ENVIRONMENTAL NETWORKING OF SMEs INTO ECO-INDUSTRIAL CLUSTERS

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Abstract: Clusters are considered particularly promising approach to increase business activities and success of small and medium enterprises in transitional countries. However, environmental and sustainability issues should not be neglected while composing networks of entrepreneurial units. Eco-industrial networking is a concept that fits well with clustering local businesses and thus deserves further attention and popularization among entrepreneurs. Environmentally friendly symbiosis between diverse local or regional businesses should become valuable component of modern cluster development. This paper strives to raise environmental awareness and performance of SMEs by promoting the "cluster approach" for confronting contemporary environmental challenges.

Key words: Eco-Industrial Networks, Sustainable Production, Business Clusters**.**

POVEZIVANJE MSP U EKO-INDUSTRIJSKE KLASTERE

Rezime: Klasteri se smatraju za izuzetno prosperitetan način povećanja poslovnih aktivnosti i uspeha malih i srednjih preduzeća u zemljama u tranziciji. Međutim, pitanja životne sredine i održivosti ne smeju biti zanemarena prilikom stvaranja mreže preduzetničkih jedinica. Eko-industrijsko umrežavanje je koncept koji se dobro uklapa u globalno poslovanje klastera i zato zaslužuje dalju pažnju i popularizaciju među preduzetnicima.
Simbioza između različitih lokalnih ili regionalnih poslovanja koja su u skladu sa principima očuvanja životne sredine treba da postanu dragocena komponenta modernog razvoja klastera. Ovaj rad nastoji da podigne svest o očuvanju životne sredine i delovanja MSP kroz promociju sa "stanovišta klastera " u suočavanju sa savremenim izazovima očuvanja životne sredine.

Ključne reči: Eko-industrijska mreža, održiva proizvodnja, poslovni klasteri

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1 INTRODUCTION

Mankind depends on resources like minerals, fuels, water, fertile soil and clean air. These resources represent inputs of crucial importance for keeping economy running, but they are limited and natural resource base is decreasing. Growing population and global demand put pressure on the environment, and competition for many resources is increasing. Long term well-being and quality of life is closely dependant on our ability to recognize and respect the natural limits of the planet's ecosystems.

Resource efficiency, in essence, means consuming limited resources in a sustainable manner. It has been proven that it is possible to produce more value with less input, to decrease impact on the environment, and to consume in a more sustainable manner. However, there are many growth and employment opportunities in the provision of green technologies and services. Resource efficiency would contribute other policies as well: wiser use of resources reduces emissions and many other environmental and health problems. There are several master platforms worldwide that support resource efficiency, such as EU's growth strategy for the coming decade titled “Europe 2020”. It aims to transform the EU into a smart, sustainable and socially responsible economy. Under the “Europe 2020” strategy the initiative for a resource-efficient Europe emphasizes sustainable growth and a shift towards a resource-efficient economy. If modern societies are to become more resource efficient, vast majority of companies and consumers will need to get involved.

Small and medium-sized enterprises (SMEs) represent a significant portion of Europe’s economy – according to some researches, SMEs make up almost 99% of all active enterprises and contribute 57% of economic value added [1]. Altogether, SMEs significantly impact the environment and should be taken into account in attempt to shift the economy to more sustainable production and consumption patterns.

An eco-industrial network (EIN) is a cluster of companies operating as a community to deal with environmental, economic, and social issues. Such network may include stand-alone companies, companies that belong to various clusters, and relevant entrepreneurial organizations. Members of eco-industrial network collaborate to benefit from shared supply chain, by-product exchange and services, while trying to enhance their business and environmental performance.

Eco-industrial networks are based on numerous interrelated concepts, such as: cleaner production, industrial ecology, environmentally friendly urban planning and green architecture, sustainable production and consumption [2]. It is all about novel relationships between companies and industries, based on innovative organizational structures that reflect environmental consciousness. Principles for organizing clustered and other motivated companies to form an eco-industrial network are quite complementary to traditional development practices.

2 BY-PRODUCT EXCHANGE NETWORKS

Last couple of decades, Industrial ecology has gained significance, being a comprehensive concept that strives to recognize industrial systems as organisms that should be improved in resource efficiency, in a manner that natural systems perform. Several researchers have so far recognized principles of industrial ecology to be basis for appropriate eco-industrial solutions, and noticed the need to transform open-loop manufacturing processes into fully integrated industrial ecosystems [3].

The most recognizable industrial ecology concept is that of industrial by-product exchange - sometimes called by-product synergy, industrial symbiosis [4], recycling network or zero emissions network. Cluster members form a system for trading material, energy, and fluid by-products with other clusters or individual companies. Participating companies get together to hand over to each other previously discarded resources. Hence, they cut disposal costs, reduce pollution, or even gain new revenues. Exchange of by-product materials, energy, or fluids among participating companies is only one, although fundamental, form of collaboration.

In the essence of every eco-industrial initiative is attempt to form a structure with intention to improve the economic performance of the participating businesses, while minimizing their overall environmental impacts. This approach includes:

- environmentally conscious supply chain,
- energy efficiency,
- cleaner production,
- pollution prevention, and
- business coupling.

As it is expected that forming clusters would enhance business opportunities, designing an EIN around or among SMEs should also provide further benefits for local communities in terms of

environmental quality and energy efficiency. The crucial element is character of the interactions among the member companies and relationship with local community and natural environment.

There is no standard algorithm for creation of an eco-industrial network, since each one of them is quite distinctive. It should fit into economic, environmental, and social circumstances of the community where it operates. Some forms of eco-industrial networks could be found across different industrial sectors worldwide.

3 THE EIN - ADVANTAGES FOR INDUSTRY AND THE ENVIRONMENT

Eco-industrial networking brings about numerous advantages and benefits to businesses, environment and local development. Financial potential of transitional economies usually doesn't allow for large scale undertakings. Thus, integration of many existing businesses into one eco-industrial network often remains only possibility to cope with sustainability issues. Local businesses and relevant stakeholders as well, should be informed trough chambers of commerce and cluster developers on advantages and motives to join one such initiative.

Eco-industrial networks, within clusters and among them, are mostly designed to decrease consumption of primary materials, improve resource efficiency, as well as to decrease amounts of emissions, pollution and waste. The companies that a cluster consists of should adopt all feasible components of cleaner production concept to reduce their environmental impacts.

An innovative approach in designing an eco-industrial cluster should bring existing ideas together and transform them in a comprehensive, fully functional unit. By integration of numerous confirmed individual strategies into EIC, it is possible to achieve results beyond expectations (the system is more than a mere sum of its components). An integrative approach guaranties each addition to the system to add value to other system components. There should be some recognizable environmental or social values of the undertaking, beyond expected environmental and economic advantages that are crucial driving force for changes.

Another important issue is level of integration of EIC into the local community, since it could provide a portion of utility services or support educational system by providing professional training and courses. That way the companies would influence formation of quality workforce beyond their instant needs. A successfully developed EIC could also provide expertise as a business incubator and support new business initiatives or expansion of existing ones.

While some of the local enterprises might opt to join EIC, others could provide services to existing members, as catering services, suppliers, or maintenance contractors. Making the supply chain environmentally friendly (trough special requirements toward suppliers and contractors) might be solution for such a situation. EIC members might require greening entire supply chain and on other hand offer training or investments in greener technologies.

Environmental strategies to be considered while organizing cluster of local companies should include: waste and water management, resource recovery, energy efficiency, pollution prevention, and by-product exchange [5]. The main goal is to contribute in decoupling economic growth and/or human wellbeing from increase in resource consumption (Figure 1).

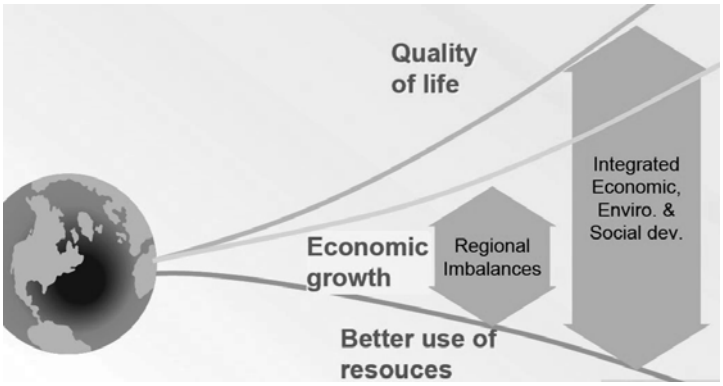

Figure 1: The Role of Industrial Clusters in Eco-Restructuring [6]

One successful eco-industrial network among various clusters might bring about significant development of community where it operates, due to improved economic and environmental performance of participating companies. Environmentally friendly manufacturing results in cleaner water and air, more responsible land use, reduction of waste, and environmental awareness of employees and general population.

4 SYNERGETIC ADVANTAGES OF AN ECO-INDUSTRIAL CLUSTER

An Eco-Industrial Cluster (EIC) represents an environmentally conscious business community of geographically concentrated and interconnected companies in a common or complementary field that cooperate mutually and with local community in order to efficiently share available resources (i.e. energy, water, materials, by-products, logistics, infrastructure and information), and thus improve environmental quality, economic gains, and contribute to overall quality of life (Figure 2).

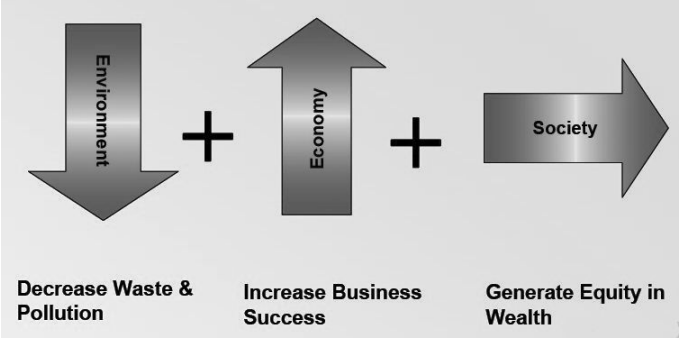

Figure 2: Operating principles of an EIC [6]

A well organized Eco-Industrial Cluster recycles not only materials and energy carriers, but information and expertise as well. Synergistic advantages of EIC are as follows:

- the by-product or waste from one manufacturing process is used as raw material for another product line
- the amounts of recycled materials and energy carriers are maximized trough so called closed loop systems
- acquired or locally produced energy can be utilized within the park
- expertise increase as a result of collaboration within the sector
- businesses and public organizations collaborate with one another to improve environmental quality and overall quality of life

Eco-Industrial Clusters are being recognized as one of the vehicles to achieve Sustainable Development through conservation of resources, cooperation between enterprises in designing supply chains and waste treatment, competition in energy efficiency and acquiring corporate social responsibility principles. Environment, economy, and local community well being are all in focus of cluster members on sustainable track. Advantages and Gains from Eco-Industrial Clusters comprise:

- Effective use of raw and waste materials
- Increased utilization of energy carriers
- Decreased water consumption
- Access to knowledge and state-of-the-art eco friendly technology
- Advantages for the introduction of cleaner production practices
- Increased incentive for innovation and new eco-product development
- Enhanced employment opportunities and social responsibility

SMEs face diverse and sometimes greater challenges than larger companies when dealing with environmental impacts and complying with stringent environmental legislation. Clusters provide a potential means of improving the environmental performance of a group of SMEs in a feasible manner. This approach brings various types of enterprises together, and enables better coordination towards shared values. Tackling sustainable production issues would probably render the cluster approach a widely popular method for improving the environmental performance

of SMEs. There are several gains to be achieved in parallel: sustainable growth could bring about new business opportunities - renewable energy production, resource management, eco-industries and recycling, all have a high potential for employment growth. Resource efficiency is also a proper way to deal with stability of supply issues. Adaptation to global changes related to pressures on resources will also improve long-term economic competitiveness. This can be done through the further development of existing technologies, such as renewable energy sources, and supporting emerging ones.

5 ENVIRONMENTAL NETWORKING OF SMES

Several areas of concern should be taken into account while developing an eco-industrial network of small and medium enterprises: by-product quantities and qualities, possibilities to increase energy efficiency per unit or among them, industrial metabolism of key players (i.e. flow of material, energy and fluids among cluster members and matching companies), protection of local natural systems, proximity of large industries and processors, etc. Although environmental impacts of different clusters might differ in quantities and scope, there are always certain regular components of every industrial metabolism that should be closely followed when designing an EIC (Figure 3).

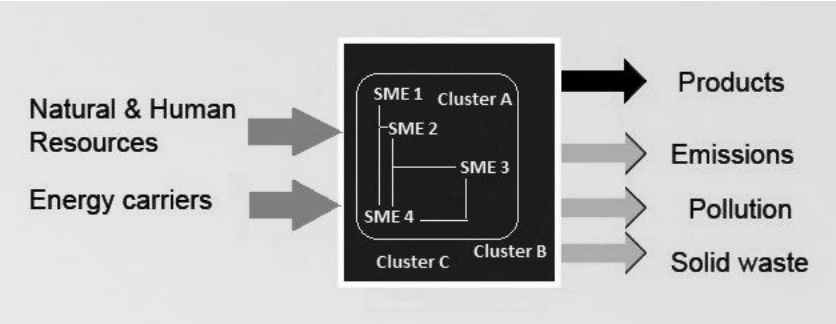

Figure 3: Environmental Impact of Industrial Clustering

Efficient use of energy is usually perceived as basic prerequisite to curb costs and reduce overall environmental burden. Companies that clusters consist of, should constantly seek greater efficiency of their premises (heating, lighting) and equipment utilization. Energy cascading - providing neighboring businesses or households with steam or warm water, could be a solution to achieve higher level of energy efficiency in the network. Water cascading (i.e. directing used water flow from one plant to the next, with or without pre-treatment) is another useful feature of eco-industrial networking with significant benefit for the environment. As well, utilization of renewable energy sources (e.g. solar, eolic, or biomass) should be promoted and explained among cluster members.

Companies taking part in an eco-industrial network commence to consider residuals and wastes as products that might be used by some compatible business. As a business community, clusters couple their manufacturing and creative powers to optimize use of materials thus minimizing the wastes. The by-products that can not be treated on the spot could be warehoused and when collected in tradable quantities shipped to some external customers. In order to achieve savings by sharing costs, the cluster members may include shared support services such as common supplies delivery or transportation logistics – both bringing about environmental benefits in terms of decreasing air pollution, CO_2 emissions reduction and decrease in fossil fuel consumption.

Eco-industrial networks might provide great opportunities for development of public–private partnerships (PPP) between cluster members and external companies, and PPP is considered very promising business organization model for transition countries.

6 THE CHALLENGES IN TRANSFORMING INDUSTRIAL CLUSTERS INTO ECO FRIENDLY ECONOMIC ZONES

Environmental costs of increasing manufacturing activities and doing business are being steadily recognizable, due to ever stringent environmental legislation. EU directives, such as WEEE and RoHS, already influence change in manufacturing practices of SMEs and large industries as well. On other hand, modest attention has been paid to the environmental impact of local industrial clusters in the Balkans or elsewhere. Among other reasons (the very concept of clustering SMEs is quite novel in many economies, particularly in transition ones), revealing cumulative environmental impact of cluster members is rather challenging task because of the complexity of the issue. Environmental impacts cannot be considered in isolation, as local clusters have a large impact on the socio-economic structure of the local communities. Increased business performance and/or increased volume of goods and services, that are desirable consequences of clustering initiative, should be followed by increased environmental awareness and devotion to sustainable production concept.

Main characteristics of Eco Industrial Clusters should be:

- Reasonable spatial proximity of premises (enables energy or water cascading).
- Relative concentration of similar or interrelated enterprises.
- Complementary economic activities
- Possibility to benefit from common supply chain for majority of members
- Complementary waste streams or common waste deposits
- Involvement in the same or similar subsidiary activities
- Existing linkages between enterprises as a result of specific forms of cooperation.
- A common business culture
- Both infrastructural and subjective sense of belonging to a local business community.

Cluster members are often located in urban fringe areas, but they might operate in wider city centers, on brownfield locations of former industrial premises. Improvement of environmental performances might be partly dependent on proximity of manufactures and workshops that are supposed to share capacities and resources.

The cluster approach requires identifying:

- the most challenging environmental issues,
- the regulatory requirements relevant to a cluster;
- opportunities for inclusion of particular SME in cluster or eco-industrial network and
- environmental technologies available to cluster members.

There are two particularly important components to take into account while designing one functional unit as an industrial ecosystem:

1. Industrial metabolism
   - energy and material flow
   - product and system structure
   - information flow
2. Inter-relationship among the elements that one industrial system consists of:
   - Shared infrastructure, facilities, logistics and services
   - Stakeholder participation and communication (corporate, citizen, academia, etc.)

On the other hand, numerous beneficial side-effects are expected to appear as a consequence of the synergism, cooperation development, resource efficiency, and socially responsible business practices.

A sort of guideline on how to use the cluster approach effectively and how to fully integrate it in future environmental policies is needed and expected to support decision makers on national and local levels. The involvement of regional authorities is always supportive for a clustering initiative, since it guarantee the continuity of once started processes..

7 OBSTACLES WITH DEVELOPMENT OF ECO-INDUSTRIAL NETWORKS

Novel undertakings in transition societies are always confronted with numerous challenges [7], and promoting environmentally friendly cluster networks would not be without obstacles since it requires an integrative approach. Stakeholders involved are companies themselves, development agencies, and members of local communities. Industrial clusters often include several small and medium enterprises. In most of the cases they get together to benefit from shared resources, services and infrastructure, but they are usually unable to invest in environmentally friendly technologies, so providing adequate financial

support is of crucial importance for a successful kick-of.

In transition countries a lot of small local enterprises produce a great deal of pollution. The reason is often obsolete technology, law resource efficiency and lack of trained staff capable to deal with environmental issues. Common training programs or joint investments in greener technologies might be beneficial for all companies involved. However, traditional manufacturers in many transitional economies are usually not used to work in clusters and therefore may be reluctant toward any form of interdependence.

Focus on narrow interests within clusters and between them is a major challenge, especially in transitional economies. Some of benefits that come out of an EIP may only become perceptible when savings are calculated in a longer time frame. Projects with a longer payback period are usually less likely to appear attractive and thus require extra effort when explaining the overall benefits.

8 CONCLUSION

Eco-industrial networks, within and among various clusters, are being designed to decrease consumption of primary materials, improve resource efficiency, as well as to decrease amounts of emissions, pollution and waste. Development of eco-industrial networks might be a promising approach to deal with environmental issues in transition societies. Organizing SMEs into Eco-Industrial Clusters would certainly help to fight the unsustainable patterns of industrial production and consumption. However, there are also other, more traditional driving forces, such as: economy of scale, technology transfer, technical knowledge, logistics and financial backing.

Doing business and creating new jobs in an environmentally friendly environment would represent great benefit for entire community. However, composing environmentally friendly cluster networks require an integrative approach, and might be confronted by various obstacles since manufacturers in transitional economies are usually not used to work in clusters and therefore may be reluctant toward some form of interdependence. Common training programs or joint investments in greener technologies would be beneficial for all companies involved in an eco industrial network. Being promising business organization model for societies in transition, public–private partnership between cluster members and external companies might provide great opportunities for further development of small scale eco-industrial networks.

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