



Process planning for IT-equipment remanufacturing

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ABSTRACT

We present an approach for the design, evaluation and implementation of remanufacturing processes in a given facility. Based on the description of the market situation and involved actors, a planning method is derived. Data acquisition procedures for product, process and facility are described. A mixed integer program is developed for optimization of a remanufacturing process and evaluation of its economic viability. Additionally, the paper describes the technical implementation, the software workflow and example application on the product category Flat Screen Monitors.

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1. Introduction

Reuse and Remanufacturing of Waste Electrical and Electronic Equipment (WEEE) are a matter of current concern, driven by economic, ecologic, social and legislative factors. The potential that lies in the reuse and remanufacturing of IT-equipment is not fully exploited yet. Only a few specific products have been considered – e.g. mobile telephones [1–4] – and not all treatment opportunities available are applied. Moreover the financial uncertainties concerning product quantities, types and conditions that are long associated with remanufacturing processes limit the entrance of new actors into the sector. Although planning decisions highly influence the efficiency of a production system carrying out remanufacturing operations, decision support and planning tools, which are standard in assembly industries, are seldom available and applied. The need for such tools is evident. Based on a market analysis and the identification of actors that are aiming to extend their operations by establishing remanufacturing processes as value adding processes, an integrated planning system is presented in this paper.

2. Actors involved and task definition

Actors involved in closed-loop-economy and their relation is given in Fig. 1, not considering legal aspects. The actors vary in access to product and material condition, amount and information's about these. The following are identified as capable to extend their operations with remanufacturing oriented value adding processes: OEM's, suppliers, maintenance shops, existing remanufacturing companies, and partly recycling companies.

These actors have in common the access to functional or non-functional products and components that are valuable enough to

justify their upgrade, through some remanufacturing treatment, to a marketable state or condition.

The same actors differ in their specific knowledge on the product itself, the products status and condition as well as their operational capability to bring it to a valuable condition. They also differ in available equipment, processes and capacities, i.e. in remanufacturing capabilities. This raises the following questions for each specific actor:

- To what extent do I incorporate remanufacturing activities in my existing facility/facilities?
- Which specific remanufacturing processes am I able to carry out?
- How much investment is needed in order to offer high quality remanufacturing?
- What are my specific costs and revenues once the remanufacturing processes are operational?

To answer these questions in a suitable manner, a three step planning approach has been developed, implemented in a software tool and applied to the example of flat screen monitors remanufacturing.

3. Planning method

The proposed approach involves three steps: the data analysis, the process design phase and the remanufacturing process optimization of the remanufacturing tasks phase.

3.1. Data acquisition

The product and facility relevant data that are required for the proposed planning approach are determined and acquired.

Data regarding the product need include the product structure, i.e. components and component groups, joining elements and techniques, disassembly sequences, material ratios etc. and end-

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