of the paper the juxtaposition of genesis, system and structural orientations, paradigms and ideas, empirical methods and practices of both approaches has been developed to show their possible contribution to the theory of sustainable industry network. The second part of the paper presents the green banking community in Poland and the conceptual analysis of the green bank as an actor of sustainable industrial network. It starts with the presentation of the concept of green banking, its definition, purpose, and activities. The paper lasts with the conceptual analysis of the role of green banking in sustainable industrial network. The conceptual analysis has been verified under the provided case study on the green bank network.

METHODOLOGY

The paper use descriptive and comparative methods of literature review for discussing the research background. Then the method of theoretical conceptualization has been used as an analytical tool of the case study of the Polish eco-bank. The case study has been mainly descriptive based on the investigation and collection of qualitative data from official documentation of the focal financer, i.e. Bank for Environmental Protection (BANK BOŚ) and individual in-depth interviews with client adviser in the BANK BOŚ and with the regional sales director in the Hybrid House Tritum Business Park. Prospects and ecological reports of BOŚ from years 2012-2016 have been used for collecting of quantitative and qualitative data on BOŚ capital group network.

Bank BOŚ has been selected among other green banks as the one and only bank that has the environmental protection in its name, and is the only specialized bank for environmental protection in Poland. Its main shareholder is the National Fund for Environmental Protection and Water Management (NFEPWM). It has the highest amount of used resources of pro-ecological credits, i.e. 4.9 MLD PLN (33.1% of total BOŚ credits) in December 2015 year (BOŚ 2015a). It has among Polish banks the most extended internal and external network of actors as well as it undertakes the most extended proecological activities.

The paper is based on the critical paraphrasing and modifying of economic approaches and concepts of industrial ecology and industrial network to hypothesize and theorize on sustainable networking preconditions and motives. It serves for conceptualization of green banking network using modified ARA – model in which industrial ecology is being considered as the main reason for connecting actors, resources and activities for creating new

industrial ecosystems based around the main financier who supports the creation of the new industrial ecosystem like hybrid house industry.

THE RESEARCH BACKGROUND

Industrial Ecology

The industrial ecology theory has changed the attitude of each industry theory towards the ways of its sustainable development. It has entered the world of industrial development and business strategy in the 70s. Nowadays, industrial ecology is at a critical stage in its evolution (Ehrenfeld, 2004, p. 825). In defining industrial ecology important attributes in connection to the industrial systems are being considered. They are:

- a systems view of the interactions between industrial and ecological systems,
- a change from linear (open) processes to cyclical (closed) processes,
- integrating industrial activity into ecological systems,
- making industrial systems emulate more efficient and sustainable natural systems (Garner and Keoleian, 1995, p.4).

R.A.Frosch and N.E. Gallopoulos (1989) stated for the first time in the history of industrial ecology that: "*The industrial systems impact on the environment would be naturally reduced. To lessen the burden the industrial ecosystem would function as an analogue of biological ecosystems. An ideal industrial ecosystem may never be attained in practice, but both manufacturers and consumers must change their habits to approach it more closely if the industrialized world is to maintain its standard of living and the developing nations are to rise to a similar level without adversely affecting the environment. Developing nations will have to leapfrog older, less ecologically sound technologies and adopt new methods more compatible with the ecosystem approach.*"(Frosch and Gallopoulos, 1989, p.144).

The industrial ecology uses the links among industry subjects to define the industry ecosystem (biosystem). The main assumption of industrial ecology is that industries which share and/or exchange inputs and outputs (e.g. raw materials, products, process wastes, or water) constitute together an industrial ecosystem. When these interacting industries are collocated, then the industrial ecosystem is referred to as an eco-industrial park or industrial symbiosis. The latter is often referred to as an industrial symbiosis complex. The model of industrial ecology was first fully realized in the eco-industrial park at Kalundborg in Denmark. The primary partners in Kalundborg, an oil refinery, power station, gypsum board facility, pharmaceutical plant, and the City of Kalundborg, literally share ground water, surface water and waste water, steam and electricity, and also exchange a variety of residues that become feedstock in other processes (Chertow, 2000, pp. 315-316).

The industrial ecology defines interactions and relationships in industrial ecosystems. Today, industrial ecology is the study of the physical, chemical, and biological interactions and interrelationships both within and between industrial and ecological systems. One of the goals of industrial ecology is to change the linear nature of industrial system to a cyclical system where the wastes are reused as energy or raw materials for another product or processes (Garner and Keoleian, 1995, p.2). New ideas of industrial ecology serve for: process and product design, defining industrial development, establishing new hybrid forms of cooperation, organizing material recycling in loop-closing systems, analyzing industrial interdependencies, and creating holistic communities (Ayres and Ayres 2002).

The industrial ecology has developed analytical tools, which may be used by firm, in particular in inter-firm networks for sustainable development. Industrial ecology has developed many tools, such as: design for the environment, life cycle design, environmental accounting, and pollution prevention. Various strategies are used by individuals, firms, and

governments to reduce the environmental impacts of industry. Each activity takes place at a specific systems level. Strategies related to industrial ecology comprise:

- pollution prevention (the use of materials, processes, or practices that reduce or eliminate the creation of pollutants at the source)
- waste minimization (the reduction, to the extent feasible, of hazardous waste that is generated or subsequently treated, sorted, or disposed of)
- Total Quality Environmental Management (TQEM) is used to monitor, control, and improve a firm's environmental performance within individual firms (Garner and Keoleian, 1995, p.12).

There are different system tools to support industrial ecology: Life Cycle Assessment (LCA), Life Cycle Design (LCD), and Design for the Environment (DfE). First of them i.e., LCA is a method of evaluating environmental burdens associated with a product, process, or activity. It embrace three elements: impact assessment - ecological health, human health, resource depletion, inventory analysis – materials and energy acquisition, manufacturing, use, waste management, and improvement assessment – evaluation, designing strategies to reduce the identified environmental impacts and implementation of opportunities to reduce environmental burdens. LCAs can be used to compare the environmental profiles of alternative products, processes, materials, or activities and to support marketing claims. Second of the tools i.e., LCD is a system-oriented approach for designing more ecologically and economically sustainable product system. The last one i.e., DfE – is a design strategy to design products manufacturability, testability, reliability and others. The design strategy focuses on integration environmental issues into product and process design (Garner and Keoleian, 1995, pp.12-22).

Industrial ecology ideas are realized on the facility or firm level, at the inter-firm level, and at the regional or global level (Figure1). Industrial symbiosis occurs at the inter-firm level because it includes exchange options among several organizations. The interacting industries may be collocated in a formal industrial parks or in informal industrial park i.e. cooperate without any element of common management. Industrial ecology is the study of the interactions between industrial and ecological systems. In industrial ecology, one focus (or object) of study is the interrelationships among firms, as well as among their products and processes, at the local, regional, national, and global system levels.

The inter-firm physical relationships are naturally suitable to be transformed into a network structure. The latest research conclude the existence of industrial symbiosis networks which emerge as a series of symbiotic relationships between and among regional activities and involve physical exchanges or material and energy carriers as well as the exchange of knowledge, human or technical resources, concurrently providing environmental and competitive benefits (Li and Shi, 2015; Schiller, Penn and Basson 2014; Posch, 2010). In the latest research on industrial symbiosis three patterns of network cooperation have been observed:

- resource recovery networks without common investment,
- resource recovery networks with common investment,
- energy cascading networks as a specific form of inter-company cooperation with common investment (Schiller, Penn and Basson 2014, p. 5).

Nowadays, industrial ecology has been identified as a strategy for promoting industrial sustainability. The perspective of industrial organization and especially of industrial networks should be considered while identifying and implementing strategies to reduce the environmental impacts of products and processes associated with industrial systems, with an ultimate goal of sustainable development. Resource conservation and waste minimization have been major concerns in the process industry. Tracing flows of energy and materials

through various systems is fundamental to industrial ecology. By quantifying resource inputs and the generation of residuals and their fate, industry and others, stakeholders can attempt to minimize the environmental burdens and optimize the resource efficiency of material and energy use within the industrial system. By tracing material and energy flows and performing mass balances, one could identify inefficient products and processes that result in industrial waste and pollution, as well as determine steps to reduce them. In the result, he waste produced by one company would be used as resources by another one and no waste would leave the industrial system or negatively impact the environment (Garner and Keoleian, 1995, p.3).

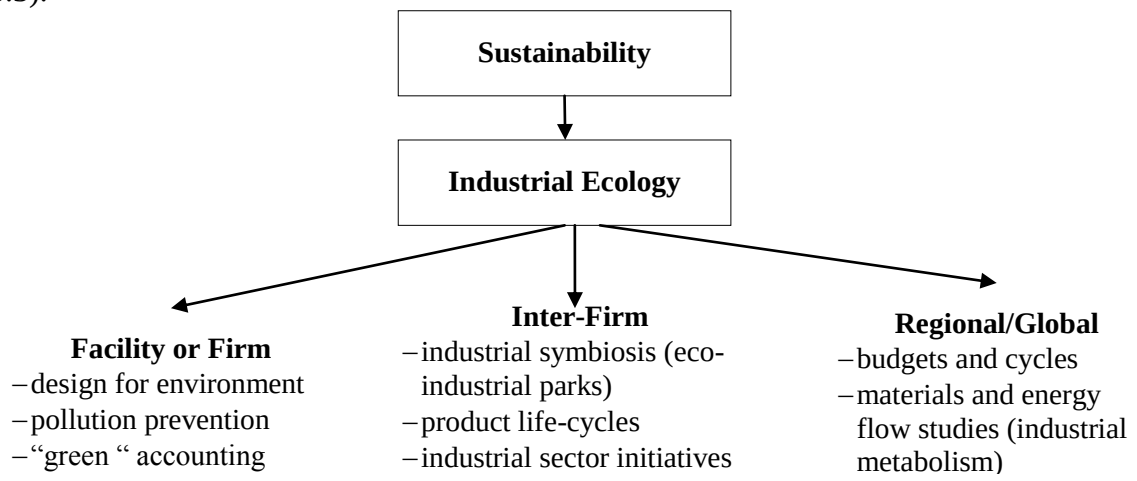

Figure 1. Industrial ecology operates at three levels
Source: M.R. Chertow (2000)

Recently, the industrial ecology is more and more often recognized as the study of the effects of the material and energy flows not only on the environment, but also on the economic, political, regulatory and social factors as well as the reverse influence of these factors on the industrial flows. The social network analysis has being used for studying of self-organizing industrial symbiosis with the assumption of the embeddedness of industrial networks in industrial ecology. It is evident that industrial nodes can be connected by various types of ties including material and energy flows, financial transactions, information, and social interaction. Despite industrial ecology's primary interest in the functional ties that establish metabolism of the network, it also needs to consider indirect social influences, e.g. research institutes spreading knowledge, banks handing out loans or regulators introducing new regulations. New models of social analysis of material flows initiate the discussion on metabolic relationships in time and space which are produced and reproduced by social relationships (Schiller, Penn and Basson 2014, p. 2, Velenturf and Jensen, 2015).

Material conversion and treatment rise also awareness in research on sustainable industry. Publications on environmental impacts of industry traditionally focused on the technology aspects. Nowadays the view shifts away from the technology approach toward holistic approach to "green industry" dealing with the social and economic aspects, as well as the complexity of "greening supply chains" (Dornfeld, 2012). When sustainable development is the goal, the design process is affected by external and internal factors like: government policies and regulations, consumer demands and preferences, the state of the economy, competition, current scientific understanding and public perception, as well as corporate policies and the companies' mission, product performance measures, product strategies, and resource availability.

Today the aspiration of broadening the concept of industrial symbiosis towards social and structural dimensions lay in:

- the fact that environmental protection is more than the recycling of materials (in fact, recycling is an end of the pipe activity and therefore counts only as a second-best solution, it does not aim at avoid or reduce the negative outcome of production processes),
- sustainable development is more than environmental protection (it implies three dimensions: economic prosperity, environmental quality, and social justice),
- transition towards sustainability requires the involvement of all relevant actors (region, industry, regulators, consumers, households, interest groups, and so on) (Posch, 2010, p.246).

To sum up, nowadays the concept of industrial ecology is being developed towards a holistic approach recognized namely as an industrial sustainability. Recent studies draw more attention from technological and metabolic relationships in industrial symbiosis towards new social, spatial, and business inter-firm relationships. Their outcomes show that only the ability to mobilize decisive managers is crucial for delivering industrial symbiosis. They need real incentives to enter eco-industrial parks and industrial symbiosis. This broadening of industrial symbiosis requires new models of social relationships, finance flows, state regulations, and so on. The industrial symbiosis and creation of industrial ecosystem is the way of reaching sustainable development nowadays.

Industrial Networks

An industrial network is one of the modern theories of industry. For industrial network the most important subject is the relationship between firms in the industry. The theory assumes that the whole activity and each change of the activity of the firm takes place in the relationship and those relationships are a central feature of business and organizational landscape of modern industries. Since the early 70s the Industrial Marketing and Purchasing Group (the IMP Group) has been concerned with the understanding of the content and shape of business relationships. This approach known as industrial network or just network approach exemplifies that an economic world consists of networks of business relationships. The approach has prevailed idea that atomistic companies are doing business in the world of anonymous suppliers and anonymous consumers. The main phenomena observable in networks are cooperation, competition, interactions, business relationships, movement, relatedness, and exchange.

The main feature of business is interaction which, according to D. Ford and H. Håkansson, (2006), has several key characteristics: time, interdependence, relativity, jointness, and subjective interpretation. The interaction that takes place between single actors is always the outcome of their previous interactions, as well as of their current interactions with others and their anticipation of future interactions of others. Therefore, business interaction is embedded in past, current and future time. The inherent characteristics of interacted network structures are interdependencies. In networks they are built mainly on technological, economic and resource dimensions. These interdependencies bring different kinds of organizational, social, strategic, logistical consequences as well as effect on production structure, product development and economic effectiveness. The observable phenomenon shows that efficiency of resources evolves together with exploitation of considered interdependencies by the network partners. Since interaction always takes place in relation to others, there are no simple or stable rules as well as everything is time relative. The next key characteristic of business interaction, i.e. jointness develops in many aspects: combined intentions, specific investments, mutual commitment, and common aims of network partners. The last but not least characteristics - the subjective interpretation means that all

actors have their individual interpretations of the actions of others and their interactions are based on those interpretations (Ford and Håkansson, 2006, pp. 7-16).

The interactions evolve into temporal relationship with specific features typical for business. H. Håkansson and I. Snehota (1995) distinguished two main kinds of characteristics for business relationship. They are: structural characteristics, as follows: continuity, complexity, symmetry and informality and process characteristics, as follows: adaptations, cooperation and conflict, social interaction and rutinization (Håkansson and Snehota, 1995). Major customer and supplier relationships of company show continuity and relative stability. The long-run relationships are precondition for change and development in the network. Business relationships are complex in many ways, e.g. number, type, contact pattern. Typical business relationships appear symmetrical in terms of resources and initiative of the parties involved. They often have a low degree of formalization. Mutual adaptations are a prerequisite of the development and continued existence of relationship between two companies. Elements of cooperation and conflict coexist in business relationships. Despite business relationships being essentially about business-specific behaviors – subjective values – the personal bonds and convictions that are always present, play an important role in formation of a relationship. While business relationships are often complex and informal, they tend to become institutionalized over time (Håkansson and Snehota, 1995, pp. 9-10).

Regardless of the type of industry, a company always operates within a texture of interdependencies that affects its development. A few are repeatedly encountered in various business relationships, i.e.: technology, knowledge, social relations, administrative routines, systems and legal ties (Håkansson and Snehota, 1995, p. 12-13). In networks technical development within one company and in its relationships is dependent on other companies' technologies. It is facilitated or constrained not only by those with whom the company maintains direct relationships but also by the technology of other third parties. In the same way, the know-how of the company reflects not only the knowledge of its personnel but also that of the other companies and organizations to which it is connected through business relationships. The solutions adopted in one (or several) relationship(s) will affect what is possible or necessary to do in some other relationships. The legal texture is of interest as it can connect different business units with privileged ties. This applies especially to different forms of ownership control or other forms of agreements. Social bonds that arise among individuals in the two companies are important for mutual trust and confidence in interaction between individuals.

H. Håkansson and I. Snehota (1995) introduced a broad analytical scheme to identify where and what effects are likely to occur as business relationship evolves. It includes the immanent independencies between organizations involved in the network. The network scheme consists of three characteristics (the layers): activities, resources and actors. It is known as the ARA Model (Figure 2). This analytical scheme is used to identify where and what effects are likely to occur as a relationship is established, evolves or is interrupted. In the model there are three distinct columns: company, relationship and network. The authors consider that it can be used in analyzing business relationships and three types of effects: the direct effect changing the potential of the relationship (column 2), on the companies and their cost-revenue payments (column 1), and effects in the overall network (column 3). Companies have its own activity structure, organizational structure and resource collection. They develop relationships with other companies as activity links, resource ties and actor bonds. The companies influence the development of relationships and the development of relationships influences the companies. There reciprocal conditioning exists. The relationship effects spreads among other companies and creates network as an aggregation of actors with activity pattern, web of actors and resource constellation. The relationships influence the network and

again the network influences the relationships. Also, the relationship layers representing activities, actors and resources interplay as activity links, actor bonds and resource ties.

By and large, network is considered as a structure with number of nodes related to each other by specific threads. Business threads distinguish from social threads or market threads with their complex interactions, resource ties, knowledge exchange, reciprocal adaptations, common specific investments as well as unique technical and human resources. The business relationships are recognized as a complex and long-term and their current form is the outcome of: previous interactions between the business units, learned knowledge about the partner and the relationship, other relationships with other partners, the expectations of the future interactions, and what happens in the wider network of relationships.

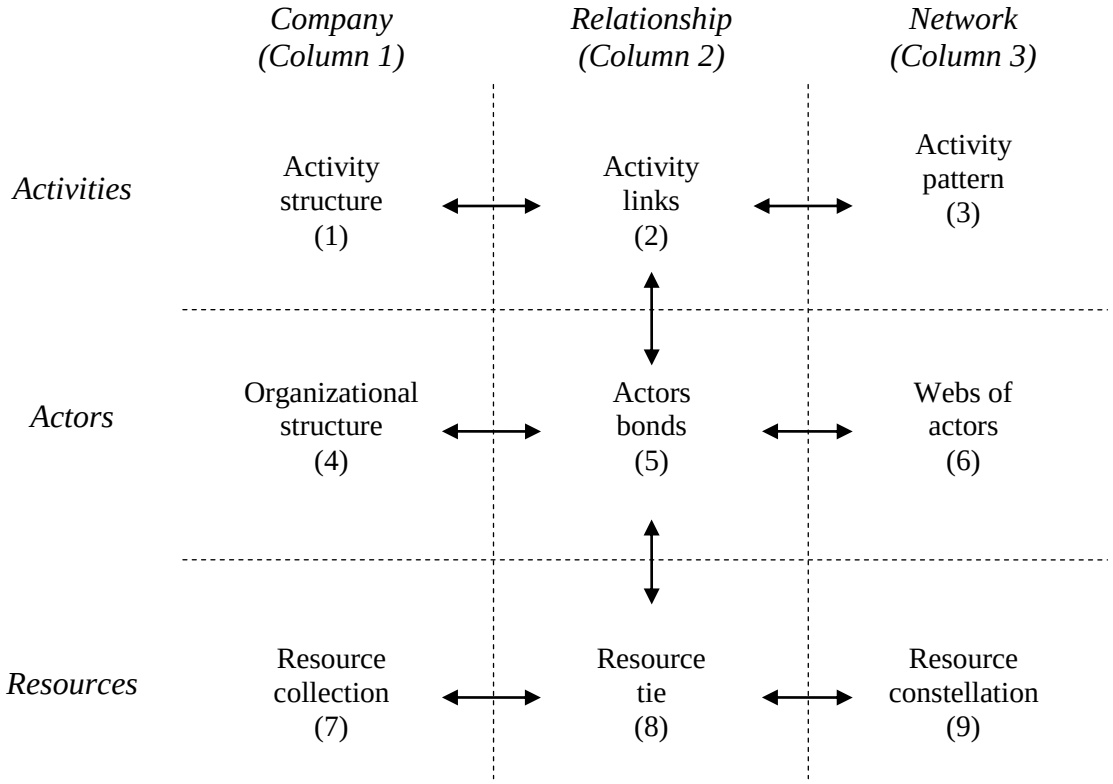

Figure 2. Scheme of analysis of development effects of business relationships
Source: H.Håkansson and I.Snehota (1995)

H. Håkansson and D. Ford (2002) underline three paradoxes which take place within the network. The first paradox is that networks creates opportunities as well as limits for the participants which actions should be considered as a part of the whole network activity. The second paradox is that each action influences other actions and each network partner influences others and is being influenced by others. The third paradox is about control and its effects for the network development. It is connected with the governance and management aspects of the network. In general, network ties should be strong, well establish and cooperative but uncontrolled. The more the one company controls the network, the less effective and innovative is the network.

The reciprocal relatedness in networks results in the strategy decisions of companies undertaken within the network. The network efficiency and effectiveness are determined by the way in which activities are configured and integrated, how resources are combined and which are the positions of the actors. These network structures are affected by, and affect, the three elements of supply strategy: relating, bounding and organizing. These elements mixed in numerous ways give the opportunity to choose different network strategies (Gadde,

Håkansson and Persson 2010, p. 242). In the network strategy business relationship is regarded as a resource that company can control and which can change the position of the company in the network. The strategy analysis of business networks consists of: network picture, networking and outcomes. The first is visualization and verbalization of the network by a particular actor. The second is initiating, responding, and maintaining the substantive networking. The third is analyzing all evolving effects of interactions, *inter alia* economic, social, and technical results (Håkansson, Ford, Gadde, Snehota and Waluszewski 2009, pp.180-197).

The last, but not least feature of business network is that building-up the activity patterns, webs of actors and resource constellations takes time. Network is a temporally evolving phenomenon, movement, change, flow, and process consisting of events, activities, and choices. L. Bizzi and A. Langley (2012) highlight that networks among organizations are not seen as structures that change over time, but rather as dynamic inter-relationships reconstituted incessantly by ongoing activity, adapted and reproduced through space and time. According to A. Halinen, Ch.J. Medlin and J-Å. Törnroos, (2012) time and space are the central constructs by which human grasp and comprehend change. In network analysis, they consider time as an individually and socially constructed event-time, and suggests that using the entities event times together with clock time can notably improve the understanding of processes, change and development in business networks.

To sum up, a business network is a specific quasi-organization with a specific structure of interactions and interdependencies and specific economic, technical, and social dimensions. Nowadays, industry networks are the main feature of the business landscapes. The network approach is an evolving academic field enclosing different kinds of studies, research, and analysis on business networks. Within the frames of network approach a general model of business relationships has been developed in terms of activities, resources and actors. The model is widely used for different kinds of analyses, e.g. the positive and negative effects of strong ties on innovation, processes of network evolution, network performance effects, effective change of management practices, interplay between network structures, process of resource development and many others.

Contributions of Industrial Ecology and Industrial Networks to the Theory of Sustainable Industrial Networks

Industrial ecology and industrial networks are pretty heterogeneous in their approaches and practices as well as in the areas covered. Both of the concepts take their roots from industrial economy. But instead of the common way of viewing individual actors (atomized) as loosely coordinated by price signals in a market, they both established systems orientation of bounded actors closely related to each other, tied by different relationships. In their worlds of specific relationships the most important are movements, flows and changes which take place among tied actors. The ties determine decisions and development. In the first issue of IMP Journal it was stated in the editor letter:

"*The conventional view of the structure of business is of independent companies and anonymous markets. In contrast, the IMP view has been that new insights can be obtained by viewing the structure of business as a network of significant relationships between interdependent companies. IMP studies have also been based on a particular idea of the process of business. Rather than considering a process based on the actions of independent companies, we have seen the process of business as one of interaction between interdependent companies*." (Ford, 2006, p. 2).

Developing green products is complex and often requires combining technologies from several actors. It is relevant to view creation of eco-sustainable solutions from an industrial network, interactive perspective (Baraldi, Gregori and Perna, 2010). Developing

green products in industrial networks is through interaction with each other and the establishment of stable relationships to comprise economically critical means of directing, organizing and exploiting eco-development over time. What the IMP literature stress, and what is missing in the industrial ecology literature is the differences among the actors approaches especially with the established investments. In the industrial ecology all investments are made for the reason of improving an industrial biosystem (ecosystem). In business networks all investments are made in relationships with other actors.

In the current forms the industrial ecology and industrial networks may be considered as two different interaction models. Contributions of both approaches into sustainable industrial network includes following (Table 1). The first and the most important is that in both concepts the main driver of interaction is sustainable development, high efficiency and high effectiveness. But the difference is that industrial ecology models drive towards eco-efficiency achieved by the delivery of competitively priced biomasses and services that satisfy human needs and bring quality of life, while progressively reducing ecological impacts and resource intensity throughout the life-cycle to a level at least in line with the earth's estimated carrying capacity (Lehni, 2000, p.11). Industrial network models drive towards relation-efficiency achieved by the stable relationship with other business units (Håkanson and Snehota, 1995, p.45). In the relational model environmental standards are being negotiated by business partners with established investments (Håkansson and Waluszewski, 2002).

The network models embraces effectiveness achieved by the interaction behavior of individuals in relationships. The activities taking place between companies, rather than activities within companies, are the determinants of the overall effectiveness of the company in achieving its goals (Håkanson and Snehota, 2006, pp. 265-266). The effectiveness of a business firm is not given by the possession of the "right" set of resources accessed by a "right" set of relationships at each moment in time but by the involvement in relevant change process-the movement, in the context of the company (Håkanson and Snehota 2006a, p. 273). Effectiveness is a long-term objective and efficiency is a short-term achievement (Mouzas, 2006, p.1128). Efficiency involves financial discipline and control over operating margins and working capital requirements, while effectiveness necessitates the company's ability to develop their own strategy for sustainable growth. Hence effectiveness is linked to the companies' access to idiosyncratic resources of other companies and to the achievement of differentiation and innovation (Mouzas, 2006, p.1131).

Economic structures are in both concepts determined by the relationships. In industry ecosystems the circulation of flows is closed as in natural systems. Contrary, in business networks, the relationships are open for direct and indirect expansion. The paradigms of industrial networks and industrial ecology underline changes and transformations towards more efficient and more sustainable development. In industrial networks the most important is efficiency of resources, activities and companies themselves. In industrial ecology the most important is reduction of wastes and looses.

The main paradigms of both approaches underline that in the economic world the most important are processes which take place between companies. They are flows and interactions. Therefore, the main coming ideas says about interrelatedness of industrial and business processes, with related episodes in a process of development that comprises a life cycle consisting of a number of different stages (metabolism, symbiosis, interdependence, relationships). Both supply-chain management and industrial ecology foster links between various types of enterprises across all manufacturing and processing industries. Theoretical concepts of industrial ecology and industrial networks shift academic and business practices towards planning and strategizing in relationship with other actors.

Table 1. Contributions of industrial ecology and industrial networks to sustainable industrial networks

Categories	Industrial Ecology	Industrial Networks
Genesis	Pioneering works in 1970s Journal of Industrial Ecology founded in 1997 International Society for Industrial Ecology (ISIE) in 2000 by the New York Academy of Science	Pioneering works 1970s In 1976 the first joint research project of the Industrial Marketing and Purchasing Group (IMP Group) 2006 first issue of the IMP Journal
Systems orientations	Industry ecosystem with materials and energy flowing through a myriad of interconnected production processes contributed to the close cycle of economy	Industry network with different modes which are related to each other by specific interactions and non-linear flow of goods, services, and knowledge
Structural orientations	Industrial ecosystem is comprised of interconnected actors which are recycling materials and energy with no waste (close loops)	Economic world is comprised of networks of interconnected relationships between independent companies (open loops)
Paradigms	Flow is a process between companies which changes and transforms wastes into an energy or raw materials for another product or processes	Interaction is a process between companies which changes and transforms resources, activities, and the companies themselves
Ideas	Industrial metabolism Industrial symbiosis	Business interdependence Business relationships
Empirical methods	Case studies An aggregate and organizational studies Material and energy flow studies	Case studies An aggregate and organizational studies Flow, point and sequential mapping
Practices	Material Flow Accounting Substances Flow Analysis Life Cycle Analysis Life Cycle Design Design for the Environment Total Quality Environmental Management	Flow and visual mapping Process perspective Pattern matching Grounded theorizing Network strategy Management of supply networks

Source: own elaboration based on the subject literature

Both of the concepts use sociologic and anthropologic studies to understand rules of social interaction. They apply such social characteristics of inter-personal relations as: communication, trust, motivation, commitment, reciprocity, and many other morphological and interpersonal characteristics of social relationship. The interaction includes both inter-personal communication and interaction through delivery of physical products and services, information, knowledge and payments. Social and material dimensions are interdependent and dynamic. Notwithstanding, both industrial ecology and industrial networks aim at other than sociological studies of inter-personal relationships. They neglect the inter-personal relationships and merely focus on the connectedness. They focus on build-up perspective on network flows and processes producing a growth instead of structural holes and different

degrees of separation, on resource interdependency instead of synergy, on comprehensive analysis of relations between organizations and surroundings than exclusive focus on inter-personal relationships (Goduscheit, 2007, p. 8; Schiller, Penn, Basson 2014, p.5).

Empirical researches in both discussed approaches are based on qualitative methods, mainly case studies. The level of analysis is on aggregate, organizational level and not on an inter-personal level. The focus is on a wider structure, not on individual relationships. They aim at qualitative understanding of the content, shape and the effects of the relationships among companies. In industrial ecology the aim is the high quality of material and energy flow measured by ecological efficiency. In industrial network the aim is the high quality of co-evolution of business activities, resources and actors measured by economic efficiency and effectiveness.

To sum up, industrial ecology literature is being reviewed for the reason of showing the effects of a proposed assumption of ecological approach as the main reason for doing any business. For industrial ecology building an industrial biosystem (ecosystem) is much wider activity than just building a business network. The logic of the presentation is to show main assumptions, tools and effects of industrial ecology for business. The juxtaposition of industrial ecology approach and industrial network approach shows different rationalities among economic actors in industrial ecology and in industrial network. Industrial ecology shows the way how business in networks may change the disadvantage of being involved in the environmental debate into advantage of totally new business encouraged to look for ecological advantages by ecological approach. Both discussed approaches are connected by the main and new view of industry, in which the most important lays in between companies. It is imperative to implement the network approach and its accomplishments of business interactions and business relationships. This is the way to link interactions to technical and organizational changes proposed by industrial ecology as well as to link strategies formed and developed not within a single company, but between interconnected companies. To create a new economy for sustainable development these two subfields of industrial economy should work together more effectively on incorporating their achievements into common practice. More has to be done to explicate their structural and system aspects in common such as interdependence, closed-loop, community, or locality. The coalescence of all industrial knowledge into a unified whole is needed as well as more work is demanded to demonstrate the benefits of bringing industrial ecology into network practices. Up to day results, in form of the supply chain protocols for large-product oriented companies, required that suppliers to these companies carry out LCA, are quite weak as for the long history of both approaches. To strengthen and to accelerate the results of sustainable development joint academic and practical efforts should be undertaken within the frames of both considered approaches.

NETWORK OF GREEN BANKING AS AN EXAMPLE OF COMBINING INDUSTRIAL ECOLOGY AND INDUSTRIAL NETWORKS

Concepts, Purposes and Activities of Green Banking

A green bank is a linkage between the theory of industrial ecology and industrial networks, because its mission is to combine business and ecology for the benefit of customers (BOŚ, 2016a). A green bank is a state chartered and state capitalized lending institution designed to fill gaps in private market finance for clean energy generation and energy efficiency. A green bank is a public or quasi-public financing institution that provides low-cost, long-term financing support to clean, low-carbon projects by leveraging public funds through the use of various financial mechanisms to attract private investment so that public money supports multiple moneys of private investment (Coalition for Green Capital, 2014, p. 2).

Depending on the state, a green bank may conform to a variety of structures, utilize many different public funds, and create a diverse array of financial products. Ultimately, all green banks will exhibit several common characteristics:

- encourage a shift from one-time subsidies and grants towards market-catalyzing financial tools,
- push innovation in policy, incentive structures, financial tools, and marketing,
- spur private sector growth and competition in order to give consumers energy choices,
- stimulate demand by covering hundred percent of the upfront costs with a mixture of public and private financing,
- leverage public funds by attracting much greater private investment to clean energy and efficiency markets,
- recycle public capital so as to expand green investment and leave taxpayers unharmed,
- reduce market inefficiencies,
- scale out clean energy solutions as fast as possible, maximizing clean electricity and efficiency gains per state money (Coalition for Green Capital, 2014, p. 1)

The approach to green banking varies from bank to bank. A survey of more literatures reveals a few more different interpretation of green banking (Table 2). Generally, the term green banking refers to banking practices that foster environmentally responsible financing practices and environmentally sustainable internal process (Rahman and Barua 2016, p. 2).

Although a green bank may take a variety of forms, there are generally three structures to consider. First, the green bank can be standalone as a quasi-independent entity. This structure allows for the most flexibility and autonomy. Another option is for the green bank to be housed within an existing state agency. Lastly, a green bank may be incorporated into an infrastructure bank, where it would likely be established as a separate subsidiary.

Table 2. Definitions of Green Banking

Author(s)	Definition
Bai, 2011	Banks' environmental accountability and environmental performances in business operation
Habib, 2010; Goyal and Joshi, 2011	Ethical bank – environmentally responsible bank Socially responsible bank or sustainable bank – considers all the social and environmental issues
Azman, 2012	Eco-friendly or environment-friendly banking to stop environmental degradation to make this planet more habitable
Schultz, 2010	It means promoting environment-friendly practices and reducing carbon footprint from banking activities
Singh and Singh, 2012	Green banking signifies encouraging environment-friendly practices and reducing carbon footprint by banking activities through various environment-friendly acts
Thombre, 2011	Green banking is functioning like a normal bank, which considers all the social and environmental/ecological factors with an aim to protect the environment and conserve natural resources
Bahl, 2012	Green banking is a kind of banking conducted in selected area and technique that helps in reduction of internal carbon footprint and external carbon emissions

Source: own elaboration based on the subject literature

Generally, there are three stages to establishing a new state green bank. In the first stage, a coalition of stakeholders (e.g., clean energy organizations, clean tech trade

associations, environmental groups, and state agencies) establishes a base of support for a green bank. This support is critical to passing legislation or achieving the required regulatory change to legally create a green bank. In the second stage, the green bank organization is established, which includes hiring staff, building capabilities, identifying goals, assessing markets and developing products. In the final stage, the green bank actually begins acquiring customers, lending in partnership with private investors, and recycling funds in order to recapitalize the bank (Coalition for Green Capital, 2014, p. 2)

The broad objective of green banks is to use resources with responsibility and give priority to interaction of environment with society. Green banks promote social responsibility, because they consider before financing a project whether it is environment-friendly and has any future environmental implications (Bihari 2011, p. 82). Therefore, green banks are gradually coming to realize that there is need for a shift from the "profit, profit and profit" motive to "planet, people and profit" which in fact establishes the rationale for green banking (Verma 2012, p.110). Green banking is a concept of shifting banks' objectives from "profit only" to "profit with responsibility" (Rahman and Barua 2016, p. 2). Over the period of time, the concept of sustainability revolved and its meaning transformed from only achieving higher profitability towards achieving the social and environmental objectives of the projects as well, and this concept is termed as corporate social responsibility (CSR) (Amin and Maran, 2015, p. 110).

The current trend in the literature on sustainability and finance is shifting from the idea that sustainability is a constraint on the profit function of firms towards a vision that financial markets can promote sustainability because of its many linkages with the rest of the economy. There are two major trends in the literature on sustainability and the banking industry, divided into external and internal practices. The external practices analyze the relevance of sustainability in the communication of banks with shareholders and stakeholders and how investors use it as a measure in optimal portfolio allocation. The internal practices relate the integration process of sustainability criteria into risk management towards lending practices (Zeidan, Boechat and Fleury 2016, pp. 1-2).

P. Kotler, H. Kartajaya, I.Setlavan (2010, p.106) strongly oppose to the influence of short-term focused shareholders. He supports conclusion that most stock-owned companies are aiming at meeting the shareholders' expectations to such an extent it severely impacts the company's long term investments and perspective. M.Porter and M.Kramer noted that in the long run social and economic goals are not inherently conflicting but integrally connected (Porter and Kramer, 2002, p. 5). They see a symbiosis between economic and social goals, and also between economic and social investments/returns, more precisely organizations must focus on that actions that bring benefits both for them and for society. There are some benefits for green banks: they increase their image, the goodwill, reputation, attract capital, partners, gaining or retaining customers, partners, reduce costs, increase the environment friendly loans, increase competitiveness, environment friendly use of resources (Dumitraşcu, Feleaga and Feleaga 2014, p. 617).

Green bank realizes its three-dimensional activities, not as a piece of property, but as a nexus of contractual and non-contractual relationships between and among a range of groups, of which the shareholders are but one (Australian Conservation Foundation, pp. 12-13). Thus, the bank directors' obligation is to act in the best interests of the bank, not only in the best interests of the shareholders, but also non-shareholder interests of its network. However, in this case, the directors are required to consider social or environmental good of all participants in this web of relationships, besides profits for shareholders, in the discharge of their duty.

The social sustainability of banking industry deals with minimizing the impact of banking activities on the society. Banks are aiming at achieving social sustainability. They need to develop ethical lending standards. Additionally, banks deal with the active involvement of theirs staff to take active part in community fund rising, charity, and other philanthropic work.

The environmental sustainability of banks deals with avoiding and minimizing the effects of the banking activities that has negative impact on the environment. The banks can achieve environmental sustainability by avoiding funds to those organizations whose business have negative impact on the green environment. On the other hand, the banks can grant funds to those organizations that are involved in renewable energy products and programs.

The economic sustainability of banks deals with the ability of business in maintaining its high earnings along with successful continuation of business activities in the longer run of business cycle. Generally economic sustainability deals with micro, macro, and industry specific factors (Amin and Maran, 2015, pp. 113-114). Therefore, green banks promote: forest preservation, water production, responsible farming practices, recycling, eco-tourism loans to displaced timber workers to help them start environmentally friendly businesses, help for low-wage earners to purchase homes, community education and mentoring programs.

Green banks activities for sustainability concerns internal activities improving sustainability: saving energy, reducing paper use, making use of paperless cash turnover, using off or reduced cooling after hours, using natural lighting where possible, using of ventilation by opening windows instead of full air conditioning, installing of modern thermal windows, controlling for dripping taps, rewards program for good performance, implementing policies on sick leave and/or maternity leave, staff training and updating of training, developing of internal communication system, implementing preventive health security of their employees, and the adequacy of employees' wages.

Green banks activities for sustainability concerns external activities improving sustainability: offering preferential interest rates for credit borrowers who intend to use solar energy or encouraging borrowers to apply environmentally-friendly management systems, offering of affinity cards (the credit cards where a certain amount of money (part of commission charged by a bank is given to a charity every time the card is used; they are issued with the approval of non-commercial organization and are issued for philanthropic purposes), running sponsorship and humanitarian campaigns, satisfying customers needs and simultaneous respect for law and ethics, honest communication with the banks' clients, providing complete information about an offer, prices etc (Rudawska and Renko, 2012, p.106-107 and pp.112-113).

Conceptualization of the Green Bank Network Interactions and Relationships with Stakeholders

The analysis of the literature of industrial ecology, industrial networks and green banking let to the conclusion of their important role in the development of sustainable industry. Nowadays, all business decisions are undertaken in relation to other industrial actors. Ecological decisions are also undertaken in relation to other industrial actors. Green banks are the main linkage for different rationalities of actors and different roles of investments in place as it is stressed in industrial network theory and in industrial ecology theory, because green banks main mission is to combine business and ecology for the benefit of customers (Figure 3).

All activities of the bank are accounted in balance of sheet (Table 3). The balance sheet consists of assets and liabilities. On assets side two groups of positions are distinguished, i.e. financial assets and fixed assets. The green bank uses its financial assets

and fixed assets for its own sustainability and its stakeholders. All the liability side deposits, own funds, securities, and profits support also sustainable development and opposite against laundering money and doing dirty business.

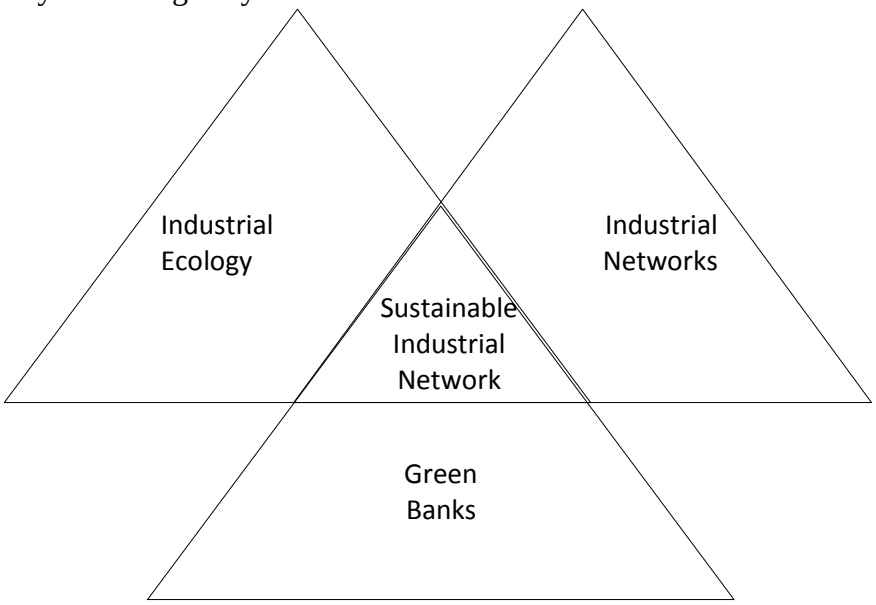

Figure 3. Green banks fulfill a gap between industrial ecology and industrial network
Source: own elaboration

The relationships of green bank with the stakeholders analyzed with ARA model shows the complexity of business network it creates and the heterogeneity of its business partners, and its interconnections and business relationships (Figure 4 and Figure 5).

Table 3. The model of balance sheet for sustainability of green bank

ASSETS	LIABILITIES
−Financial Assets (not for laundering money and doing dirty business - no ethical, social and ecological business - by stakeholders) 1) Cash, 2) Loans 3) Securities −Fixed Assets (green building, green house, green investing by green bank)	−Deposits and Securities (not for laundering money and doing dirty business by stakeholders) −Own Funds (no owners or co-owners from "dirty business" or from laundering money procedures) −Profit (for owner or co-owner of green bank) for: 1) social activities (foundation of charities, education programs, volunteering, and philanthropy) 2) ecological activities (green investment, eco-parks, environmental programs) 3) economic sustainable development −Reserve for sustainability of green bank

Source: own elaboration

The basic activity of the green bank is lending by loans or securities. For that reason main actors of green banks are credit departments and treasury departments which use deposits and securities to collect resources. The green bank is a nexus of stakeholders' relationships. It is particularly noticeable in connection between lending and green investments. The bank has to assess the credit risk of investment and later has to monitor the process of investing. Green bank and the investor are bounded with the credit contract. Both

bank and investors in business networks are never independent, isolated or alone; they are formed in their perceptions, knowledge, capabilities and intents by others (Håkansson and Snehota 1995, p 193).

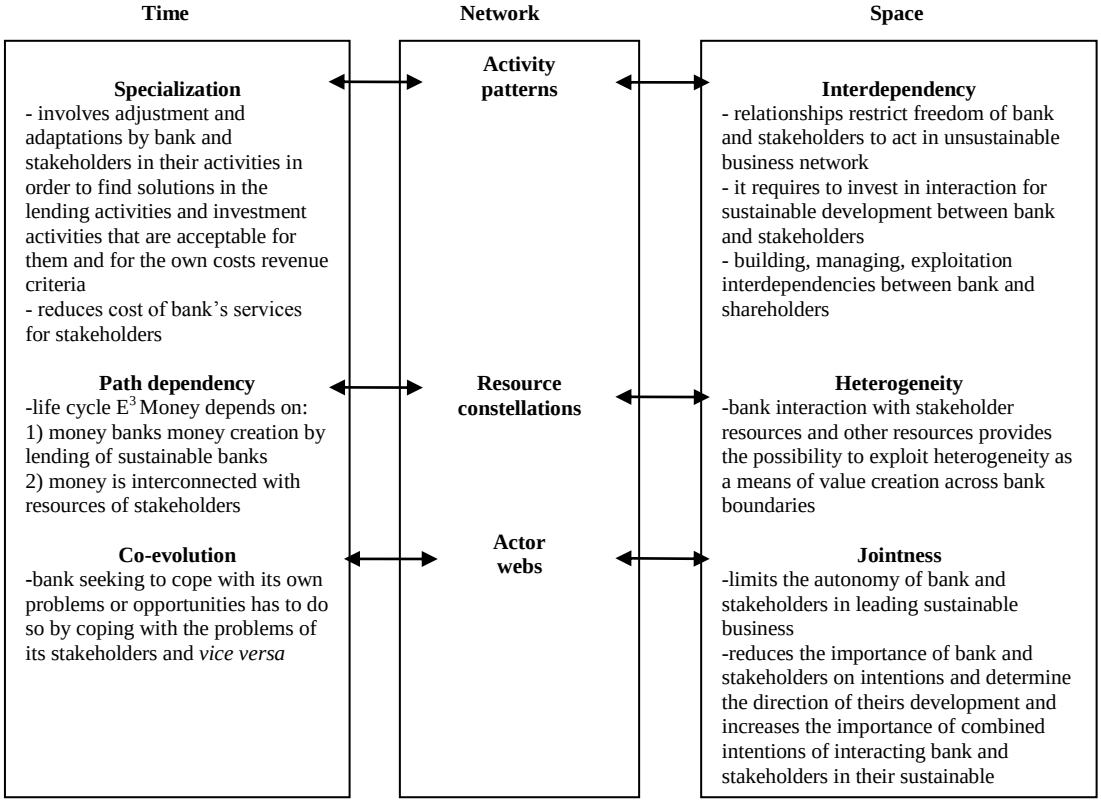

Figure 4. The model of business interactions of green bank with stakeholders
Source: Own elaboration based on Håkansson, Ford, Gadde, Snehota and Waluszewski, (2009)

Bank and investors connect their resources. A relationship connects two heterogeneous collections of resources of the two parties – bank (takes deposits and sells securities or issues own securities) and investor (deposits money and buy securities). As it develops, the two companies direct and orient some of their resources towards each other. Adaptations are made in resource features and in the use combinations. A relationship between two companies can tie together more or less tightly some of their resources in a specific way (Håkansson and Snehota 1995, p 136).

In the network lending by bank interconnects stakeholders. It limits the freedom of stakeholders in using bank's money for another aim than sustainable business. These independencies provide a way for bank and stakeholders together to capitalize on the specific investments that they make in their own and each other resources (Ford, Håkansson 2006, p.11). It serves for building of trust, commitment and reciprocity.

Specialization reduces costs of bank's services and costs of stakeholders through adjustments and adoptions. Resource constellation overtime depicted as lifecycle seems to be based on two basic features of the most resources of bank E^3 Money, i.e. ethical, ecological and electronic money. This money is created in sustainable bank and is being lent to sustainable business of stakeholders. Sustainable business is ethical, ecological and economic. Interaction enables heterogeneity of bank's resources to be exploiting as a means of value creation for stakeholders and bank. Actor webs link to co-evolution and joitness. Co-evolution strengthens the trust, commitment, common motivation in solving problems for sustainable development. On the other hand jointness limits the autonomy of bank and stakeholders and requires interactions.

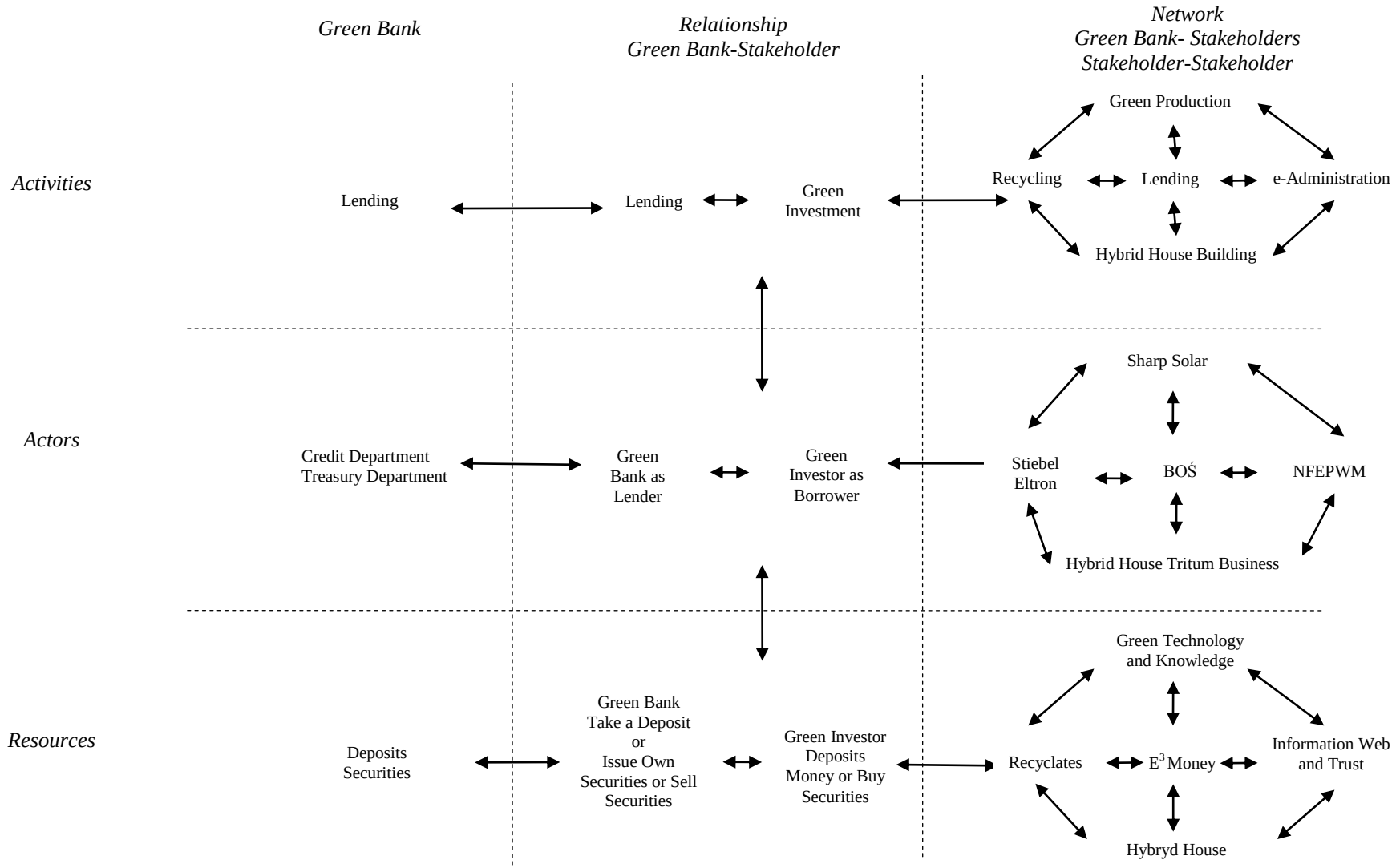

Figure 5. The model of green bank relationships with stakeholders
Source: Own elaboration based on *Håkansson, Ford, Gadde, Snehota and Waluszewski, (2009).*

The green bank will attach a price to this reduction uncertainty through interest rate and provision. So tariff differentiation for sustainability can be justified from a risk standpoint: clients with high environmental risks will pay a higher interest rate. The possibilities for tariff differentiation will be even larger if banks can attract cheaper money – by paying less interest for their own funding because of the relatively high quality and lower risk of their credit portfolio. This tariff differentiation by banks will stimulate the internationalization of environmental costs in market prices. In this sense, banks are a natural partner of governments (Jeucken and Bouma, 2001). BOŚ Bank with the main public shareholder is facilitated in offering ecological credits. Although, playing the high role of public government in supporting green banking is worldwide extended. It gives also the perspective of the long term value.

The green bank may well go a qualitative step further and contribute to sustainability on ideological grounds as well on risk assessment grounds. Through their intermediary role, green banks may be able to support progress toward sustainability by society as a whole – for example, by adopting a 'carrot-and-stick' approach, where environmental front-runners will pay less interest than the market price for borrowing capital, while environmental laggards will pay a much higher interest rate. This may result, at least initially, in a loss of profitability, but certainly doesn't require a loss of continuity (Jeucken and Bouma, 2001).

Green banks support a long-termist and profits-only mentality that appreciates much environmental and social reality. Therefore green banks are not hindering the achievement of sustainability. Although, non-green banks play hindering role in the achievement sustainable industrial network, in contrast to green-banks. Firstly, non-green banks prefer short-term payback periods, while many investments necessary for achieving sustainability must be long-term. Secondly, investments that take account of environmental side-effects usually have a lower rate of return, while non-green banks usually look for investments with highest rate of return (Jeucken and Bouma, 2001).

In a sustainable industrial networks of profit and benefit maximization, companies will take account of the environmental side-effects of their economic decisions as long as the environment is represented in the prices on which they base these decisions. Green banks facilitate in taking these decisions. As a financial intermediary between market players, a bank has four important functions. First, it transforms money by scale. The money surpluses of one person are mostly the same as the shortages of another person. Second, banks transform money by duration. Creditors may have short-term surpluses of money, while debtors mostly have a long-term need for money. Third, banks transform money by spatial location (place). For example, a bank brings money from a creditor in Stockholm to a debtor in Warsaw. Four, banks act as assessors of risk. As a rule, banks are better equipped to value the risks of various investments than individual investors who have surpluses available. In addition, through their larger scale, banks are more able to spread the risks (Jeucken and Bouma, 2001, Freixas and Rochet, 2008, Matthews and Thompson 2005). Therefore, green banks in sustainable industrial network allow developing activities, resources and actors combining business and ecology. In this way, green banks serve to aid the process of combining business and ecology will have value for industrial ecology theory and industrial networks theory.

The Network of the Polish Green Bank for sustainable development

In this part of the paper the Bank for Environmental Protection Group (Bank BOŚ Group) serves as a case study for developing the analysis of the role of green bank network in sustainable development. This bank is a commercial bank established in 1991 with the main office in Warsaw. It is organized in 17 departments, 82 operational departments and 11 corporate centers. It is listed on the main market of the Warsaw Stock Exchange.

The major actors of the BOŚ Group are: BOS Finance AB, Brokerage House BOŚ SA and BOŚ Eko Profit SA. The majority shareholder is the National Fund for Environmental Protection and Water Management (NFEPWM) (56.62% of shares), the second shareholder is the Nationale-Nederlanden OFE oraz Nationale-Nederlanden DFE (5.26% of shares) and shares in free trading (38.12% shares). It cooperates with many Polish and foreign institutions, like National and Voivodship Funds for Environmental Protection and Water Management (VFEPWM), Bank Gospodarstwa Krajowego (BGK), the European Investment Bank and many others (BOŚ 2015, p.17). The Group established other institutions for sustainable development, like: the BOŚ Foundation - for the environment protection, promotion of ecology and sustainable development, BOŚ Ekosystem Ltd - for financing investments in form of leasing and providing energy saving solutions and renewable energy, as well as BOŚ Eko Profit SA - for equity investments, raising debt financing, process management and business consulting (Figure 6).

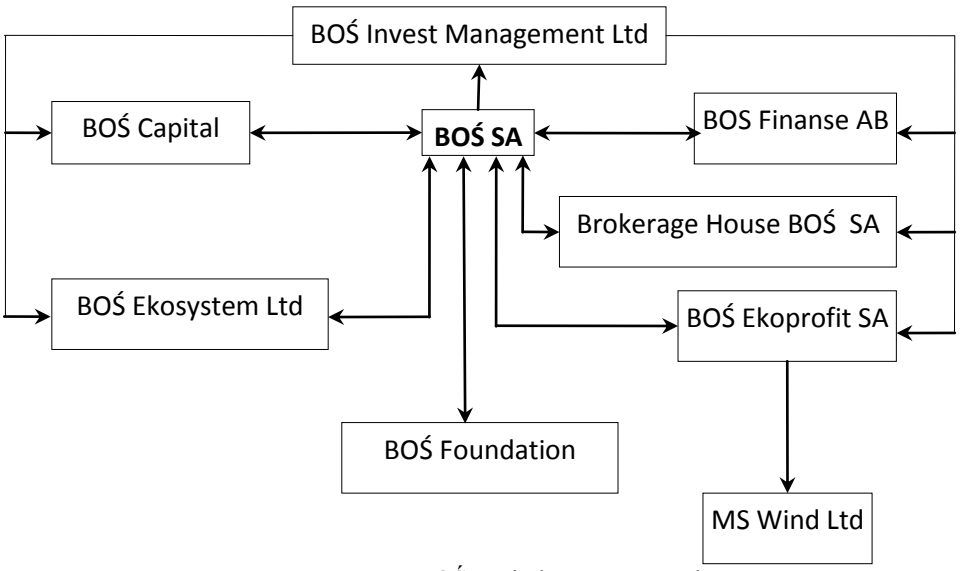

Figure 6. BOŚ capital group network

Source: own elaboration based on Prospects of BOŚ (2016).

BOŚ Bank network main actors, resources and activities are focusing on ecological purposes (Table 4). Bank's top strategic goal is to be an efficient channel for transfers' funds for environmental investment projects and sustainable development in Poland.

Table 4. Actors, resources and activities of BOŚ sustainable network in the context of model ARA

Components	**BOŚ network for sustainable development**
Actors	Private and public customers who are affluent, demanding, active and interested in ecology, stakeholders: shareholders, customers, partners, employees, society
Resources	Complete range of basic financial products, characterized by simple, ecological procedures and modern services, modern ICT systems, mobile banking, a network of branches and third party advisors
Activities	Promoting knowledge of ecology and environmental protection, active in local and nation-wide communities, building a long-term relationships with different stakeholders following Bank's ecological mission of combining business and ecology for the benefit of customers

Source: own elaboration based on Prospects of BOŚ (2016a)

Bank BOŚ is a creator of two kinds of sustainable networks and acts as a link between them. The first one is the internal network of the capital group and the second one is the external network. BOŚ co-creates model for the emerging ecological society and ECO lifestyle (Figure 7). It offers new project financing solutions and delivering finished environmental products like hybrid houses – passive and energy – saving houses fed with renewable energy sources.

The major activities of the BOŚ Group are to financing or co-financing environmental projects: atmosphere protection, water protection, water management, monitoring, nature protection, and ecological education. The Group offers a combination of professional services in the field of banking activities with eco-friendly products. During 25 years its contribution to environment effects is said to be significant (Table 5).

It is one of a few Polish institutions offering preferential credits for ecological credits. The list of the green activities of the Polish banks (Annex 1). It is the leader in financing environment protection. The value of credits systematically increases (Figure 8). The offer of BOŚ SA is addressed to both individual and institutional customers, to local government units and municipal companies. The Group offer focus on investments in clean technologies, environmental protection and in particular investments in renewable energy sources. Perceiving ecology as one of the key factors determining the activities remains open to projects from other areas of business. In the model of 'single counter' rule the Group offers: business consulting, raising funds, equity investments, and process management. The offer of BOŚ Eko Profit SA is meant to embrace the expectations of local-governments whose investment capabilities in the context of debt limits restrain the implementation of projects.

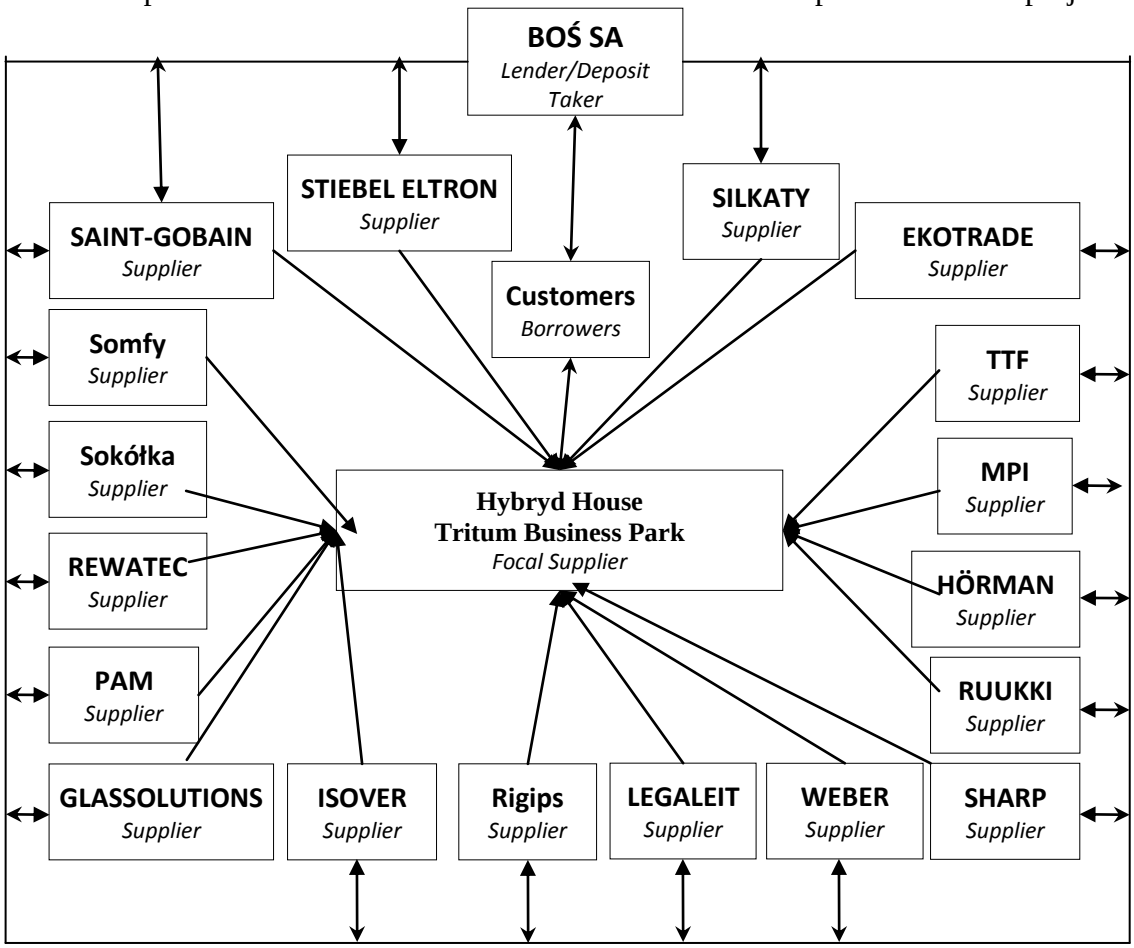

Figure 7. Hybryd House Tritum Business Park Network

Source: own elaboration based on Prospects of Hybryd House Tritum Business Park

The offer includes i.e. assuming the role of a substitute investor. The activities are: implementation of investments in municipal infrastructure, financing activities being part of municipalities' own tasks, e.g. modernizing the lightning infrastructure, carrying out investment tasks contracted by local government units. In the renewable energy they finance such investments as: leasing and installment sales with deferred payment for photovoltaic power station (Sharp Solar), wind farms, heat pumps for economic units (Stiebel Eltron), energy saving lighting for firms and local self-government units. Other forms of eco promotion are special financial products of BOŚ Eko Profit S.A. like: saving accounts named EKOprofit, EKOdeposits, Ekocredit. BOŚ provides also special financial solutions for tenant communities, and nongovernmental organizations.

Table 5. The contribution of the Bank for Environmental Protection Group to environment effects

Environmental effects	Measure
Reduction of emission of dust	151,4 tons/year
Reduction of emission of sulfur dioxide	667,2 tons/year
Reduction of emission of carbon dioxide	142 992 tons/year
Reduction of heat consumption and loss	140 671 GJ/year
Production of energy from renewable sources	128 410 mwh/year
Wastewater treatment plant capacity	5 403 m3/d
Length of the sewage network	89,2 km
Quantity of waste neutralized or recyclable materials reclaimed	49 104 tons/year

Source: BOŚ 2015

In 2009 The BOŚ Foundation was established for the environment protection, promotion of ecology and sustainable development. It promotes and implements the rules of sustainable development, to raise the standard of living without environmental costs. The conscious citizen is responsible and respectful for the environment. They carry out own programs and projects, cooperate with NGO, develop, employee voluntary, implement the strategy of social responsibility of the BOŚ and financing ventures. They implement three kinds of programs: active health (fit nutrition and fitness activity), ecology (education for sustainability development and ecology), and employee voluntary (social activation).

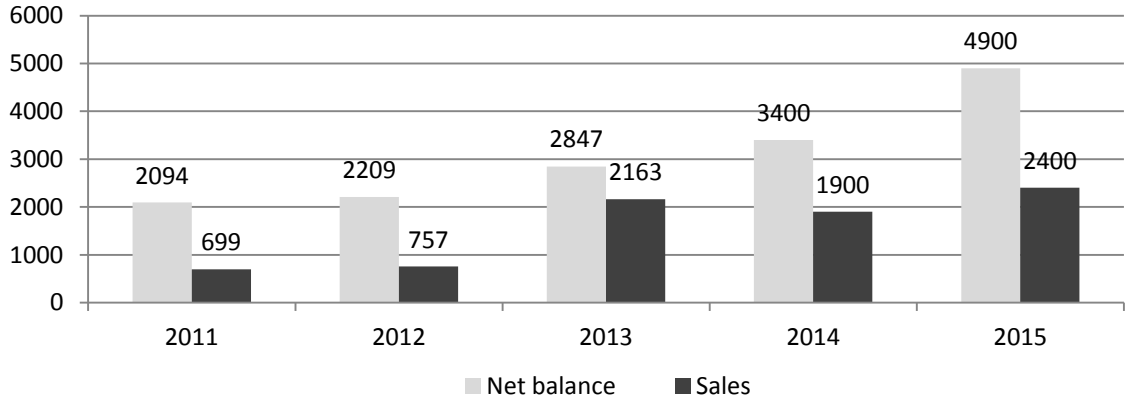

Figure 8. Pro-ecological credits in the Bank for Environmental Protection Group in 2011-2015 (in mln zl)
Source: own elaboration based on Prospects of BOŚ 2012, 2014, 2016.

The major resources of the Group come from cooperation among the major actors. The ecological credits are financed from the resources of the National Fund for Environmental Protection and Water Management or with its allowances and subsidies. The fund offers also its own credit lines. Other credits are funded from resources of Voivodship Funds for Environmental Protection and Water Management, with its subsidies and

allowances separately. There are also credits granted together with the NFEPWM and VFEPWM. Another resource is commercial pro-ecological loans.

Table 6. Credit terms and the results of simulation of total costs in Bank BOŚ

	Ecological mortgage credit	**Standard mortgage credit**
Total Credit	500.000,00 PLN	500.000, 00 PLN
Own Contribution	20%	20%
Number of monthly instalments	240	240
Level of the base interest rate WIBOR 6M	1,79%	1,79%
I. Without fulfilling additional terms of BOŚ SA		
Margin	1.70%	2.20%
Level of the base interest rate and margin	3.49%	3.99%
Provision	8.750,00 PLN	10.000,00 PLN
Interest	175.227,08 PLN	200.331,25 PLN
Total credit cost	183.977,08 PLN	210.331,25 PLN
Effective interest rate	3.77%	4.33%
Credit worthiness	660.000 PLN	630.000 PLN
Additional terms		
A variant	1.In the period of 5 years obtaining credit products, e.g. credit card 2. Inflow on the bank account 2.000 PLN monthly	1.In the period of 5 years obtaining credit products, e.g. credit card 2. Inflow on the bank account 2.000 PLN monthly
B variant	1.Insurance of credited real estate in the Europe Group Insurance in 3 years 2. Inflow on the bank account 2.000 PLN monthly	1.Insurance of credited real estate in the Europe Group Insurance in 3 years 2. Inflow on the bank account 2.000 PLN monthly
II. With fulfilling additional terms of BOŚ SA		
Margin	1,50%	2,00%
Level of the base interest rate and margin	3,29%	3,79%
Effective interest rate	3,56%	4,12%

Source: own elaboration on BANK BOŚ, July 2016

To underline the benefits of the ecological mortgage credit of Bank BOŚ its comparison to standard (non-ecological) mortgage credit of Bank BOŚ. The credit offer has been compared as well as the credit terms (credit margin and credit provision) as well as simulation of total costs of both credits. In the credit offer of Bank BOŚ the ecological mortgage credit differs from traditional mortgage credit. The minimum 5% of total credit amount has to finance one of the ecological purposes (purchase and installation) as:

- solar collector,
- photovoltaic power station,
- heat pump,
- adjacent house wind micro-power station,
- boiler plant fed with biomass,
- installations of heat recovery with recuperation,
- fire place with water jacket,
- low energy building status,
- passive house status.

As the comparison of both mortgage credits shows that total costs of ecological mortgage credit are lower for the borrower by the amount of 26.534,17 PLN than standard mortgage credit (Table 6). The costs of ecological mortgage credit amounts to 183.977,08 PLN and the costs of standard credit are 210.331,25 PLN. The difference is also proved by the lower effective interest rate for ecological mortgage credit (3.77%) in comparison to standard mortgage credit (4.33%). This lower total credit costs results from the lower margin of ecological mortgage credit by 0.5% than standard mortgage credits as well as lower provision of the ecological mortgage credit by 1.250 PLN in comparison to the standard mortgage credit. The lower margin benefits the borrower with 25.104,17 PLN.

Bank BOŚ offers lower margin of both of the analyzed credits by 0.2% for clients fulfilling two terms from variant A and B. In-depth direct interview has shown that the A variant is more beneficial for client, because in variant B the insurance costs of Europe Insurance Group (TU Europe) is rather not the lowest in the comparison to other insurance companies. The analysis of the insurance market in Poland brings to the same conclusion. Bank BOŚ organizing the financial network should take care of lower insurance costs for borrowers of ecological mortgage credit.

The lower total cost of ecological mortgage credits of 26.534,17 PLN in comparison to the standard mortgage credit in the case of financing the ecological purpose (purchase and installation) is not always the financial incentive for borrowing, taking into account higher costs of the ecological investments, than 26.534,17 PLN.

Hybryd House Tritum Business Park and the BANK BOŚ network is implemented with disturbances. Private investors developing hybrid houses with Hybryd House Tritum Business Park make remarks towards the Hybryd House Tritum Business Park to BANK BOŚ concerning delays in the construction stages of hybrid house building, nevertheless of the established construction data. The mortgage credit is released in tranches and its release depends on keeping the construction deadlines. Therefore, borrowers cannot settle the credit tranches for the construction stages. They have to ask the bank for annexing the credit agreements for changing the constructing and tranche deadlines of credit in comparison to the earlier deadlines. Some of the borrowers have to annex their credit agreements even monthly. In this way the construction of the hybrid house is delayed and the time of construction is longer and the time of crediting as well as the credit costs increase. For each annex the BANK BOŚ charges 300 PLN. In this situation clients are discouraged for borrowing to invest in complex product of Hybryd House Tritum Business Park network. The reason of this is non-compliances of timetables of hybrid house constructing by the focal supplier in the network.

One of the recommendations is to increase due diligence of the management of BANK BOŚ in controlling the branches of BANK BOŚ for timetables of house constructing by Hybryd House Tritum Business Park network. The in-depth investigation has shown that the network develops rather at headquarters than in branches. The final complex product – hybrid house is not failing, but its constructing by the network (because of the delays in construction). In this way the development of the sustainable industrial network is threaten, because the focal node is not keeping deadlines. As a result clients are discouraged to buy complex product of the network and instead they buy separately intermediate products directly from other companies in the network. They find another solution encouraged by BANK BOŚ offering intermediate products instead of final product. It is observed particularly in the photovoltaic power stations purchases, which are supported by the BANK BOŚ for its promptness and professionalism at work.

CONCLUSIONS

In the paper the ARA-model framework has been applied for analyzing the example of the sustainable industrial network failures activity patterns and actor webs in time and in

space. It is observed that the interdependency of network nodes fails. The network nodes are not investing long-lasting relationships. Their interactions are costly for clients. The network has been built but it is not well managed and exploited because of delays in timetables. In this case the dependency of network actors restricts its freedom and its own choice requires to investing in interactions within existing relationships in order to supply complex ecological product.

The specialization of BANK BOŚ towards ecological mortgage credits involves finding acceptable solutions for the network partners for the own cost revenue criteria. Specialization involves the reduction of costs for clients of the total credit cost for client. But it is not sufficient for financing the complex ecological solutions. Bank seeking to cope with its own problems or opportunities has to do so by coping with the problems of its stakeholders and *vice versa*. Analyzing actor webs in time, taking into account, that existence of jointness means that the evolution of each single actor in the sustainable industrial network is not individual process but one that takes place interactively with others, so it is a co-evolution. BANK BOŚ seeking to cope with its own problems or opportunities has to do so by coping with the problems of Hybryd House Tritum Business Park. In the long-term jointness increases the importance of combined intentions of interacting BANK BOŚ and Hybryd House Tritum Business Park in their development their sustainable industrial network. Unfortunately, activity patterns in space (interdependency) and in time (specialization) as well as actor webs in space (jointness) and in time (co-evolution) fail in the analyzed case. In the studied network interdependency, jointness and evolution fails totally and specialization fails partly. BANK BOŚ and Hybryd House Tritum Business Park take part fully in the process of resource constellation in space (heterogeneity) and in time (path-dependency). The only beneficial activity in the network is the selling of the separated ecological products instead of complex product, because counterparts producing separated ecological products (suppliers) participate fully in the multidimensional interaction process in contrast to the focal supplier.

This paper results in providing confirmation that there are different exogenous incentives for business to network for sustainable development like NGO's, public policy or even public investments and finance. But the network for sustainable development depends finally on links which are negotiated as an independent business deal, and are established only if they are expected to be economically beneficial. The green bank is fulfilling the gap between business (industrial network) and ecology (industrial ecology) only if the multidimensional interaction process is fulfilled and built on long-lasting relationships in the sustainable industrial network. This verification creates an important contribution to support the IMP Group theory.

Bibliography

1. Amin, J. and Maran, M. (2015). Bankruptcy and Sustainability: A Conceptual Review on Islamic Banking Industry. *Global Business and Management Research: An International Journal*, 7(1), pp. 109-138.
2. Australian Conservation Foundation (2005). *Submission to Parliamentary Joint Committee on Corporations and Financial Services*. pp. 1-43.
3. Ayres, R.U. and Ayres L.W. (Ed.) (2002). *A handbook of industrial ecology*. Edward Elgar, Cheltenham.
4. Bahl, S. (2012). Role of Green Banking in Sustainable Growth. *International Journal of Marketing. Financial Services and Management Research*, 2(1), pp.27-35.
5. Baraldi E., Gregori G.L. and Perna A. (2010). Developing and embedding eco-sustainable solutions: the evolution of the Leaf House network. 26th IMP-conference in Budapest, Hungary.

1. Bihari, S.C. (2011). Green Banking Towards Socially Responsible Banking in India. *International Journal of Business Insights and Transformation*, 4(1), pp. 82-87.
2. Bizzi, L. and Langley, A. (2012). Studying processes in and around networks. *Industrial Marketing Management*, 41, pp. 224-234.
3. BOŚ (2012). Prospects 2012. BOŚ, Warsaw.
4. BOŚ (2014). Prospects 2014. BOŚ, Warsaw.
5. BOŚ (2015). Ecological Report 2015. BOŚ, Warsaw.
6. BOŚ (2015a). Prospects 2015. BOŚ, Warsaw.
7. BOŚ (2016). Prospects 2016. BOŚ, Warsaw.
8. BOŚ (2016a). Main Assumptions for Framework Development Strategy of Bank for Environmental Protection SA for 2016-2020. BOŚ, Warsaw.
9. Chertow, M. R. (2000). Industrial symbiosis: Literature and taxonomy. *Annual Review of Energy and Environment*, 25, pp. 313–337.
10. Coalition for Green Capital (2014). *Report: Green Bank Academy*. Washington.
11. Desrochers P. (2001). Cities and Industrial Symbiosis: Some Historical Perspectives and Policy Implications. *Journal of Industrial Ecology*, 5(4), pp. 29-44.
12. Dornfeld, D.A. (Ed.) (2012). *Green Manufacturing, Fundamentals and Applications.* Springer, New York.
13. Dumitraşcu, M., Feleaga , L. and Feleaga N. (2014). Green Banking in Romania. *Annals of the University of Oradea Economic Series*, 23(1), pp. 617-624.
14. Ehrenfeld, J. (2004). Industrial ecology: a new field or only a metaphor? Journal of Cleaner Production, 12 (8-10), pp.825-831.
15. Ehrenfeld J. and Gertler N. (1997). Industrial Ecology in Practice. The Evolution of Interdependence at Kalundborg. *Journal of Industrial Ecology*, 1(1), pp.67-79.
16. Ford, D. (2006). A letter from the Editor. *The IMP Journal*, 1(1), pp. 2-3.
17. Ford, D. and Håkansson, H. (2006). The Idea of Business Interaction. *The IMP Journal*, 1(1), pp. 4-20.
18. Freeman, R.E. (1984). *Strategic Management: A Stakeholder Approach*, Pitman Publishing, Boston, MA.
19. Freixas, X. and Rochet, J-Ch. (2008). *Microeconomics of Banking*. MIT, USA.
20. Frosch R.A. and Gallopoulos, N.E. (1989). Strategies for Manufacturing, *Scientific American*, 261(3), pp.144-152.
21. Gadde, L-E., Håkansson, H., Persson, G. (2010). *Supply Network Strategies*. John Wiley & Sons Ltd, West Sussex.
22. Garner, A. and Keoleian, G. A. (1995). *Industrial Ecology: An Introduction.* National Pollution Prevention Center for Higher Education, University of Michigan, Michigan.
23. Goduscheit, R. C. (2007). *Networks and Networks – Social network theory vs. the IMP tradition*. Paper presented at New Directions for Marketing: Interactions and Partnerships, Moscow, Russian Federation.
24. Goyal, K.A. and Joshi, V. (2011). A Study of Social and Ethical Issues in Banking Industry. *International Journal of Economics and Research*, 2(5), pp. 49-57.
25. Håkansson and Waluszewski (2002). *Managing Technological Development, IKEA, the Environment and Technology*. Routlege, London.
26. Håkansson, H. and Ford D. (2002). How should companies interact in business networks? *Journal of Business Research*, 55(2), pp.133-139.
27. Håkansson, H. and Snehota, I. (2006). No business is an island: The network concept of business strategy. *Scandinavian Journal of Management*, 22(3), pp. 256-270.
28. Håkansson, H. and Snehota, I. (2006a). "No business is an island" 17 year later. *Scandinavian Journal of Management*, 22(3), pp. 271-274.
29. Håkansson, H. and Snehota, I. (Ed.) (1995). *Developing Relationships in Business Networks*. Routledge, London and New York.
30. Håkansson, H., Ford, D., Gadde, L-E., Snehota, I. and Waluszewski, A. (2009). *Business in Networks*. John Wiley & Sons Ltd, West Sussex.

31. Halinen, A., Medlin, Ch.J., Törnroos, J-Å. (2012). Time and process in business network research. *Industrial Marketing Management*, 41, pp. 215-223.
32. Iivonen, K. and Moisander, J. (2014). Rhetorical construction of narcissistic CSR orientation. *Journal of Business Ethics*, 131(3), 649-664.
33. Jeucken, M. and Bouma, J.J. (2001). *The changing environment of banks*. [in:] Bouma, J.J., Jeucken, M. and Klinkers, L. (Eds.) *Sustainable Banking. The greening of finance*, Deloitte & Touche, Greenleaf Publishing, UK.
34. Kakabadse, N.K., Rozuel, C., and Lee-Davies, L. (2005) Corporate Social Responsibility and stakeholder approach: a conceptual review, *International Journal of Business Governance and Ethics*, 1(4), pp. 277-302.
35. Kotler, P., Kartajaya, H. and Setlawan, I. (2010). *Marketing 3.0: From Products to customers to the human spirit*. Times Group Book, New Delhi.
36. Lee, S. Y. and Carroll C. E. (2011). The emergence, variation, and evolution of corporate social responsibility in the public sphere, 1980-2004: the exposure of firms to public debate. *Journal of Business Ethics*, 104 (1), pp. 115—131.
37. Lehni, M. (2000). *Eco-efficiency creating more value with less impact*, WBCSD, Geneva.
38. Li, Y. and Shi, L. (2015). The Resilience of Interdependent Industrial Symbiosis Networks. A Case of Yixing Economic and Technological Development Zone. *Journal of Industrial Ecology*, 19 (2), pp. 264-273.
39. Matthews, K. and Thompson, J. (2005). *The Economics of Banking.* John Wiley & Sons Ltd, England.
40. Mouzas, S. (2006). Efficiency versus effectiveness in business networks. *Journal of Business Research*, 59 (10-11), pp.1124-1132.
41. Porter, M.E. and Kramer, M.R. (2002). The competitive advantage of corporate philanthropy. *Harvard Business Review*, 80(12), pp. 56-68.
42. Porter, T., Derry, R. (2012), Sustainability and business in a complex world, *Business and Society Review*, 117(1), pp. 33-53.
43. Posch, A. (2010). Industrial Recycling Networks as Starting Points for Broader Sustainability-Oriented Cooperation? *Journal of Industrial Ecology*, 14(2), pp. 242-257.
44. Rahman, S.M.M. and Barua, S. (2016). The Design and Adoption of Green Banking Framework for Environment Protection: Lessons from Bangladesh. *Australian Journal of Sustainable Business and Society*, 2(1), pp. 1-19.
45. Rudawska, E. and Renko, S. (2012). Sustainability as the Direction for the Long-term Success in Banking: Poland vs. Croatia. *Folia Oeconomica Stetinensia*, 1, pp. 97-117.
46. Schiller, F., Penn, A. S., Basson, L. (2014). Analyzing networks in industrial ecology - a review of Social-Material Network Analyses. *Journal of Cleaner Production*, 76, pp. 1-11.
47. Schultz, C. (2010). What is the Meaning of Green Banking? *Green Bank Report*, 2, pp. 127-131.
48. Singh, H. and Singh, B.P. (2012). An Effective and Resourceful Contribution of Green Banking towards Sustainability. *International Journal of Advances in Engineering Science and Technology*, 1(2), pp. 41-45.
49. Thombre, K.A. (2011). The New Face of Banking. *Green Banking. Research Paper – Commerce*, 1(2), pp. 1-4.
50. Velenturf, A.P.M. and Jensen, P.D. (2015). Promoting Industrial Symbiosis. Using the Concept of Proximity to Explore Social Network Development. *Journal of Industrial Ecology*, online version, pp. 1-10.
51. Verma, M.K. (2012). Green Banking: A Unique Corporate Social Responsibility of Indian Banks. *International Journal of Research in Commerce and Management*, 3(1), pp. 110-114.
52. Zeidan, R., Boechat, C. and Fleury, A., (2016). *Developing a Sustainability Credit Score System*, p. 1-6. Accessed on April, 2016 from: https://umsbe.wufoo.com/

Annex 1.

Table A1. The activities of Green Banks for sustainable development in Poland

Bank	Activities
Bank Ochrony Środowiska SA (Bank for Environmental Protection)	– the key component of the bank's mission is to contribute to environmental protection as its statute assumes the obligation to cooperate with ecological organizations – establish and maintain lasting relations with the National Environmental Protection and Water Management Fund, regional environmental protection and water management funds, the Polish Countryside Development European Fund – it supports: the Natura 2000 Programme, donating part of the profit to All-Poland Society of Birds Protection and Green Lungs of Poland Fund by offering EKOKONTO and EKOPROFIT services – the award of "Solid Employer" for modern and ethical human resources management
PeKaO SA, PKO BP SA, Citi Handlowy SA, Fortis SA, Kredyt Bank SA	– include developing relationships with their employees in their in their mission and their strategic goals – strive to provide a pleasant and favorable working environment for their employees and to maintain balance between their professional and personal lives – emphasize their aspirations to be perceived as the best employers in the banking sector – support charities and maintaining good relationships with local communities by sponsoring cultural and artistic events, concerts by establishing their own charities
ING Bank Śląski	– ING Foundation for Children whose aim is to equal chances by providing chronically ill children with education, by promoting business awareness among young people and by helping young people from poor families gain access to higher education – running a program called "In the company of a Lion" whose aim is to provide aid for children with cancer, program was awarded in the Golden Clip 2005 competition in the category of CSR
BGŻ BNP Paribas (earlier Fortis Bank)	– Foundation BGŻ BNP Paribas whose objective is to counteract social exclusion of children and young people; the foundation entered into a strategic partnership with the Society of Children's Friends – joining the Strategic Partners of the Responsible Business Forum
mBank (earlier BRE Bank)	– joining the Strategic Partners of the Responsible Business Forum
PKO BP SA	– affinity cards supports the Program of Building Polish Artificial Heart
BISE, BPH, BZ WBK, Polbank EFG	– affinity cards supports the Fund for Fulfilled Dreams
Bank Millennium	-affinity cards supports the WWF

Source: own elaboration based on Rudawska and Renko, 2012, pp.106-108 and the Internet banks pages