Practical Demonstrator 1

Implementation of D4R (Design for Recycling, Repair, Refurbishment and Reuse) in high-tech products

IDEA
The main aim is to form an industrial network with end of life (EOL) IT asset management firms, IT refurbishers, component manufacturers and local industries to create a new design that can have the effect of creating a new use for their waste and thus turning wastes into by-products.

RESULTS

- Reduction of GHG emissions: 66%
- Reuse and recycling of waste: 87%
- Reduction of freshwater utilisation: 65%

PARTNERS
MicroPro Multimedia Computer Systems Ltd. (IE)
AU Optronics Corp. (TW)
Asociacion de Industrias de las tecnologías Electronicas y de la Informacion del Pais Vasco (ES)
University of Limerick (IE)
University of Natural Resources and Applied Life Sciences (AT)
Technical University Berlin (DE)

About ZeroWIN

Project Motivation
Waste prevention has been assigned the highest priority under European waste management law. However, the initiatives which have been taken so far have not reduced the regular increase in total waste arisings across Europe.

Goals
The ZeroWIN project develops innovative approaches and effective strategies for the prevention of waste in industrial networks based on industrial symbiosis. Expected results are a reduction of at least 30% of greenhouse gas emissions, 70% of overall re-use/recycling of waste and 75% of fresh water utilisation.

Consortium
The ZeroWIN consortium has 30 partners from 11 countries (AT, DE, ES, FR, HU, IE, PL, PT, RO, UK, TW), dominated by industry – 6 large companies (one of which is the electronics cluster in the Basque region) and 10 SMEs.

Project Facts
Cooperation: SAT
Consortium: 30 partners from 11 countries
Duration: May 1, 2009 – April 30, 2014
Budget: 9.5 Mio. €
1. Introduction

The D4R laptop computer – designed and manufactured by MicroPro (a SME based in Dublin) – combines eco-design with a maximization of the reuse potential of the computer, in order to minimise waste through-out the life-cycle and across the supply chain.

The D4R laptop makes extensive use of by-products from other companies along the supply chain, including reused components from existing computers recovered by social economy enterprises. The D4R laptop uses retooled plywood from the automobile industry and recycled industrial aluminium for the housing and facilitates the use of reused parts and components, including the LED screen, the hard drive, the memory, the power supply and so on. To permit the incorporation of a variety of reused components, MicroPro has developed a unique "universal motherboard" that can fit a wide range of recovered parts and components.

The D4R laptop also proposes a novel product/service marketing model where "hubs" or partner companies in different regions will provide a localised repair, upgrading and take-back service ensuring that equipment is properly maintained and upgraded, rather than disposed of, and that parts and components are recovered rather than discarded or reprocessed. Local hubs will also act as local assembly points for the D4R, using locally sourced parts and components wherever possible, thereby minimising new materials use and transport costs. Savings of 75% on waste, fresh water and GHG emissions are therefore expected. The D4R laptop has considerable potential in facilitating the reuse of computer parts and components world-wide, as well as presenting a design response to environmental problems facing the electronics sector including e-waste pollution and rare metals scarcity.

2. Implementation

Five Prevention Practices – From the company to the network level

Process design vs. network design
The design of the product is based on the cradle-to-cradle principle where reuse of parts and components as well as of the entire appliance is maximised in design. This approach is dependent on setting up a network of associated suppliers and services agents that can source used materials, such as wood and aluminium as well as used part and components for initial manufacture, but also provide upgrade, take back and possible remanufacture services on a regional basis. The network design is therefore responding to the product design and vice versa.

Input substitution vs. primary resources substitution
Import of initial materials for manufacture is achieved by recovery of used materials. Primary materials are avoided in favour of reused materials. Imports of new parts and components for upgrading repair and manufacturing are substituted by recovery of usable parts and components locally.

Plant improvement vs. network infrastructure improvement
The manufacturing process (and remanufacturing process) is based on the synergy developed with network partners that perform complimentary functions throughout the life of the product. Rather than expecting the return of the product to the point of manufacture, region "hubs" will be responsible for upgrading, repair
and possibly remanufacture, using local personnel and resources, including spare parts and components sourced locally. It is likely that many PCs and laptops will be remanufactured on a local, outsourced basis rather than centrally.

**Good housekeeping vs. cooperative network responsibility**
The entire manufacturing and remanufacturing process will be the responsibility of the co-operative network, as materials will be recovered and sourced locally, but some (such as the basic "barebones" housing) will be shipped from a central point. It is an important part of this model that all network partners share an on-line inventory of material parts and components, and their availability as well as location.

**Reuse, recovery & recycling vs. exchange of resources**
This is of course a key factor in the proposed model. The D4R laptop is designed for reuse, rather than disposal and purchase of a new model. This is based on the possibility of dismantling, accessing and upgrading with minor effort and cost. The laptop is also designed to use used components, by means of a universal motherboard, that can accept a variety of components. The production and service network is organised regionally to be able to operate this model.

**Five Resource Productivity Themes – From the company to the network level**

**Effective resource utilization and materials efficiency**
The model ensures effective resource utilization by maximising reuse of materials, parts and components that have a remaining useful life. This also means that there is less call on finite and non-renewable resources. Everything is used until it has to be discarded. Use of finite resources is reduced by 70%.

**Reduction of process waste and enhancement of by-product values**
The reuse model also reduces waste by designing out obsolescence and proliferation and by reusing materials, parts as well as components. The fact that fewer new resources are required for production also eliminates material and energy waste at the level of production. By-products, in terms of parts and components that would otherwise be discarded, are also used in this model.

**Reduction of water use and impacts**
Reducing the need for new manufacture really reduced the need for fresh water use and consequent environmental impact. This is particularly true for extending the life and reusing the motherboard and other components that require large quantities of water in manufacture.

**Reduction of energy consumption and greenhouse gas emission**
Energy consumption is also reduced by the use of reused parts and components, which have very significant embedded energy. The design for disassembly and remanufacture approach also means that less energy is required for initial manufacture. The regional based part recovery, upgrading and assembly also save energy expended in transport and export.

**Improvement of control over minor elements and toxic materials**
Items that would previously have been directed towards dumping or storing will now be recovered, entered into an online inventory and reused. In addition to this, the D4R laptop itself avoids and minimises use of toxic material such as plastics, mercury and lead.

**3. Assessment**
The assessment results are referred to one laptop with four years use as stated as functional unit. As principle in ZeroWIN project, the use phase is out of scope and therefore not considered.

The reduction of environmental burden ranges between 44% and 70%, whereby the reduction is highest for climate change (-66%) and lowest for the ozone depletion (-44%).
In an overview, it can be shown that largest burdens in most categories are connected with the LCD panel production with biggest shares in the case of global warming potential (carbon footprint) and primary energy consumption.

8,170 litres of water are necessary for the production of the baseline laptop. The highest amount is needed for LCD module production and mainboard production which sum up to approx. 82% of total water input. Other processes of minor relevance are the production of chassis, battery production and power adaptor. Potential reductions regarding water in the pilot scenario that highlight most significant changes for the LCD module and mainboard components are achieved by prolongation of use phase and design changes of the chassis (magnesium).

The reuse and recycling of each relevant component of the iameco D4R laptop was modelled on the basis of average expected use phases and assumption about the replacement of old or defect parts in case of upgrades. Under the mentioned assumptions and based on the bill of material and expectable spare parts, a reuse and recycling quota of 89% can be reached in the industrial network. The value succeeds the targeted 70% clearly. The following measures used to reach the recycling / reuse target are:

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<th>Strategy</th>
<th>Potential reuse / recycling rate</th>
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<tr>
<td>Sourcing wood for chassis from industrial network</td>
<td>67% / 90%</td>
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<tr>
<td>Use of by-product LCD panels from industrial network</td>
<td>43% / 83%</td>
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<tr>
<td>Sourcing packaging from industrial network</td>
<td>0% / 95%</td>
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<tr>
<td>Use of by-product motherboard (incl. CPU and RAM) from network</td>
<td>50% / 85%</td>
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<tr>
<td>Use of other by-product from industrial network (e.g. DVD drive, hard disk drive, cabling)</td>
<td>50% / 85%</td>
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<td>Total product including spare parts and packaging</td>
<td>58% / 87%</td>
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In the course of the social assessment, the analysis showed significant and realistically expectable improvement potentials in the following three focus areas covering the information and transparency in relation to consumers, local stakeholders and external experts; the education, training and assistance of consumers, workers and local suppliers; and the creation of jobs, especially for disabled persons in cooperating social enterprises.

To sum up, in case of the D4R laptop two of the three ZeroWIN targets can be fulfilled. The third goal – fresh water utilisation – is out of reach, but is approximated remarkably in the course of ZeroWIN project due to numerous improvement measures as described in Deliverable D6A.3.

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<th>Target</th>
<th>D4R laptop</th>
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<td>Decrease of 30% greenhouse gas emissions</td>
<td>66% decrease</td>
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<tr>
<td>Reduction of 75% of fresh water utilisation</td>
<td>65% decrease</td>
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<tr>
<td>70% of overall re-use and recycling of waste</td>
<td>87% overall reuse and recycling</td>
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