



ARVIS ENVIRONMENTAL ENTERPRISES OF GREECE SA

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Innovative 3D training platform for recycling of waste electric and electronic devices

Progress Report

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Executive Summary

In order to achieve a significant reduction in the environmental pollution caused by the hazardous materials contained in Electrical and Electronic Equipment (EEE), EU established Directive 2002/95/EC to restricting their use and promote the collection, treatment and recycling of these materials. There is an obvious need of reducing the volume that ends in landfills untreated and the need of increasing the quantities of e-waste that are appropriately treated and furthermore reused. Apart from the obvious environmental benefits, there is significant potential to increase work places to WEEE treatment and recovery business sector. Until now, recycling of WEEE is usually of manual nature, available for lower skilled employees. In most cases this workforce is unaware of the materials contained in EEE, especially the hazardous/toxic or the ones with high value. This fact showed the gap in relevant Vocational Skills and Qualifications and raised the need to train the relevant personnel handling devices with a quick and easy to comprehend method in order to maximize recovery of useful materials included as well as minimize the waste that cannot be further treated. This need gave birth to the idea of project "Innovative 3D training platform for recycling of waste coming from electric and electronic devices-RECDEV" which proposes the development of an innovative method of training for both higher and lower skilled personnel. Also for higher level personnel of the recycling industries to develop skills on identifying the types and qualities of the material in the WEEE. The proposed educational method will be tested by employees already working in the relative sector in order to have feedback on how to improve the tool and maximize its training value. The final software will be a dynamic tool, easily updatable and applicable to all facilities related to WEEE recycling that are interested or obligated (by law per country) to educate accordingly their personnel. Due to its nature (ICT- based tool, easy use etc.) it could be accessible by workers with very low educational status not only in EU but any other part of the planet where illiteracy is an issue.

Project RECDEV (www.recdev.eu) comprises seven partners. Three from Greece (including the Lead Partner) and one from Austria, Slovenia, Romania and the Czech Republic. Among the seven partners, there are three SMEs, two Universities and two Associations. The project proposes and innovative training methodology which will be conducted with the use of a 3D software application in which 50 selected devices (WEEE) will be presented in a 3D interactive environment. Each scenario/device will be depicted in such a way that by selecting each part, pictures and information about the materials contained will be displayed. Based on the "learning by acting and doing" methodology, trainees will be able to interact by – digitally - disassembling each device and have access to information for each part, the including materials, their toxicity and potential reuse.

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1. Project Objectives

RECDEV project's objective is the development of ICT-based self- and distance learning training courses familiarizing learners/users with the disassembly of Electrical and electronic devices and the identification of types and qualities of materials embodied. It targets both low level workforce(disassembly), aiming at strengthening employability, safety at work and developing skills as well as higher employers (materials identification) covering a crucial training gap in the WEEE industry. The training material will be prepared in the form of scenarios, will be enhanced with multimedia material and developed so as to take the form of 3D training scenarios. The scenarios will in turn be transformed into 3D situations through Virtual Environment applications (ICT) stimulating the real world. In these 3D virtual representations of real devices will be enacted. The beneficiaries/learners will thus be able to participate in simulations of real-life situations (based on the training scenarios) and disassembly the devices.

The specific objectives of the RECDEV project are:

- to integrate existing practices and experience of the partners into the design of high-quality 3D training scenarios.
- to develop, pilot implement and evaluate an interactive, multimedia and multilingual training approach that will familiarize low level trainees with the WEEE disassembly and packaging allowing them to perform it virtually before going to the physical device.
- to develop, pilot implement and evaluate an interactive training approach that will help higher level personnel of the recycling industries to develop skills on identifying the types and qualities of the material in the WEEE.
- to modernize WEEE educational content with state of the art ICT tools and an ontology on WEEE.
- to offer multilingual easy to understand, training tools for economic immigrants, a target group that constitutes a great proportion of the workers in WEEE recycling.
- to enhance networking between WEEE employers and experts in the sector from different European countries.
- to offer an incentive to EU Recycling businesses towards a periodical training of their managerial and technical staff in aspects of modern disassembly methodologies and (most importantly) to the Health & Safety issues that arise with each new developed product and raw material used
- to ensure dissemination and further exploitation of its outcomes.

2. Project Approach

The project consortium worked together for about a year prior to submitting the project, to identify the gaps in the training offered in the sector. In visits to recycling factories, there were identified the following important shortcomings that the proposal planned to address:

- There was a problem in the higher personnel of the factories to identify the recycling materials in the devices (especially the new ones). This led to tonnes of electronic devices waiting for recycling because nobody knows exactly what to recycle from them. This is a common case for medical equipment where there exist big differences in their technology. The current practice at that time was a time consuming one, contacting the manufacturer for technical details.
- There was a new need, not only to identify the type of materials to be recycled, but also the quality of these materials (e.g. metals and plastic parts).
- There was a training need for employees (low skilled profile) to be trained in the different packaging required for the different recycling materials.
- Knowledge and recall was a key point to the recycling of the WEEE. The employees needed to be trained in identifying the internal parts of the devices. For example for PCs, the factories use to hire people with previous experience in computers. But the technology evolves and continuous training for them and their supervisors is necessary. To this must be added the need for early identification and removal of the toxic parts of the aforementioned products.
- Part of the employees, as already mentioned were economic immigrants, so the language part of offered training needs to be addressed.

The WEEE devices can be divided in the following categories:

- House equipment (refrigerators, washing machines, ovens, heating equipments, air conditions, vacuum cleaners, clocks, scales, etc)
- ICT equipment (main frames, mini computers, printers, photocopiers, CPUs, laptops, monitors, etc)
- Consumer Goods (radios, TV stations, cameras, etc)
- Lighting equipment (different kinds of lamps)
- Electric and electronic tools (not industrial)
- Electric Games and game machines
- Medical Devices (with the exception of all implanted and infected products)
- All kinds of Sensors

The most common problems in disassembling these devices are:

- Huge variety of different types of devices and assemblies
- Complex physical structure of the devices
- Many different materials in each device (economy and performance reasons)
- Lack of data from the manufacturers

RECDEV project comes to offer a brand new solution to these barriers by the development of specialized training methodology and content for the disassembly of electric and electronic devices and the identification of the type and quality of materials in these. The training material for the disassemblers will be developed in the form of scenarios for 3D environments allowing the users to learn of the geometry and parts of each different device, disassembling it to the virtual world with less text and more sound and animation instructions, before it performs it to the actual device. The training material for the higher level personnel will be offered also in 3D scenarios, but with the help of an ontology they will be able to access further information around the devices, the materials for recycling, how to identify the quality of different parts and their potential exploitation.

The advantage of RECDEV project is that the 3D training scenarios can be easily updated by non-expert content authors that they will be able with drag and drop parts to present different variations of the EEE devices, manufacturers' tips and other best practices.

The pedagogical methodology behind the project idea is based in an adaptation of the 'learning by doing' method to the singularities of the recycling sector, utilizing the interactivity and the simulation offered by virtual worlds. Using realistic disassembly physics, RECDEV scenarios will simulate the experience of taking everyday objects apart. Screws, bolts, nuts and every single part will be able to be removed by touch dragging in full stereoscopic 3D. Trainees will be able to interact, use and disassemble the object intuitively by just touching and dragging the parts. Camera will be controllable allowing the trainee to zoom in or out.

The proposed project falls under the Development of innovative ICT-based content, pedagogies, practices and services Leonardo Da Vinci operational objective, and under the action Multilateral projects for the Development of Innovation (DOI).

The duration of the project will be three years; Twelve months will be devoted to pilot implementation. There is already interest for Recycling Factories (see annexed letters of intent) to exploit the benefits of the training tools. The participation of real users to the pilot implementation phase is ensured as well as that the project outputs are going to cover real users' needs. The problems that the project is going to cover have already identified in research work and study visits to the same recycling factories.

The project's outputs will be available in several languages (English, French, Greek, Slovenian, Czech, Austrian and Romanian). The methodology and tools will be developed with the aim to be easily extended to other industries beyond the WEEE recycling sector. The proposal clearly addresses the strategic priority "NEW – Sector Skills Alliances – Activities" of the Leonardo DaVinci, Development of Innovation projects.

3. Project Outcomes & Results

The project will be able to supply in a simple and easy to understand way what hazardous waste is, how it looks and the correct way of storing, transporting and disposing of it. It will also help citizens and businesses to produce less hazardous waste, which will save money in waste disposal costs and reduce impact on the environment. Moreover the target group, people with low academic level, will be able to follow a complete training program regarding WEEE understanding, disassembly and disposal, giving them a professional ability to work in the aforementioned sector. The project will be open to all Social Partners and can be easily integrated to any possible academic or Vocational Training Program and can be adjusted to the needs of each target group.

In order to serve the needs of the unskilled workforce, the 3D scenarios will have an optional “video mode” where the whole procedure will be presented without the need for interaction from the trainee. This in the case that the trainees do not have the technical skills for the completion of the interactive training. Part of the pilot implementation is to train them how to use the tools and to access the effectiveness of this training.

The persons involved in Project’s pilot implementation, test and evaluation procedures are 250 (50 persons percountry) employees of recycling companies involved in WEEE. From them 10 % will be higher personnel, while he 90 % will be low skilled disassemblers. 10 users in each country will be receive traditional training to perform as control groups for the project achievements. The above targets will be monitored with goal to assess the market potential of the 3D training material in each country. The users' satisfaction, along with the system's effectiveness, efficiency and safety will be measured following ISO/IEC 9126, "Quality in use metrics".

Long term target groups include:

- vocational training providers as well as any organization at national and European level that are involved with recycling
- recycling companies (public and private) that want to train their employees or newcomers to specific requirements or to upgrade skills
- training institutions and all types of education providers that want to integrate virtual environments in their training tools

4. Partnership

The consortium brings together the resources of 7 participating organizations from 5 countries of which, 3 partners with expertise in Recycling, Environmental Protection and Waste Management (ARVIS SA, Hellenic Solid Waste Management Association and the NCSPC), 2 universities with research work in the recycling sector (Un. of Maribor and Mendel Un of Brno), a consulting company dealing with implementation of sustainable development with a special emphasis on preventive environmental protection (BAN Sozialökonomische BetriebsgmbH)¹ as well as a strong technological partner with expertise in 3D content management systems (Omegatech).

All roles have been matched and clearly assigned. Also all the other partners are fully compatible with the project objectives. More specifically:

- ARVIS Environmental Enterprises of Greece SA is an SME with expertise in Waste Management & environmental Protection Service. ARVIS has significant experience in EU applied & research EU funded projects
- OMEGATECH mainly provides advanced IT services and has been involved in many national research and EU funded programs. The company is highly competitive in 3D programming and gamification.
- University of Maribor and more specifically the Laboratory for Process Systems Engineering and Sustainable Development (University of Maribor) represents an important research center working on the development of methodologies for measuring and introducing the concepts of sustainable development into industries and public institutions, and initiatives in the field of interdisciplinary research.
- STENUM has participated in several FP research projects and a number of LEONARDO DA VINCI projects to develop training courses on environmental management, integrated management (including risk management, quality management, health and safety), innovation management and social responsibility. In this context, STENUM was as well involved in the development of web-based learning platforms and software tools. STENUM will offer valuable expertise to the development of the business plan.
- NATIONAL CENTRE OF SUSTAINABLE CONSUMPTION & PRODUCTION – CNPCD develops activities for advocacy, promotion and information sessions with recipients from industry and tourism, business proposals for the implementation of Resource Efficiency and Cleaner Production concept (RECP), in plant demonstrations and trainings. The Centre through his members has also high expertise in the area of waste management, environmental management, environmental auditing and corporate social responsibilities.
- MENDEL UNIVERSITY OF BRNO provides education in Waste management for 15 years. The study is focused on the treatment of agricultural waste, municipal waste, industry waste and take-back waste (including electrical and electronic waste).
- HELLENIC SOLID WASTE MANAGEMENT ASSOCIATION is the National member of International Solid Waste Association for Greece. It was founded in 2001 and now comprises all the stakeholders of solid waste management (consulting firms, universities, management authorities, etc.).

¹ The original Partner No 4 was STENUM GmbH which has withdrawn from the project for internal reasons and has been replaced by BAN Sozialökonomische BetriebsgmbH since 01/2015

5. Plans for the Future

Work package Title	Project Management	Work package Type and Reference	WP1
<p>Management of the project is a continuous activity and will be performed accordingly. The Lead Partner will be performing the relevant duties for the on time and within schedule completion of the project. The planned activities until the end of the project include:</p> <ul style="list-style-type: none"> • Organization of Steering Committees • Organization of frequent Skype Meetings • Participation of Synergies Meetings with other projects of common thematic interests • Organization of Workshops and Dissemination Activities • Production of Final Report • Finalize budget redistribution due to partner change 			

Work package Title	Quality Assurance	Work package Type and Reference	WP2
<p>Quality Assurance is a continuous activity performed by all partners. The planned activities until the end of the project include:</p> <ul style="list-style-type: none"> • Perform continuous monitoring of Performance of the Partners and Project Deliverables • Perform continuous Internal Evaluation • Perform continuous External Evaluation • Provide, at the end of the project, a critical evaluation of the project overall and, in particular, the extent to which it will have achieved its aims and objectives as defined at the outset. • Continuous monitoring and control activities in order to ensure that all Work Packages stay on course and – if necessary – react to unexpected events 			

Work package Title	Development of the training methodology and scenarios	Work package Type and Reference	WP3
<p>The planned activities until the end of the project include:</p> <ul style="list-style-type: none"> • Completion of the translation to all working languages of the Content outline and Ontology (Del. 3.1) • Completion of the translation to all working languages of the Training Scenarios for the two courses (Del. 3.3) • If necessary, update all WP3 deliverables according to users comments that will derive from the Pilot Testing in WP5 			

Work package Title	Development and setup of the virtual environments	Work package Type and Reference	WP4
<p>The planned activities until the end of the project include:</p> <ul style="list-style-type: none"> • Completion of the remaining 3D Models as part of Del 4.1 • Completion of the RECDEV 3D Training Platform and Translation to all working languages 			

Work package Title	Pilot implementation and evaluation	Work package Type and Reference	WP5
<p>The planned activities until the end of the project include:</p> <ul style="list-style-type: none"> • Start the Pilot implementation to all countries by setting up the Training Platform to Recycling Centres • Training the trainers on the function of the Platform • Perform training/pilot sessions in recycling centres • Monitor the training/pilot sessions and support the users to any possible problems • Evaluate the training/pilot sessions at their completion • Produce a Mid-term evaluation Report • Produce the Final Evaluation Report • Make corrections/updates if necessary to the Training Platform and the supporting technical/scientific material based on the users info and Pilots evaluation 			

Work package Title	Dissemination	Work package Type and Reference	WP6
<p>The planned activities until the end of the project include:</p> <ul style="list-style-type: none"> • Website continuous update • Further production of promotional material based on the completion of WP3 and WP4 • Production of Newsletters • Promotion of the project via the 3 planned Workshops in Austria, Czech Republic and Greece • Promote the project via extra dissemination activities • Production of a scientific paper • Participation in an International Conference in June 2015 and present a scientific paper • Participate in Synergies Meetings of other relevant or of common interest and Thematic areas 			

Work package Title	Exploitation of results	Work package Type and Reference	WP7
<p>The planned activities until the end of the project include:</p> <ul style="list-style-type: none"> • Development of the Exploitation Strategy • Production of the Business Plan 			

6. Contribution to EU policies

EU legislation restricting the use of hazardous substances in electrical and electronic equipment (Directive 2002/95/EC) and promoting the collection and recycling of such equipment (Directive 2002/96/EC) has been in force since February 2003. The main objective is to increase the recycling and/or re-use of such products. Despite such rules on collection and recycling only one third of electrical and electronic waste in the European Union is reported as separately collected and appropriately treated. A part of the other two thirds is potentially still going to landfills and to sub-standard treatment sites in or outside the European Union. The collection target of 4 kg per person per year does not properly reflect the amount of WEEE arising in individual Member States. Illegal trade of electrical and electronic waste to non-EU countries continues to be identified at EU borders.

In December 2008, the European Commission therefore proposed to revise the directives on electrical and electronic equipment in order to tackle the fast increasing waste stream of such products. The aim is to increase the fraction of e-waste that is appropriately treated and to reduce the volume that goes to disposal. The Commission proposes to set mandatory collection targets equal to 65 % of the average mass of electrical and electronic equipment placed on the market over the two previous years in each Member State. This proposed 65 % WEEE collection rate refers to the fraction of electrical and electronic equipment placed on average on the market in the preceding two years. The proposed collection rate would need to be reached by producers every year starting in 2016. The rate applies both to household and non-household WEEE.

The EU incentives and active policies in WEEE are predicted to increase jobs further in the WEEE treatment and recovery sector in the EU. These jobs are frequently manual jobs available for lower skilled sectors of the workforce (e.g. disabled people, economic immigrants). The evolution of the WEEE sector should also lead to more jobs for socially disadvantaged people.

7. Extra Heading/Section

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