Research concerning the achievement of eco-innovation virtual hub tools to increase Romanian economic environment competitiveness

I Radulescu

1 University POLITEHNICA Bucharest, Romania
E-mail: irina.radulescu@upb.ro

Abstract. The paper presents the virtual hub experimental model achievement consisting of an innovative tools series in order to facilitate innovation, knowledge transfer and waste recycling efficiency of electrical and electronic equipment. The Hub includes a tools set to increase recycling efficiency: the passport for electrical and electronic products recycling, the multi-criteria analysis method for the product, pointing relevant features for recycling, the implementation model of eco-innovative technologies at company level, the recyclability evaluation method based on idealism. It also includes an eco-innovation library, an eco-innovation and training laboratory, a Forum, as well as User Guides for each tool and a cost-benefit analysis guide for e-waste recycling. The obtained tools, in their form, are an absolute novelty in the field of WEEE recycling and they address a new way of thinking and a new philosophy about material recovery and recycling and resource economy.

1. Introduction
Actual development directions to put in practice the Europe 2020 strategy are focused to an intelligent and sustainable growth based on eco-innovation, that will reduce the impacts on the environment, by “increasing resilience to environmental pressures or using natural resources more efficiently and responsibly”. [1].

It is the 7th Environment Action Programme guides the European environment policy until 2020, being focused to reduce the pressure over environment and to eliminate the gap between innovation and market. The eco-innovation and green technologies represent the key to a competitive and prosperous Europe, creating new jobs in this field, by linking the natural environment to economy, the global demand for renewable energy to resource-efficient solutions, [1]. It is an important way to do research in studies and policy documents about how to develop eco – innovation capabilities and practices aiming “significant commercial potential across all economic sectors”. Market developments focused on investment increase and “accelerate innovation in environmental technologies, products and services”.

Helping companies and innovation service providers by delivering integrated information on eco-innovation represent useful tools for a “solid decision-making basis for policy development”.

A 3-year initiative financed by the European Commission's Directorate-General for the Environment from the Competitiveness and Innovation framework Programme (CIP) is represented by the Eco-Innovation Observatory. It “is developing an integrated information source and a series of analyses on eco-innovation trends and markets, targeting business, innovation service providers, policy makers as well as researchers and analysts” by directly information on two major EU initiatives: the Environmental Technologies Action Plan (ETAP) and Europe INNOVA. The
Observatory emphasizes that eco-innovation represents a phenomenon present in all economic sectors, being relevant for all types of innovation: "Eco-innovation is the introduction of any new or significantly improved product (good or service), process, organizational change or marketing solution that reduces the use of natural resources (including materials, energy, water and land) and decreases the release of harmful substances across the whole life-cycle", [2].

The key-role of Eco-Innovation Observatory is to publish studies and reports of European Commission that broadens the area for “green sectors and activities, by collecting information on firm-level strategies”. So, “eco-innovations are most widespread in the manufacturing industries, such as: electricity, gas, stream and air conditioning supply; and water supply, sewerage, waste management and remediation activities”. [3]. New directions to improve resource efficiency are represented by the development of resource efficient products and services and their introduction in production and on the market. The Framework Program Horizon 2020 and technology and innovation platforms must disseminate the eco – innovative results in the European Union, by using instruments as trade fairs, market information, technology platforms and innovation partnerships.

At national level, one of the instruments that supply enterprises and SMEs to increase their competitiveness is represented by COSME Program, with its 2.5 billion euros budget for the period 2014 – 2020. Being a financial instrument, it promotes and sustains the access to finance, being a support to encourage the “entrepreneurial culture and the creation of new companies”, [2].

Romanian SMEs have to face many difficulties to enrol in a sustainable development: poor information on environmental impacts and risks, lack of knowledge regarding the potential benefits of environmental management and eco-innovation, insufficient access to information or appropriate training, [3].

Taking all this into account, the paper presents the achievement of an experimental model for a virtual hub, which consists in innovative tools series in order to facilitate innovation, knowledge transfer and waste recycling efficiency of electrical and electronic equipment.

2. Provided and achieved objectives of the eco – innovation virtual hub
Research made in the national project EcoInnEWaste: „Virtual hub for eco-innovation to increase competitiveness in the field of electrical and electronic equipment waste recycling” were focused on objectives responding to economic, social and environmental challenges, in order to increase Romanian organizational competitiveness in the electrical and electronic equipment waste recycling and the involvement of public and private entities in promoting eco-innovation and development of green economy, [5].

The main provided and achieved objectives are:
- increasing the competitiveness of economic agents that are active in the field of WEEE recycling, by providing innovative tools to facilitate collaboration and knowledge transfer on eco-innovation, between universities - research institutes - authorities - business environment,
- creating a multidisciplinary research network and a sustainable partnership to lead toward a short term increasing of the institutional capacity and human resource skills devoted to applied research and innovative technologies development,
- increasing the visibility of Romanian and European research by knowledge creation  and its dissemination, which will allow the creation and strengthening of a field of competence in the field of sustainable e-waste recycling, [5].

Business environment faces a lot of challenges concerning the solving of main issues related to e-waste recycling, in order to recover recyclable materials, to eliminate hazardous components and to preserve in safe conditions the environment and human health.

Developing modern tools in e-waste recycling domain is a must for entrepreneurs, at cooperation level and in suppliers area. Information related to this topic must circulate and be disseminated and the network universities - research institutes - authorities - business environment should be strengthened.

Encouraging the eco – innovation and the innovators involves sustaining the idea, finding support at authorities level and in research field, implementing and disseminating obtained results, especially the ecological ones.
3. Development of the eco-innovation virtual hub tools. Results and discussions

In order to support SMEs to increase their management potential toward eco-friendly directions, a national research project focused on eco – innovation hub achievement, designed to offer useful business tools and to allow users access to relevant information resources. WEEE recycling and eco – innovation are up to date targets of SMEs management, being a modern way to increase their competitiveness, to facilitate the collaboration and knowledge transfer between key- actors.

During 3 years project, it was developed an experimental model of a virtual hub consisting of a series of innovative tools facilitating innovation, knowledge transfer, efficiency of the general waste recycling and electrical and electronic equipment waste (e-waste, WEEE) - in particular.

The working space of the Hub consists of four platforms, their application is done by the access of a common interface (www.hubecoinnewaste.ase.ro) – Figure 1, being possible to have a separate access, [5].

![Common hub interface](image)

**Figure 1.** Common hub interface
So, there are:
- a range of tools designed to improve the efficiency of recycling and located on the platform: www.instrumente.ecoinnewaste.ase.ro – Figure 2:
  - recycling passport for electrical and electronic products, with separate sections for the manufacturer and the recycler;
  - multicriteria analysis method of product characteristics relevant for recycling;
  - implementation model of eco-innovative technologies at company level;
  - assessing method of recyclability based on ideality.
- an eco-innovation library, at the address: www.biblioteca.ecoinnewaste.ase.ro;
- an eco-innovation and training laboratory, at the address: www.portal.ecoinnewaste.ase.ro;
- a Forum, at the address: www.forum.ecoinnewaste.ase.ro.

![Figure 2. Instruments](image)

To help the user on the common interface there are user guides for each tool and a Cost-Benefit Analysis Guide for e-waste recycling.

The particularity of these instruments consists of the novelty in WEEE recycling domain, bridging the innovative conceptual thinking with the innovative applicative plan, which offers detailed design of these tools, including associated software applications.

By using the Recycling Passport for electrical and electronic products many actors involved in recycling are aware of the materials value that can be recovered from WEEE and the resulting economic effects. The recycling passport offers the possibility to connect the user, the recycler and the manufacturer and to know information about product embedded materials and their market value. The structure of this instrument is designed to give briefly and clearly the most important and relevant information for recycling.
The recycling passport represents a special environment, linking the manufacturer and the recycler and providing to the recycling departments employees easy and fast access to necessary information for professional dismantling, re-use and sorting. [5].

Analyzing the Multi-Criteria Method for Product Recycling Characteristics it must be mentioned that the proposed method permits simultaneously:
- the association of some important coefficients to the classified elements;
- easy application for a big amount of elements to be classified, with minimal use of time and human involvement,
- easy application of evaluation criteria, using also their analytical hierarchy.

The method works with a a set of 19 criteria created for WEEE analysis relevant to Romanian recycling, taking into account the basic characteristics of the product categories. These criteria are proposed for traders that treat, reuse and recycle the e-waste and they have been structured into three areas: economic, environmental and technical.

Because WEEE are very different, there were divided into categories mentioned in the European and Romanian legislation (10 categories up to 2018 and 6 categories in 2018) and they are grouped according to the recycling technology or treatment. Users can also choose a product-level analysis, which offers the selection from a predefined list or the user may bring in products to be compared, [5].

The eco-innovative technology implementation model represents a path to eco-innovation offered to firms, helping to develop and/or bring to market new ecological technologies, products and services that reduce the overall environmental impact. Influence factors analysis can lead to the creation of sustainable solutions, by the economic use of resources and negative environmental impacts reduction.

Familiarizing the applicant with the model is done by an 6435 method example, a relatively new method, which is proposed and used in innovative product and service management, representing the basis for using the implementation model for eco - innovative technologies. It was developed an Excel application to understand how to use the method in an application example, then the user can analyze the options and chances of success, by completing with own data the proposed implementation model. The possibilities of analysis and control for the technology and for the product are the same, being specific for each one the parameters and factors involved in finding the optimal version, [5].

Another instrument is represented by the methodology for the recyclability assessment based on idealism. The central element of innovation is based on translating the theory of evolution into idealism in the WEEE products recycling. According to this philosophy, all systems/products evolve in the sense of materials substitution with fields, which are immaterial elements. A product is the easier to recycle as the material is smaller part. If the material is very small, even if the product is not recycled, the loss of potential reusable material is very low. An ideal recyclable product is a product made up of fields only that no longer requires recycling. This ideality theory can be used as a target in product development, [5].

The structure of the eco-innovation library proves its usefulness by its multi-level documentation components that enable users to access relevant information resources concerning materials recovery, WEEE recycling and eco-innovation areas. The development of eco-innovation library components were focused on all business issues, being useful for producers, users, suppliers or companies interested in WEEE issues.

The library content is divided into five modules concerning WEEE management and eco-innovation topics:
- Module 1 - Legislation, with sub-modules: National Legislation, European Union Legislation, Legislation of Other Countries;
- Module 2 - Stakeholders, with sub-modules: Companies involved in WEEE management, Organizations and NGOs, Authorities and relevant information;
- Module 3 - Studies, guides, methodologies in WEEE and eco-innovation domain, with sub-modules: Doctoral theses, dissertations; books; Guides, reports and specialist studies; Journals and conferences papers;
- Module 4 - Examples of good practices in eco-innovative technologies;
- Module 5 – Statistics.
Each module and submodule are filled with materials, their purpose is to be updated constantly from databases and to offer permanent new information. Modules interfaces have been designed to become a user-friendly tool.

Considering the descriptive documentation module side, it is designed to provide users a complex key-role template in the area of eco-innovation and WEEE management and to facilitate the inclusion in virtual learning communities that have been set up at national and international level in the e-waste management field: non-governmental organizations, forums, institutions, associations, agencies, etc.

Considering the formative training module side, it is designed to ensure the learning process dynamics and training, skills development and skill accumulation for all actors of the target groups, [5].

Another direction of the project research is to create a multidisciplinary research network and a sustainable partnership, by using instruments as eco – innovation and training laboratory and the project forum. The aim is to increase the institutional capacity and human resource skills devoted to applied research, also the development of innovative technologies.

By participating in scientific and technical events in Romania and abroad there were established a series of contacts and best practices exchanges between academic and scientific environment and business environment: the University of Bucharest, Babes Bolyai University from Cluj, GreenWEEE, Remat Holding, Ecotor, Environ, Rorec. Specialists from Spain, Italy, Czech Republic, Turkey, the Netherlands, Republic of Moldova, Croatia brought knowledge in this research field, [5].

4. Conclusions
The project aims are to design useful instruments for many entities involved in e-waste recycling and to offer information to be aware of the materials value that can be recovered from WEEE, also economic effects of the recovery activity. Also, the WEEE platform of the project is a relationship tool for all those involved in recycling, bridging the users, the recyclers and the manufacturers in order to work toward sustainable development of their products, technologies and services, meaning their firms activities.

Project team partners have a good cooperation with Romanian and abroad specialists and their participation in various national and international events developed a system of relationships that is reflected in the institutional capacity increasing and human resources competencies dedicated to applied research and innovative technologies development.

By increasing the visibility of Romanian and European research by the recycling knowledge progress and its dissemination there are created and consolidated new and modern fields of interest in sustainability area.

The experimental hub and its instruments meet the EU’s 7th Environment Action Programme objectives that require new technologies and approaches to business, by using innovative and sustainable ideas and contribute to transform firms in European companies more competitive, [1].

The modern thinking of WEEE platform involves legislative, utilitarian, informative, associative and formative aspects in this domain, offering easy access, interaction and information to a large number of users: citizens, potential investors, local governments, representatives of regulatory bodies, SMEs - as beneficiaries, RDI entities (universities, research institutes) or service providers on WEEE recycling.

5. References
[1] http://ec.europa.eu/environment/index_en.htm, accessed on 26.06.2018
[2] http://www.eco-innovation.eu/index.php/, accessed on 26.06.2018
[3] http://eco-inovare.ro/en/eco-inovarea-si-imm-urile, accessed on 27.06.2018
[4] European Commission, Eco-innovation observatory, Annual Report 2012, January 2013, “Europe in transition. Paving the way to a green economy through eco-innovation”.
[5] http://www.ecoinnewaste.ase.ro/, accessed on 27.06.2018.