Fostering sustainable electronic waste management through intelligent sorting equipment

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Ilaria Barletta[a], Björn Johansson[a], Klas Cullbrand[b], Max Björkman[b], Johanna Reimers[c]
[a]Department of Product and Production Development, Chalmers University of Technology, SE-41296, Gothenburg, Sweden.
[b]Chalmers Industriteknik, Materials Group (Recycling), Sven Hultins gata 9, SE-41258, Gothenburg, Sweden.
[c]ReFind Technologies, Bror Nilssons gata 4, SE-41755, Gothenburg, Sweden.
ilaria.barletta@chalmers.se

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EXTENDED ABSTRACT

Joint forces of industry and academia can pave the way to truly foster sustainability of Waste of Electric and Electronic Equipment (WEEE) management. Against this background, the WEEE ID project funded by VINNOVA (Swedish Agency for Innovation Systems) developed an intelligent, automated sorting equipment for used electronics' segregation and grading. It prevents operators from being exposed to hazardous substances from segregation processes and enables higher recycling rates within downstream processes thanks to increased sorting efficiency and accuracy. This abstract explores how the knowledge and technology developed within the WEEE ID project may have a positive impact on WEEE (or "e-waste") management sustainability performance.

A. Background

E-waste sorting is one of the pre-processing stages within the e-waste supply chain. Sorting criteria may be oriented to electronics' grading per purity level of virgin material contents or per type of components' material (e.g., metals, plastic, glass). In addition to this, sorting is accountable for carefully separating hazardous WEEE items from non-hazardous ones, as in case of error the formers would contaminate downstream recycling processes that are not supposed to deal with acid-resistant substances. Therefore, sorting accuracy deeply affects the environmental performance of the following processing stages of e-waste treatment, recycling among them. When looking at factory operations, today e-waste sorting is performed mostly by humans, as up to now they are the most flexible and self-learning resource available.

Operators not properly equipped by protective devices get exposed to hazardous substances from electronics' segregation. This makes social sustainability concerns for workers be one of the current hot topics within this sector.

Moreover, as compiling operational data turns out to be costly, quantities and material contents of WEEE streams are currently not recorded and shared by the actors of the e-waste supply chain. This results in a lack of data usable to support decision making processes within e-waste management. Even because of these reasons, huge amounts of resource-intensive and valuable materials end up in landfills or shipped to developing countries instead of being properly recovered [1] [2]. Against this background, WEEE ID (IDentification) project [3] aims at making identification and grading of e-waste more efficient and sustainable by introducing automation and ICT tools.

B. The WEEE ID project

The project puts together knowledge and competences from industries and academia in order to develop a unit essential for small- and medium- sized recycling plants.

The leading vision is to make a major contribution to sustainable development by providing an automated sorting process for the segregation of various types of e-waste. The WEEE ID equipment that will realize such a

process enables to achieve higher process efficiency and to replace manual operations that risk workers' health.

Some of the main functions that the equipment is expected to deliver are to:

- Identify key waste contaminant streams and quantify environmental/economic impact of these foreign objects on the process.
- Achieve detailed and automatically-generated statistics of e-waste streams, which enable new models for financing extended producer responsibility.

C. Results

The sorting and grading equipment built by the project partner ReFind Technologies (Figure 1) puts the WEEE-ID goals to work.

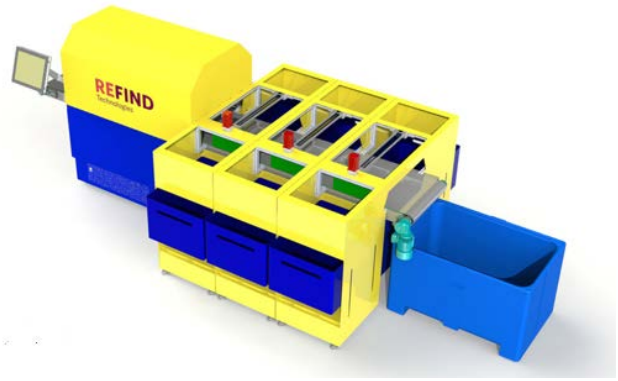

Figure 1: Automatic equipment for e-waste sorting and grading developed within the WEEE ID project.

The sorter uses sensors and intelligent data processing to detect almost in real time whether used electronic products are good for reuse, refurbishment or recycling, and sorts them accordingly. One of the criteria driving this functionality is based on the knowledge of the possibility to obtain reusable spare parts from a particular model. The whole set of criteria to sort phones per optimal downstream are currently being developed. The equipment also lists the products in optimal fractions by making them instantly available for trading, either directly with customers or through digital marketplaces.

D. Impacts and future developments

Over 30,000 tons of discarded IT and communication items were collected in Sweden in 2010 [4] including over 6,000 tons of computers. An assumed improvement of 5% of material recovery thanks to better sorting would represent a saving of about 8,500 tons of CO2-eq annually for computers only. Moreover, it was estimated that for a contaminated batch of lighting waste the processing time will be reduced 12 fold (from 3 hours to 15 minutes) and the associated costs will be reduced 3.5 fold.

Logging e-waste quantities and composition can provide the basis of an efficient market within the e-waste management sector. Three evidences support this statement:

- Collectors and ITADs will increase the yield from current streams being processed
- Recycling companies will be equipped with data to apply fair payment models for their customers
- Reuse and refurbishment companies will profit from an improved quality of recovered material and recycling efficiency.

A natural consequence from implementing the WEEE ID technology consists in more transparent models of responsibility, where producers get an incentive for environmentally adapted product development and better waste management. To conclude, smart, efficient and automated identification of the waste streams provides the basis for decision making, creates benefits and value along the entire recycling chain.

Acknowledgments

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