

Stimulating Eco-innovation Development in Small and Medium-sized Enterprises: Ecolabnet Eco-innovation Network

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Abstract: The issues of the article concern the development of eco-innovations, which determine the level of eco-innovativeness not only of individual enterprises but also of regions and countries. Given the low level of eco-innovativeness in many economies of the world, it is necessary to take action targeted at increasing the objective level. Such a result can be obtained by saturating all business processes with eco-innovative solutions. An example of an initiative aimed at stimulating eco-innovative behavior is the Ecolabnet project, implemented by an international network of partners (Network of Service Providers for Eco-innovations in Manufacturing SMEs - Ecolabnet) representing research and development units from six Baltic Sea countries. The network has been established as a part of the ongoing Baltic Sea Region Interreg Programme 2014-2020. In order to support enterprises—SMEs in particular—in the development of eco-innovation, it is first necessary to diagnose their needs and expectations in this respect. These needs have been identified using surveys carried out among SMEs based in the Baltic Sea countries. In response to the identified needs, eight packages of eco-innovation services dedicated to SMEs have been developed: Business strategy, Eco-innovation management, Bio-based materials, Product design and development, 3D printing, Environmental assessment, Marketing, and Other eco-innovation expertise. For targeting the offered services more precisely, companies were categorized in terms of their eco-innovative attitudes. Six types of eco-identity were distinguished: Eco-Opportunist, Eco-Booster, Eco-Developer, Eco-Optimizer, Eco-Cautious, and Eco-Laggard. A digital collaboration tool (DCT) has been developed to enable unrestricted access to network resources, such as services and products. DCT stimulates the creation of a service providers network to support eco-innovative activities in small and medium-sized enterprises. The main objective of the article is to present the potential of the international network of Ecolabnet partners to stimulate the development of eco-innovation in enterprises.

Keywords: Knowledge, eco-innovation, eco-innovation network, Ecolabnet, SME

1. Introduction

Today's economy is facing another major crisis triggered by the COVID-19 pandemic and exacerbated by Russia's military aggression against Ukraine. The pandemic resulted in global social and economic disruption, including the most severe global recession since the Great Depression. Following Russia's invasion of Ukraine in February 2022, many countries imposed numerous sanctions on the Russian Federation. In addition, many Western companies suspended, reduced, or withdrew from their operations in Russia. This has led to losses and financial crisis in Russia, but not only. The sanctions have also deepened the economic crisis practically all over the world. Price increases are accelerating. In many countries, inflation is reaching record levels. More and more often, one can hear about possible stagflation in the public space. If this phenomenon occurs, the crisis will intensify even more on account of a deepening economic slowdown – there will be a reduction in investment and an economic downturn.

The economic crisis caused by the pandemic and the war in Eastern Europe, which is slowing down economic development, is not the only problem for the economy. Another problem is the growing consumption, which leads to overexploitation of natural resources and excessive environmental pollution. Increasing urbanisation and existing production and consumption patterns are causing nature to degrade faster than ever before (Earth Overshoot, 2022). Humanity has already realised the severity of this problem. Various entities - economic unions, national governments, consortia, scientific research entities, corporations - have made numerous efforts to bring about, in the first instance, a slowing of the trend and then a reversal. This has resulted in the development of multiple concepts in economic theory and management science. The key ones include corporate social responsibility, sustainable development, and circular economy. However, the undertaken actions are not sufficient. The trend is still growing. This is, among others, because a significant part of the society still pursues the excessive and unjustified acquisition of material goods and services and ignores social and environmental costs. This attitude characterises not only individual consumers - individual consumer habits and choices, but also state governments - adopted policies, such as industrial, fiscal, energy or social, among others. All countries (national economies) strive for the greatest possible economic development. The primary factors of economic development are considered to be: human capital, land and raw materials, both renewable and non-renewable, technical progress, investment and entrepreneurship. However, innovation is of the most significant

importance. R.M. Solow (1957) showed, based on data on the American economy, that innovation is most responsible for the development of the economy.

As in the case of economic development, also concerning the problem of overexploitation of natural resources and excessive environmental pollution, very great importance is attributed to innovations, especially those referred to as eco-innovations. Eco-innovations are innovations that improve the efficiency of the use of natural resources in the economy, reduce the negative impact of human activity on the environment and strengthen the resistance of the economy to environmental pressures. They contribute directly or indirectly to improving the environment (Rennings, 2000; Daddi et al, 2012; Tamayo-Orbegozo et al., 2017; Pecorari and Camello Lima, 2020). They can be implemented in all business processes (OECD, 2019). In business practice, process and product eco-innovations predominate. The notion of eco-innovation is often identified with environmental innovation and green innovation, but they are not entirely identical (Karakaya et al, 2014).

The concept of eco-innovation emerged in the 1990s, sixty years after the concept of innovation was introduced into economics. It is a relatively young concept that is only beginning to develop. Therefore, the level of eco-innovativeness in virtually all economies of the world is low or very low, much lower than the level of innovativeness (Sobczak and Głuszczyk, 2022). Actions and initiatives are thus needed to increase this level by saturating all business processes with eco-innovative solutions. An example of an initiative aimed at stimulating eco-innovative behavior is the Network of Service Providers for Eco-innovations in Manufacturing SMEs (Ecolabnet) project, implemented by an international network of partners representing research and development units from six Baltic Sea countries. The network has been established as a part of the Baltic Sea Region Interreg Programme 2014-2020.

The main objective of the article is to present the potential of the international network of Ecolabnet partners to stimulate the development of eco-innovation in enterprises. The main focus is placed on the construction and functionality of the digital cooperation tool, referred to as the DCT system, which is a knowledge base of eco-innovative products and services offered in the network.

2. Ecolabnet Eco-innovation Network – synthetic overview

Ecolabnet (2019) is a transnational cooperation network between: Research and Development Institutes (RDI), Intermediary Organization (IO) and enterprises from the SME sector (Small and Medium Enterprises), in the area of the development of eco-products for small and medium-sized enterprises in the Baltic Sea region. Its origin resulted from the lack of solid links between small and medium-sized enterprises and R&D centres, resulting in a low level of adsorption of eco-innovations among small and medium-sized enterprises from the BSR. The aim of the network is to increase access to specialist knowledge, new eco-innovative products and services and to support their implementation by small and medium-sized enterprises. Ecolabnet increases the potential for commercialization of various eco-innovations from scientific and research institutions. It offers services and carries out research in the design and implementation of eco-innovation solutions in the following areas: Business strategy, Eco-innovation management, Bio-based materials, Product design and development, 3D printing, Environmental assessment, Marketing, and Other eco-innovation expertise. The underlined areas form packages of eco-innovative services.

The Ecolabnet eco-innovation network was developed as part of the following project: Network of Service Providers for Eco-innovations in Manufacturing SMEs (Ecolabnet)ⁱ. The total budget of the project was EUR 2.25 million. The project was implemented in the period from January 2019 to December 2021. The project leader was Design Center MUOVA from Finland, and the core consortia consisted of 11 partners from six Baltic countries: Centria University of Technology (Finland), Czestochowa University of Technology (Poland), Estrotech Ltd (Estonia), Kaunas University of Technology (Lithuania), Labsamera MB (Lithuania), Lithuanian Business Confederation (Lithuania), Sustainable Innovation (Sweden), University of Tartu (Estonia), VIA University College (Denmark), Vilnius University (Lithuania). On the part of the Polish partner – Czestochowa University of Technology, the interdisciplinary team implementing the project consisted of research and teaching staff from the Faculty of Management and the Faculty of Infrastructure and Environment. The author of this article was the main contractor in the project team from the Czestochowa University of Technology.

The primary objective of the Interreg Baltic Sea Region Programme is to foster integrated territorial development and cooperation to make the Baltic Sea Region (BSR) more innovative, greener and more resilient

to environmental pressures and more accessible and sustainable. The European Union finances the programme. It involves the transnational cooperation of partners from eleven countries around the Baltic Sea, who work together on various projects. Only international partner consortia can implement projects. The 2021-2027 programme distinguishes four priorities: 1: Innovative societies, 2: Water-smart societies, 3: Climate-neutral societies, 4: Cooperation governance (Interreg, 2021).

3. Ecolabnet Eco-innovation Network – fundamental stages of the knowledge management process in a project

The main objective of the project was to create a cooperation network for the provision of consulting services in the area of eco-product development and eco-services for small and medium-sized enterprises in the Baltic Sea region. Three main groups of actors can be distinguished in the established network: Research and Development Institute, Intermediary Organisation and Small and Medium Enterprises. Each type of entity is assigned a different role in the network. Research and Development Institutions are experts in eco-innovative solutions, offer eco-innovative services and products, and play an advisory role, both at the stage of designing and implementing eco-innovative solutions. Enterprises from the SME sector are the primary beneficiaries of the network. The network is primarily intended to meet the needs of these enterprises and contribute to their development. This does not mean that enterprises in the network only have to be buyers of eco-innovative services and products. They can also be suppliers. Companies range from those with a very high level and knowledge of eco-innovation to those with a deficient level and low expertise. The SME sector is dominated by those with a low level of eco-innovation. In turn, Intermediary Organisations act as integrators between research institutions and enterprises. They cooperate with both groups of entities. They facilitate the flow of information between them. They promote eco-innovative solutions, possess knowledge of available sources of knowledge on eco-innovation and encourage enterprises to implement them. At the same time, they know the specifics and problems of enterprises and can communicate them to scientific and research institutions. They do not have to be eco-innovation experts themselves.

The operationalisation of the objective required an understanding of the SME needs, vision, and challenges related to eco-innovation and how, and through which services, Ecolabnet can meet these needs and contribute to business development. The operational activities were divided into three elementary stages:

Stage 1. Gathering knowledge about enterprises in the field of eco-innovation.

Stage 2. Using the acquired knowledge to develop packages of eco-innovative services available in the created Ecolabnet network.

Stage 3. Creating a knowledge repository on eco-innovative solutions available within Ecolabnet, referred to as the Digital Collaboration Tool (DCT) system.

Defining the stages was based on the concept of the knowledge management process model (Davenport et al, 1998; Probst et al, 2002), which distinguishes three main phases of the knowledge management process:

- knowledge acquisition (knowledge creation),
- sharing knowledge,
- transforming knowledge into decisions.

3.1 Re. Stage 1

The starting point was to research and assess the level of eco-innovation awareness of enterprises from the SME sector and to identify their needs and expectations regarding eco-innovation. The research within this stage was conducted in July-December 2019. It aimed to identify, measure, and assess the relevance of drivers and inhibitors of eco-innovation diffusion in SMEs in the Baltic partner countries. In particular, it focused on: identification and classification of eco-innovations created or co-created by manufacturing SMEs, assessment of their knowledge about eco-innovations, categorisation of eco-innovations, motivators, needs, and barriers to eco-innovation development and implementation. The research was carried out in two phases. First, the partners, on the basis of the literature study (Burger, 2005; Triguero et al., 2013; Bocken et al, 2014; Karaarslan, 2015) and their own experience (numerous panel discussions), developed a portfolio of features attributed to the highlighted drivers and inhibitors of eco-innovation diffusion. The result of the first phase was the generation of a research survey questionnaire, which consisted of 26 questions, both qualitative and quantitative. Then, a survey was conducted using the CAWI technique. The research sample covered 298 entities, including from: Estonia – 23% of the research population, Poland – 19%, Finland – 18%, Lithuania – 16%, Sweden – 13%, and

Denmark – 11%. The quantitative research was complemented by qualitative research. Several in-depth interviews were conducted in each country.

The results of the study showed that the needs and expectations of enterprises in the area of eco-innovation are diverse, ranging from no need for external support, due to extensive experience in this field, to the need for appropriate support in all aspects related to the implementation of eco-innovative solutions – in terms of financing sources for eco-innovative projects, legal regulations and new eco-innovative solutions, especially in terms of materials, technologies, services, and products. The study results also showed that in the studied population of enterprises, there is a significant variation in the level of knowledge about eco-innovation and its importance in business. The results of project research in the field of the needs and expectations of enterprises from the SME sector in the area of eco-innovation are presented in more detail in Jędrzejczyk (2021) and Kucęba et al (2020).

3.2 Re. Stage 2

Within the framework of the first research stage, the SMEs' needs and expectations in terms of eco-innovation were determined, and the level of their eco-innovation awareness was assessed. The findings were used primarily to establish categorization of users to better adapt the network offer to customer expectations and to develop packages of eco-innovative services that should be available in the created Ecolabnet network. Furthermore, the partners' competencies were diagnosed in the context of the identified needs, and then the competence gap was determined. Specific measures have also been taken to minimise the designated competence gap – a strategy for the internal development of the project partners was developed, aimed at improving cooperation with SMEs and developing eco-innovative initiatives in relation to their needs, both current and prospective (issues of competence, competence gap, and internal development strategy will not be addressed in this article).

The identified needs of enterprises and levels of knowledge about eco-innovation made it possible to develop a categorisation of SME enterprises, mapping their eco-innovative nature. Six types of eco-innovative attitudes so called eco-identity have been distinguished: Eco-Opportunist, Eco-Booster, Eco-Developer, Eco-Optimizer, Eco-Cautious and Eco-Laggard. The first three types of eco-identity are the most advanced enterprises in terms of eco-innovation, and the last three are enterprises with a much lower level of advancement, which pay attention primarily to compliance with the legal requirements in terms of eco-innovation. The developed typology refers to E.M. Rogers' (1983) diffusion of innovations theory and partly coincides with his categorisation of participants in the diffusion of innovations. E.M. Rogers divided participants in the diffusion of innovations into five groups: 1) innovators, 2) early adopters, 3) early majority, 4) late majority, and 5) laggards. The main criterion for the division was the attitude to innovations and the propensity to implement them. It resulted in a peculiar gradation of participants: from those who are very keen on innovations and tend to take risks to those who are not in favour of innovations and display high resistance to innovations. The adoption of E. Rogers' typology in the project was insufficient given the purpose of categorising users – better adjustment of the network's offer to customers' expectations. In developing the eco-identity typology for enterprises, not only the level of eco-innovation knowledge and commitment was taken into account, but also the importance of eco-innovation for the enterprise, the main areas of interest in developing eco-innovation, and the main barriers for the enterprise in developing eco-innovation. Legal aspects, which are often very important in the case of eco-innovation, were also taken into account. Enterprises, even if they are not interested in implementing new solutions of an eco-innovative nature, are forced to do so by the legislation in force, for example, in terms of norms and standards for gas and dust emissions into the air or water pollution. The results of project research in the field of eco-identity of enterprises are presented in more detail in the study of Jędrzejczyk (2021).

The identified gaps and eco-innovation needs of SMEs enabled the development of the concept of eight eco-innovation service packages. The service packages address issues related to: 1) business strategy, 2) eco-innovation management, 3) bio-based materials, 4) product design and development, 5) 3D printing, 6) environmental assessment, 7) marketing, and 8) other eco-innovation expertise. Each package of services supports SMEs in a specific area, e.g., the environmental assessment package should include services that enable: 1) conducting impact analyses and evaluation of the environmental impact of investments, 2) determining ways to prevent, limit or minimise adverse effects of implemented projects, 3) testing of materials and products, as well as 4) carrying out research on end-of-life solutions. In this way, a specific categorisation of services has been made – the developed packages can be treated as portfolios of eco-innovative services. Each package has been assigned a specific set of services, consisting of services developed and offered in the first

instance by the project partners. Examples of services defined in the environmental assessment package are as follows:

- Analysis of compostability of plastics.
- Environmental impact assessment.
- R&D on end-of-life solutions to improve sustainability.
- Analysis of the impact of investment on the environment.

The developed service packages are not a closed set. They can be created on an ongoing basis as part of competence improvement by existing service providers, or completely new ones. The resulting packages of services may meet the needs of potential recipients – enterprises from the SME sector to an ever-greater extent, contributing to reducing identified gaps. SMEs are a possible direct group of recipients. Intermediary organisations can also use the network's resources to connect SMEs with service providers. The created typology of service packages was developed for the needs of the Ecolabnet Eco-innovation Network. However, the compiled portfolios are universal in nature. The research results concerning the developed eco-innovation service packages in Ecolabnet are more extensively presented in Jędrzejczyk (2022) and Kulej-Dudek (2021).

3.3 Re. Stage 3

To enable unrestricted access to Ecolabnet's eco-innovation resources, a concept of a knowledge repository of eco-innovation solutions available on the network, the so-called DCT system, was developed and implemented in September 2021. The created DCT system enables the collection and presentation of eco-innovative products and services developed by website users with the possibility of searching for connections between entities, services, and products. The concept and functionality of the DCT system are presented in more detail in the next section of the article.

4. Digital Collaboration Tool in Ecolabnet as a knowledge repository for eco-innovative services and products – construction and functionality

The DCT system is a tool that enables effective cooperation between research and development units, intermediary organisations, and enterprises from the SME sector in the field of eco-innovation. It provides a source of professional knowledge about eco-innovative solutions provided within the ECOLABNET network (Figure 1).

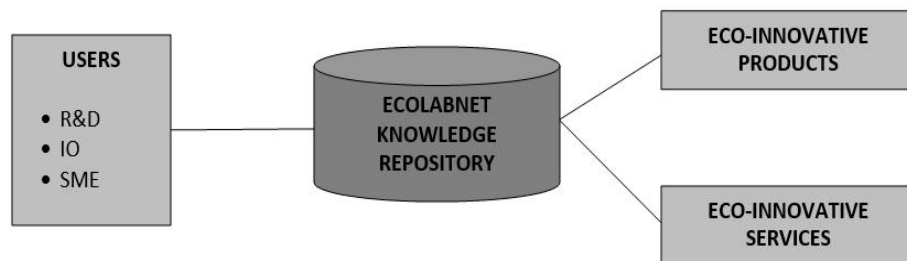


Figure 1: Ecolabnet knowledge repository: main objects

Source: own study

Each user, who has an account in the system, is described by the following attributes: User type, User name, Contact data, Trade, NACE code, Offer type, Expected support forms, and Green activities. They can offer eco-innovative products, services, or technologies. The expected forms of support are divided into four categories: 1. Business (branding communication, customer insights, supplier relations, business models, value chain assessment, financial aspects, intangible legal assets, legislation); 2. Finances (credits, loans, donations, capital venture, business angels, crowd financing); 3. Development (product design, packaging development, lifecycle assessment, service design); 4. Technology (biocomposites, bioresins, recycling, energy optimization, material efficiency, other alternative materials, certifications, 3d printing). The user profile is also assigned the main areas of green activity, such as: minimising waste, energy savings, material savings, water savings, waste recycling/reuse, eco-product development, waste material sale, res installations, and prosumer models. The distinguished attributes characterise the user in detail and define their role in the system.

Each service, determined in the system, is described in detail with the following components: Name of service, Offeror's logo, Offeror of product, Category of service, Type of service, Description of service, Areas of interest/Trade, Related services, and Status of service. It has a specific purpose and a described infrastructure of the service provider. The eco-innovation products defined in the system are also described using analogous components. The elementary attributes of the DCT system objects and the chief relations between them are illustrated in Figure 2.

The DCT system has a modular structure which consists of eight autonomous, integrated modules. These modules can be grouped into three groups: 1. information modules – News, Success stories; 2. modules in the operational layer – User module, Product module, Service module; 3. modules in the analytical layer – Module for searching and matching eco-innovative products and services, as well as surveying and reporting. Three types of interfaces have been defined in the system:

1. Basic interface (public level, not logged in user) including the following modules:
 - module for search for content according to basic criteria,
 - module for presenting basic information regarding the element searched for.
2. Extended interface that includes (classified level, logged in user) all the modules of the basic interface and also:
 - registration form and product and services forms,
 - extended search module, intelligent search for the relationships among elements according to the selected criteria: user, product, service, technology, type and kind of eco-innovation, implementation area,
 - search display module.
3. Administration interface that includes a module for managing the service and its content (administrative level, for administrators and editors of the system).

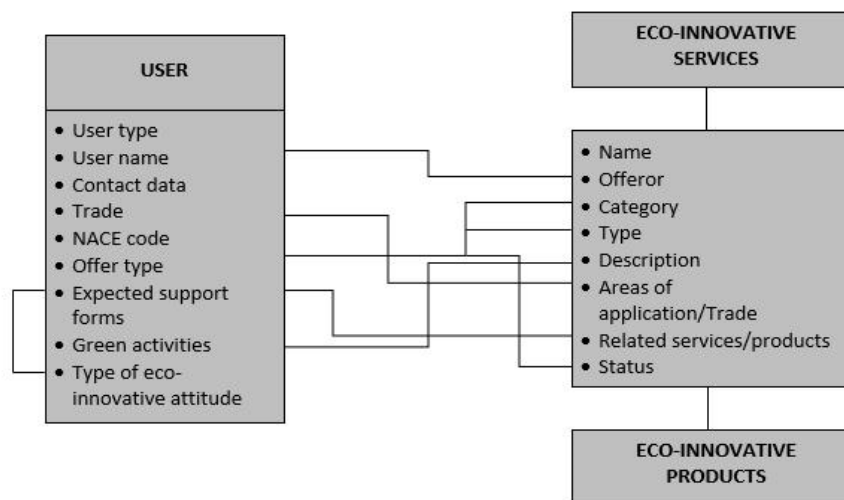


Figure 2: The DCT structure: elementary attributes of the DCT system objects and chief relations between them

Source: own study

The DCT system can be used by users, both registered and non-registered. Users can search for links between partners, services, and products in the field of eco-innovative solutions. The module for searching and matching eco-innovative products and services is supposed to filter the values of fields and display matching positions. The search is supposed to be based on the selection according to the list of keywords or terms. For example, while searching for and matching eco-innovative products and services, based on the list of related keywords or terms, information will be displayed on entities registered in the DCT system and their eco-innovative products, business processes or services that match: the offer, interests or orders of the company/user conducting the search.

5. Conclusions

The main issue of the article concerns the subject of eco-innovation development, which is a specific type of innovation. Eco-innovations are new or significantly improved solutions, primarily products, processes, technologies, and services, which create opportunities for businesses, contribute to increasing their business efficiency, allow the use of new opportunities for development, and positively affect the image of the organization. They also benefit the environment through more optimal use of resources and a reduction in the negative impact on the environment. Eco-innovations are closely linked to the way humanity uses natural resources. It is not only how goods are produced, but also how they are consumed. Therefore, eco-innovation makes it possible to manage resources more efficiently and contribute to economic growth in an environmentally sound way. Eco-innovation is connected with the concepts of sustainable development and corporate social responsibility.

The contemporary world needs eco-innovation to cope with critical environmental challenges such as climate change, depletion of natural resources, or biodiversity loss. New economic and social models and technologies that benefit the environment are needed. Unfortunately, eco-innovation can still be treated as an abstraction due to the substantial barriers to its implementation. The main barrier is not technology but economics, law, and human mentality. Another barrier is the growing global economic crisis caused by the COVID-19 pandemic and the war in Eastern Europe. As a result, the level of eco-innovativeness in almost every economy of the world is low or even very low. Therefore, actions and initiatives are needed to increase this level. An example of an initiative aimed at stimulating eco-innovative behavior is project Network of Service Providers for Eco-innovations in Manufacturing SMEs – Ecolabnet. The network has been established as a part of the Baltic Sea Region Interreg Programme 2014-2020.

Ecolabnet integrates research and development units, intermediary organisations, and small and medium-sized enterprises. It targets the SME sector, i.e., enterprises for which the barriers to implementing eco-innovation are significantly higher than those for large enterprises. The research conducted within the project has shown that both the level of eco-innovation advancement of SMEs in the Baltic Sea Region and their level of knowledge about eco-innovation varies considerably. Companies range from those with a very high level and knowledge of eco-innovation to those with a deficient level and low expertise. The diagnosed needs and expectations in the area of eco-innovation were also significantly differentiated, from no need for external support to the need for support in virtually all aspects related to the implementation of eco-innovative solutions. Thus, needs that could be supported by the environment were identified, including the Ecolabnet network. As a result, eight packages of eco-innovation services that should be available within the created Ecolabnet network were developed: Business strategy, Eco-innovation management, Bio-based materials, Product design and development, 3D printing, Environmental assessment, Marketing, and Other eco-innovation expertise. They do not constitute a closed set.

In order to tailor the network offer more precisely to the needs of SMEs, companies were categorized in terms of their eco-innovative attitudes. Six types of eco-identity were distinguished: Eco-Opportunist, Eco-Booster, Eco-Developer, Eco-Optimizer, Eco-Cautious, and Eco-Laggard. The created user typologies and service portfolios were developed for the Ecolabnet Eco-innovation Network. However, the compiled categories are universal. They can become usable for all entities operating in the market of eco-innovation services in the process of customer and service portfolio management.

Unrestricted access to Ecolabnet's resources is provided by the DCT system, a tool developed within the project that acts as a system for collecting and presenting eco-innovative products and services. The developed tool allows compiling a detailed characterisation of a registered network user and defining their role in the network. It also enables a precise description of eco-innovative services and products identified in the network. An important feature is the ability to search for links between partners, services, and products. The DCT system, constituting a repository of knowledge on eco-innovation, is an open database of eco-innovative solutions.

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