

# Scientific and business networks as a stimulator of eco-innovations diffusion in small and micro-enterprises

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## Article Info

Volume 82

Page Number: 7471 - 7479

Publication Issue:

January-February 2020

## Abstract

The underlying objective of the paper is to indicate the nature of multi-actorial scientific and business networks, which support knowledge transfer, designing and implementing eco-innovations: product and process ones. The authors have introduced the taxonomy of these eco-innovations based, among others, on the literature review and the valid Oslo Manual, which constitutes a methodological repository in the domain of statistical research of innovations. Levels of pro-environmental awareness of micro- and small economic entities have been defined in it, justifying that the size of this sector and the greatest value added in the economy, therefore its significant impact on the natural environment is not correlated with the quantity and quality of eco-innovations implementations. They have summarised and conducted a qualitative evaluation of heterogeneous determinants that influence the decisions of these enterprises in the scope of eco-innovations implementation, but also stimulating their sustainable development. In the context of the evaluated previous pro-environmental awareness and willingness to implement eco-innovations by micro- and small enterprises, the cognitive focus concerned the evaluation of knowledge transfer and determining the “strength” and role of multi-actorial organisational networks, which stimulate the diffusion and growth of the value of planned and implemented eco-innovations. Based on the case-study of an international network of eco-innovative services, the authors attempt to justify the selection of three groups of partners that create the value of eco-innovations for the sector of micro- and small enterprises: scientific and research units with facilities, intermediary organisations between research entities and business, as well as the distinguished economic entities.

**Keywords:** eco-innovations, micro- and small enterprises, organizational networks.

## Article History

Article Received: 18 May 2019

Revised: 14 July 2019

Accepted: 22 December 2019

Publication: 03 February 2020

## I. INTRODUCTION

The term innovations was actually introduced in the half of the past century, however, it is still subject to modifications, not only in the theoretical approach, but also in the transfer to the practice of business. It was already in 1960 when J. Schumpeter defined innovations as ways of introducing new or improved products, also their creation, which favours development of new markets and therefore new forms of sales. Simultaneously, it has been indicated that innovations are the foundation of process

organisation [1]. P.F. Drucker [2] in turn postulates that innovations are a specific tool of entrepreneurship – an activity that provides the resources with new possibilities of value creation. Certainly, entrepreneurship in this meaning can be recognised to be actions aimed at ensuring effective and rational coordination of resources of economic organisations, including process organisation. A justification is that the ability to utilise the ideas, opportunities, building new processes reduces heterogeneous threats and risk that result from them, which are associated with

conducting business on competitive and at the same time turbulent markets.

In 2005 an attempt was made to unify the interpretation of innovations, but also their classification and diagnosing. In the Oslo Manual [3] it was adopted that innovations should not only be evaluated with regard to their economic, utility (e.g. concerning a new product or service) or technological (e.g. concerning a new or improved process) aspect. They were extended with new marketing methods, new organisation methods in the scope of business practices or workplace organisation. They considered the nature of the relationship between innovations and the external environment, among others, the natural environment through the reduction of resource intensity, energy intensity, and therefore capital intensity at a simultaneous social acceptance. The nature of the relationship of innovations with the external environment has been confirmed and at the same time justified by J. Tidd, and J. Bessant [4]. They postulate that innovations are really processes that turn new ideas into new products or technologies. However, a limitation is their implementation to the practical application. This limitation in a synthetic manner allows to distinguish between innovations and inventions (which certainly can become innovations).

While making a reference to the unification, defining, perceiving and diagnosing innovations, it is necessary to refer to the last edition of Oslo Manual of October 2018 [5]. Actually, the previous, indicated in this text, attitude to innovations is changing. Certainly, product innovations have been considered – new or improved products or services, which differ significantly from goods and services that have been previously introduced by economic organisations to the market. However, technological innovations have been included into business process innovations. Business processes do not only concern technological innovations in production, but also innovations in: logistics and distribution, marketing and sales, ICT, administration, organisation and management with the consideration of environmental/ecological and social limitations. It needs to be stressed in the context of the subject scope defined in the title of the present paper that the current definition of eco-innovations (Oslo Manual 2018) is not limited only to the substantive area, as the nature of its

subjective interpretation has been emphasised. The authors have introduced a subjective unit responsible for innovations. This concerns any institutional unit in any sector of households, but also organisational networks that create and implement heterogeneous innovations. In this context, in the present paper its authors have focused on the relationships between creating particular innovations and their value for the environment and social acceptance and “an institutional unit”, which are, among others, presently created consortia in the form of scientific and research entities as well as micro- and small enterprises, which compared with medium-sized and large organisations do not possess their own or outsourcing R&D units. The selection of micro and small enterprises as partners in the abovementioned consortia and simultaneously recipients of values: planned, created and implemented innovations is not a coincidence. In the context of innovations development and at the same time in accordance with the assumption to implement environmentally-friendly innovations this is one of the most crucial groups of entities, which is confirmed by the size and “economic power” of this sector. In the EU itself micro- and small enterprises account for 98.8% of all the enterprises, where micro ones constitute 93.0 % and small ones 5.8%. The added value of the entire SME sector is 4.030 (in EUR trillion), which constitutes 56.8% in the European economy, where the analysed in the present paper micro enterprises account for 20.9 % and small ones 17.8 % [6]. The European Union have noticed the impact of this sector on the environment and introduced, among others, in July 2014 „Communication on the Green Action Plan for SMEs” [7].

This communication summarises the determinants of green activity diffusion primarily with relation to micro- and small enterprises, therefore also selected support mechanisms promoting their active mobilisation. According to this plan the EU supports, among others, consortia, organisational networks created by these enterprises with the cooperation of scientific and research units and intermediary entities.

## **II. ECO-INNOVATIONS – SUPPORT MECHANISMS FOR MICRO AND SMALL ENTERPRISES**

Innovations in the context of pro-environmental awareness and therefore proper actions undertaken by economic organisations are commonly termed

as eco-innovations. In the literature on the subject the transformation of innovations into eco-innovations emerged at the end of the past century. Obviously, the foundations for the term of eco-innovations were innovations in the process grasp. Some of the early precursors include C. Fussler and P. James, who defined eco-innovations as new products and processes that provide the business and customers with added value, simultaneously reducing the impact on the environment [8].

An attempt at unification was undertaken by the European Commission in 2009, which defines eco-innovations as all forms of innovations, technical and non-technical ones – that create opportunities for enterprises and are beneficial for the environment, prevent the negative impact of economic activity on the environment, e.g. by optimisation of resource use [9].

In turn, in the context of innovations defined in Oslo Manual 2018, OECD defines eco-innovations as environmental innovations related to development or implementation of new or significantly improved products, processes, but also marketing methods, organisational structures and institutional solutions that lead to an improvement of the natural environment's condition, compared to corresponding alternative solutions [10].

Presently, eco-innovations are not limited to product and process ones. According to Oslo Manual 2018 eco-innovations are extended to all business processes, e.g. in: logistics and distribution, marketing and sales, ICT, administration, organisation and management.

It needs to be stressed here that defined in such a way eco-innovations are fully in line with sustainable development strategies, both at the macro scale (strategies: global, EU, national) and the micro scale (enterprise strategies). At present, the benefits that result from the implementation of heterogeneous eco-innovations can be analysed in three dimensions of sustainable development:

- Economic one – e.g. reduction of costs, materials and energy, new environmentally-friendly products and services, new business models, new markets, as well as an increase in security of “resources” through resource intensity.
- Environmental one – sustainable management of resources, materials, production factors, reduced pollution of lithosphere, hydrosphere,

aerosphere.

- Social one – improved life quality, development of new „sustainable” work positions, growth of products and services in their environmental portfolio, optimum redistribution of resources, willingness to bear higher external costs, willingness to buy pro-environmental goods, which unfortunately are still considered luxury ones.

With reference to the subject scope defined in the title of the present paper **the scope of eco-innovations may go beyond the boundaries of innovations organisation and comprise wider social systems, resulting in changes of the existing social and cultural standards as well as institutional structures.** The scope of implemented eco-innovations varies and depends on the adopted attitude to changes, e.g. modification – slight or progressive improvements of products and processes; redesign – significant changes to the existing processes, products, business processes; supplementation – introducing pro-environmental products and services – supplements of products or services available on the markets and “novelty” – developing and introducing completely new products, processes, organisation structures and business procedures. Certainly, while discussing the scope of changes and the intensity of eco-innovations implementation it is important to correlate and associate them with pro-environmental awareness and simultaneously attitude of entities, in this case economic organisations. Given that pro-environmental awareness is an aggregate of knowledge, opinions and imaginations on the impact of organisations on the environment as well as possibilities, tools and ways of its protection, according to T. Burger [11], but also the research conducted by the authors [12] there are three basic levels of pro-environmental attitudes: autocratic one – full subordination of the natural environment; passive one – pro-environmental indifference, but environmental threats are recognised; active one – high level of interest in environmental issues, which translates into offensive pro-environmental actions, among others, through implementation of eco-innovations.

By associating a high level of pro-environmental awareness with an active attitude of economic entities in previous literature query and own research of the authors [13] it has been justified

that a growth in awareness occurs the moment entrepreneurs become actively involved through developing own abilities and competences related to recognising, evaluating and designing eco-innovative solutions. Additionally, high pro-environmental awareness, which is reflected in an intense transfer of eco-innovations, is also justified by a willingness to bear higher external/environmental costs.

Based on the secondary research for the European Commission [14], it should be emphasised that 33% of the European micro and small entrepreneurs have undertaken and 89% of them are planning at least one action that stimulates a decrease in resource intensity, frequently through implementation of eco-innovations: product ones and business processes (including technological, organizational ones in production and logistics). Currently implemented eco-innovations in the scope of resource intensity regard reduction in consumption of various primary and auxiliary materials/resources and also maximised use of source materials. According to Flash Eurobarometer 456 – TNS Political & Social at the request of the European Commission, Directorate-General for Enterprise and Industry [15] the dominant areas of pro-environmental activity of the European sector of micro and small enterprises in 2017 constituted (the research was conducted on a sample N=13. 117): 1. reduction of harmful waste - 65% of the surveyed micro-enterprises/66% of the surveyed small ones – among others, transition to more environmentally-friendly resources, replacing primary raw resource sources with secondary resources; 2. energy savings - 62% of the surveyed micro-enterprises and 64% of the surveyed small ones – including replacement of electrical devices, e.g. lighting with energy-saving one or replacing office equipment with energy-saving one, thermal improvement of buildings; decrease in energy consumption per one product unit; 3. material savings - 55% of the surveyed micro-enterprises and 62% of the surveyed small ones, e.g. optimising particular elements of the production process, introducing new technologies, electronic documentation; 4. water savings - 47% of the surveyed micro-enterprises and 46% of the surveyed small ones, for instance: leakage sealing, recycling and reuse of used water (grey one), installing rain water tanks and including them into

the circulation of hot utility water; 5. waste recycling and its reuse - 40% of the surveyed micro-enterprises and 46% of the small ones; 6. eco-product development - 24% of the surveyed micro-enterprises and 28% of the surveyed small ones, including optimisation of single product elements, applying new product elements, new product designing, use of biodegradable resources; 7. waste material sales - 18% of the surveyed micro-enterprises and 31% of the surveyed small ones; 8. RES installation in prosumer models - 13% of the surveyed micro-enterprises and 17% of the small ones, e.g. photovoltaics, solar collectors application for heating water and buildings. Actions of micro and small enterprises in the scope of eco-innovations concentrate on optimisation of resource use and therefore preventing or limiting the negative impact on the natural environment. They also favour growth of competitiveness and image of these companies thanks to introducing new environmentally-friendly: products, technological processes, green marketing or organisational solutions [16]. While discussing the reasons, determinants of eco-innovative activity of micro and small enterprises, referring additionally to own research of the authors (limited to the Polish sector of micro and small enterprises) [17], cost reduction needs to be distinguished. Based on own research, described in the previous papers of the authors, in the group of eco-innovative activity determinants of micro and small enterprises one should distinguish the following: gaining a competitive advantage, considering eco-requirements of contemporary consumers, withstanding competition in the face of growing social pro-environmental awareness [17]. Financial support mechanisms are also relevant, such as: subsidies, grants, preferential credits or tax benefits. Micro and small enterprises as determinants of eco-innovative activity also perceive: expected profits from sales of eco-products, improved company's image, social acceptance of their activity. Micro and small enterprises also expect support from scientific and research units through permanent cooperation in the scope of developing eco-innovations prototypes and also their commercialisation in practice of the conducted business activity. Therefore, it needs to be stressed that these enterprises perceive the need of constant support from scientific and research units as a need to create mutual alliances, networks of



competencies relationships with entities that can participate in creating and commercialising eco-innovations. Certainly, the thematic scope of organisational networks has been the area of interest for two decades, especially at the centralised level – the top-down approach. The European Commission provides its patronage heterogeneous networks of entities, whose goal is to create green activity, including a diffusion of eco-innovative solutions, e.g. European Cluster Observatory, European Entrepreneurship Network (EEN) or network created within the programmes Horizon 2020 or INTERREG [7].

The roadmap of these networks is based on the roadmap in the scope of innovations (EcoAP) [18], which determines directions of eco-innovations policy and financing within the strategy „Europe 2020”.

However, with reference to actual needs of micro and small enterprises (the bottom-up approach), the subject scope of networking in creating eco-innovations according to Oslo Manual 2018: product and business processes constitutes a novelty both in the theory and practice of business. There still exists a research gap in this scope.

### **III. STRUCTURE OF SCIENTIFIC AND BUSINESS NETWORKS IN CREATING ECO-INNOVATIONS VALUE OF MICRO AND SMALL ENTERPRISES**

While focusing on scientific and business networks as an organisational form that supports diffusion of eco-innovations in micro and small enterprises, a reference can be made to a network of entities that combine in their structure (institutional nature) key competencies [19]. Activity and cooperation of heterogeneous groups of entities that create such networks should concentrate around carrying out their particular competencies (functional nature) [20]. A network of associated competencies of various groups of entities, e.g. scientific and research, micro and small enterprises – differentiated, among others, with respect to the industry, creates “a new organisation” of volatile structure. Such an organisation lacks unambiguously defined in time and space mutual relationships – management boards and decision-making panels. The temporary structure of the networks is adjusted depending on the entities’ competencies in the scope of creating particular eco-innovations – as an answer to the present, frequently “momentary” market demand. In the group of entities that create organisational

networks one can also distinguish entities that are termed “network integrators”. The roles and privileges imposed on them by the remaining members entitle them to carry out actions, among others, such as organising networks of eco-innovations, increasing pro-environmental awareness and therefore knowledge of micro and small enterprises, introducing support mechanisms for eco-innovations (financial and non-financial) or monitoring. An example of such intermediary organisations, which together with scientific and research units (carrying out scientific research, developing and testing eco-innovations prototypes) and first of all micro and small enterprises (result commercialisation) cocreate the value of eco-innovations include: regional innovation centres, scientific and technological parks, entrepreneurship incubators, e.g. start-ups, spin-offs, technology transfer bureaus, training organisations/associations (knowledge transfer), consulting agencies, networks of experts as well as ones financing eco-innovative technological or product “inventions” (characterised by a high probability of being commercialised by micro and small enterprises), venture capital, business angels, commercial banks, leasing companies). While discussing the network structures in the scope of planning, implementing, utilising and commercialising eco-innovations, micro and small enterprises can create networks of horizontal and vertical relationships.

*Horizontal networks* – are organisational networks of mutual heterogeneous relationships of competences, but also of technical, technological, product and business relationships between micro and small enterprises, whose goal is joint increase of eco-innovation value, e.g.. in a given industry.

*Vertical networks* – organisational networks of mutual heterogeneous relationships of competencies: technical, technological and business ones between micro, small enterprises, intermediary organisations and scientific and research organisations. Creation of these networks favours diffusion of eco-innovations through their transfer directly to the currently absorptive sector of the analysed sector of economic entities. Intermediary organisations through heterogeneous mechanisms, e.g. knowledge transfer, mediation in acquiring external financing sources of scientific research, developing prototypes and implementation, fulfil the role of integrators

between science and business within these networks.

Creation of scientific and business networks strengthens the potential, position and competitive advantage of all the three groups of organisations on sustainable markets.

**It should be mentioned that the scientific and business networks where eco-innovations are created and later commercialised in the sector of micro and small enterprises can also be initiated within the alliances taking place between entities that compete one with another. Alliances of these entities within the business and scientific networks simultaneously stimulate the competition and mutual cooperation (coopetition).** These are primarily strategic alliances not only, as it was the case previously, but first of all vertical integration. The abovementioned alliances created within scientific and business networks are especially dedicated to small economic entities, which separately are unable to compete on the markets dominated by large organisations operating, e.g. within the same industry or the same market. It should be stressed here that the network structure is one of the most advanced organisational forms applied in contemporary economic organisations [21]. Mutual relationships have equal importance. Equivalent exchange of information occurs without hierarchical limitations [22]. Organisational relationships networks: scientific units, micro and small enterprises, intermediary organisations at all the stages of creating, commercialising and utilising eco-innovations are the structures based on common interest, of all participating economic units of their direct and voluntary participation. The entities within this network mutually delegate tasks based on the analysis of own competencies and abilities in the subsequent stages: 1. developing. 2. implementing 3. commercialising eco-innovations. 4. dissemination and promotion. At the same time micro and small enterprises through the network cooperation with scientific and research units and intermediary organisations strengthen the position of their operation. Based on the literature study and also own research of the authors in the scope of creating such networks, particular stages of eco-innovations value creation have been assigned partial tasks and groups of entities that carry them out, simultaneously increasing the value of eco-innovations and

stimulating their diffusion.

#### **IV. SCIENTIFIC AND BUSINESS NETWORKS OF MICRO AND SMALL ENTERPRISES ECO-INNOVATIONS VALUE - SUBSTANTIVE AND ACTIVITY DIMENSION**

The authors of the present paper have been carrying out research related to measurement, analysis and evaluation of determinants and barriers of “green activity” of SMEs, level of their readiness, their pro-environmental awareness with regard to their pro-environmental attitudes and willingness to bear higher external costs, for over a decade, among others, within the programmes „Green Marketing” and “Before we are suffocated by smog – social platform of knowledge transfer”. The cooperating group, among others, micro and small enterprises constitutes 136 entities that declare at least one green activity in line with their primary activity. The detailed results of the research have been summarised in previous paper, among others, such as: *Levels of Pro-Environmental Maturity in Micro and Small Enterprises, Environmental Management and Green Attitudes of the European SME Sector, The Influence of Environmental Awareness and Attitudes of Entrepreneurs on the Acceleration of eco-Innovation in Micro and Small Enterprises* [12-13], [17].

Currently, another project has been launched „*Network of Service Providers for Eco-innovations in Manufacturing SMEs*”. A justification for undertaking this venture is confirmed in the previous research interest of the SME sector, micro and small enterprises in particular, in eco-innovations. Within the groups of entities that cooperated in previous projects 56 (41.2%) of them have declared that they had been implementing or were interested in implementation of eco-innovations. 25% of the declared enterprises demonstrated interest in product eco-innovations (e.g. utilising biodegradable or materials or product digitisation), the remaining ones in turn 75% - in business processes eco-innovations (e.g. reducing production energy intensity through application of new technologies based on *machine learning* or applying innovative filtering installations). However, in creating the value of their eco-innovative solutions they expect from external entities (scientific and research units or intermediary organisations) not only financial support but primarily substantive ones. As it has

already been indicated in the present paper micro and small enterprises with regard to medium-sized and large organisations do not possess their own outsourcing R&D units and find it more difficult to start direct cooperation.

Meeting the expectations of the investigated micro and small enterprises, based on the EU's legislative documents [7], literature on the subject and won research and observations, the authors have summarised a portfolio of partial activities at particular stages of eco-innovative solutions value creation (Development, Implementation, Commercialisation, Dissemination and Promotion)

for the sector of micro and small enterprises. Based on the preferences/indications of the investigated micro and small enterprises the authors have made an attempt to assign these partial tasks in the matrix form to particular groups of entities that can create organisational scientific and business networks of eco-innovations value. In the present paper in order to synthetically present the substantive-activity matrix – organisational scientific and business network of eco-innovations value the authors have introduced preferences/indications that in the investigated population exceeded:  $N_{\%}>50\%$ .

Table 1. Substantive-activity matrix of organisational scientific and business network of micro and small enterprises eco-innovations value			
Partial tasks in scientific and business networks of eco-innovations value	Entities cocreating scientific and research networks of eco-innovations value		
	scientific and research	intermediary	micro and small enterprises
<b>1. Developing eco-innovations</b>			
Market replication, benchmark analysis, so as to accelerate eco-innovative ideas for new products or business processes	x	x	x
Analysis of market and competition and evaluation of eco-innovative potential of organisational network	x	x	x
Search for eco-innovative solutions	x		x
Analysis and evaluation of economic, environmental and social profitability – eco-innovative concept, which is characterised by a significant novelty (new products, processes, services and technologies or new market applications) for the sector of micro and small enterprises	x		
Developing feasibility study taking into consideration technological issues of the product/process, organisational ones	x		
Identifying “bottle necks” in the capacity to increase the profitability of micro and small enterprises in the stages of planning, developing and implementing eco-innovations	x		
Conceptual works, preparation to carrying out research and development works	x		x
Identifying, analysing and acquiring external sources of eco-innovations financing		x	
<b>2. Implementation</b>			
Prototyping, piloting, miniaturisation, designing eco-innovations	x		
Testing and validating the developed project of eco-innovations	x		x
Increasing the scale through preparing and launching the production of an eco-innovative solution	x		x
<b>3. Commercialisation</b>			
Commercial introduction of an eco-innovative solution			x
Improving eco-innovations and search for	x		x

ides for new solutions			
Technological audits, advisory services, e.g. in the scope of managing and acquiring intellectual property and eco-innovative value of solutions in the models pay-per-value	X	X	
<b>4. Dissemination and promotion</b>			
Promotional and marketing actions, training services in order to disseminate the value of eco-innovations – substantive grasp, scientific and organisational networks and their beneficiaries – subjective grasp		X	X
Developing and validating new business models in the scope of effective resource management, improved energy efficiency	X	X	
Developing and disseminating repositories of heterogeneous eco-innovations and their value – a repository of best practices in the scope of effective resource management in micro and small enterprises	X	X	X
Source: Own elaboration			

In the table form the matrix has been presented in Table 1.

The developed matrix is a foundation of functional and activity cooperation of particular groups of entities. **The evaluation of partial tasks and their substantive and subjective assignment by micro and small enterprises is their answer to expectations and forms of cooperation both dedicated by scientific and research units as well as intermediary organisations.** Micro and small enterprises also indicate tasks that should be carried out jointly or autonomously by the distinguished groups of entities in the scientific and business networks of the created value of eco-innovations. Certainly, the selection of entities in these groups consists in adjusting their competencies in the scope of the whole creation chain of particular eco-innovations. The above matrix has been adopted as a functional and activity etalon in the developed business model of scientific and business network cocreated, among others, by the research team of the authors – within the newly-implemented project regarding designing and developing a pilot system of services and portfolio of eco-innovative products dedicated in the network of a project partners consortium and their commercialisation in the sector of micro and small enterprises. The project that is being currently carried out is of international nature – the partners, scientific and research units, micro and small enterprises, intermediary organisations from the Baltic Sea Region.

## Conclusion

To sum up, eco-innovations reflect the “green activity” of micro and small enterprises and simultaneously are a tool of entrepreneurship, which provides resources with a possibility of creating sustainable value. The scope of eco-innovations may go beyond the boundaries of innovations organisation and may comprise broader social structures, resulting in changes of the existing social and cultural standards and institutional structures. In the present paper its authors have focused on the organisational form of eco-innovations development support and at the same time dissemination in this sector. An attempt has been made to justify the „existence” of scientific and business networks – organisational networks of eco-innovations value for micro and small enterprises. These enterprises within the scientific and business networks are not only beneficiaries of commercialised in their operations eco-innovations, but also a legitimate group that cocreates these networks. Scientific and business network stimulate active involvement of these enterprises through developing their abilities and competencies in the scope of recognising, evaluating, implementing and commercialising eco-innovative solutions. It should be also indicated that processes of eco-innovative product or business processes commercialisation pertain also research results of scientific and research entities, structured new knowledge that can be made available in the network by intermediary



entities, as well as intellectual property - intangible assets of the developed eco-innovations. These values may be introduced to the market, among others, by micro and small enterprises, but also the remaining entities of the organisational network, among others, as licenses, patents, trade designs or made available in the *pay-per-value* model.

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