Product Takeback Systems Design

Markus Klausner and Chris Hendrickson

Carnegie Mellon

Green Design Initiative

http://www.ce.cmu.edu/GreenDesign/

Introduction:

Product disposal incurs costs and may waste valuable resources. The paradigm of product takeback implies liability of manufacturers for their products over the entire life cycle, including disposal. Instead of customers disposing of products at end of life, manufacturers are responsible for collecting and recycling end-of-life products. Legislation, current and pending, is a major driving force behind product takeback. Most takeback legislation is passed or drafted in Europe. For example, Germany's Eco-Cycle Law, in effect since October 1996, mandates extended product liability of manufacturers. Such legislation has major impacts on business processes since companies that traditionally focus on product design and manufacturing are increasingly faced with the problem how to handle end-of-life products.

Problem:

Product takeback requires an integrated approach to product design, reverse logistics, product recovery, and remarketing. Design changes that facilitate product recovery generally result in higher initial manufacturing cost but reduce cost at end of life. Manufacturers need tools that allow them to assess the economic consequences of design changes for product recovery. Products are often recycled for their materials since quality concerns, technological progress, and low return rates are arguments cited against higher levels of product recovery like reuse and remanufacturing. Also, the lack of information on the product may prohibit higher levels of product recovery. Yet reuse and remanufacturing are generally economically more attractive than materials recycling. The economic efficiency of takeback programs is a major concern, particularly if a significant fraction of the products sold is returned through thetakeback program. Guidance on sustainable product takeback design has to be provided. Especially higher product recovery levels require sound remarketing concepts. Reverse logistics in the context of takeback (collection, storage, and transportation of end-of-life products from the point of return to the point of product recovery and disposal) has not yet been well documented. A major problem in reverse logistics is the irregular return flow of end-of-life products and the uncertainty about the expected number of products returned through a takeback program. Concepts are required that allow the manufacturer to influence the customer's decision about when and where to return a product.

Approach:

We studied in detail two European large-scale takeback programs, one for consumer products and one for automotive components. Based on this study and further research, a framework for the design of takeback systems for electronic products and electromechanical consumer products is under development. Product recovery strategies and reverse logistics systems have been developed for electromechanical consumer products. For example, a product takeback system for power tools was designed. This system would combine profitable remanufacturing and unprofitable recycling such that product takeback could pay for itself. Novel reverse logistics systems which allow for a control of the product return flow were also conceptualized. In a joint project with Robert Bosch GmbH, Germany, an Electronic Data Log (EDL) for electronic and electromechanical products was developed and integrated in consumer products. During product use, the EDL records and stores data correlated with the degradation of the product and its components. After product return, the EDL data are retrieved and used to identify reusable components. The EDL is an enabler for reuse and remanufacturing. We have developed analytical models addressing the economic efficiency of the EDL. We are now working on generalizing the results obtained from the specific projects to provide both guidance on the implementation of takeback programs and policy recommendations. For example, the economic model developed for the EDL can be applied to situations where higher manufacturing cost due to design for environment lower cost at end of life if the return rate of end-of-life products is sufficiently high.

Representative publications:

"Sensor-Based Data Recording of Use Conditions for Product Takeback," Klausner, M., W.M. Grimm, C. Hendrickson and A. Horvath, *Proceedings of the 1998 IEEE International Symposium on Electronics & the Environment.*

"Reuse of Electric Motors of Consumer Products: Design and Analysis of an Electronic Data Log," Klausner, M., W.M. Grimm and C. Hendrickson, *Journal of Industrial Ecology*, Vol. 2, No. 2, 1998.

For more information contact:

Markus Klausner
Phone: (412) 268-5666
Email: klausner@andrew.cmu.edu

Chris Hendrickson
Phone: (412) 268-2941
Email: cth@cmu.edu

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