Chapter 5.6
From Traditional Non-Sustainable Production to Closed Loop Manufacturing:
Challenges for Materials Management Based on PPC and EMIS Integration

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ABSTRACT

The scope of this chapter addresses the issues related to materials management for closed loop manufacturing based on the integration of material flows management systems with production planning and control systems (PPC) or business systems (like ERP) applicable to remanufacturing environments. It aims to identify and discuss the main issues and further research steps needed in order to improve materials management, as well as assessment of the environmental impact of remanufactured products. The main problems that appear in the area of materials management by shifting from non-sustainable production to closed loop manufacturing have been identified and discussed. The integrated materials management approach has been presented.

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INTRODUCTION: ON THE WAY TO SUSTAINABILITY

For almost two decades companies have made an effort to meet the goal of sustainability of their operations. The Burndtland Commission defined sustainability development, as "development that meets the needs of the present without compromising the ability of future generations to meet their own needs" (WCED, 1987). In order to be competitive in the market, companies have to enter two new elements in their strategy beside Profitability; namely People and Planet (the 3Ps). The circular economy concept introduced by D.

Pearce (1990) is opposite to the open-ended approach. It introduces thinking about the economy as a closed system. It highlights four economic functions of the environment (Andersen, 2007):

1. amenity values
2. a resource base for the economy
3. a sink of residual flows
4. a life-support system

From a materials management perspective; it is essential to not only minimize waste streams (sink function) but minimize the usage of both renewable and non-renewable raw materials (resource based function). The circular economy concept is now very strongly promoted in China where its main goal is the promotion of resources usage minimization and the introduction of cleaner production technologies. In a number of countries a big effort is made in the framework of circular economy, in order to reduce material throughput and introduce friendlier eco- designs of products.

Growing concerns of sustainability exert huge pressure on companies to measure their impact on the environment and engage in environmental reporting to account for the energy and other resources they consume and the resulting footprint they leave behind (Kleindorfer et al., 2005). Primary activities that contribute to their footprint are manufacturing operations and logistics operations, as transportation and storage. The secondary activities that contribute to the footprint are connected to remanufacturing, recycling and reuse operations. The closed loop supply chain model, which is described in detail in next section, provides a suitable framework to integrate and to follow all the material and information flows. Companies are likely to improve their operations under pressure from strict legislative regulations. However, companies don't need to make trade-offs between sustainability and profitability.

Porter (1991, pp. 96) argued that "properly constructed regulatory standards which aim at outcomes and not methods, will encourage companies to re-engineer their technology. The result, in many cases, is a process that not only pollutes less but also lowers costs and improves quality". Companies very often face the question of how to commit to strict environmental health and safety regulations in the most cost- effective manner. The sustainable 3Ps operations model should be treated as a new business opportunity to improve the competitiveness of a company. The closed loop supply chain refers well to this shift in business approach. The closed loop supply chain provides the integration of traditional 'forward' supply chain processes and 'reverse' supply chain processes (Guide & Wassenhove, 2003). The ideal closed loop supply chain (CLSC) can be defined as a zero-waste supply chain that completely reuses, recycles or composts all materials (Golinska et al., 2007). The main factors influencing the sustainable "closing the loop" approach in a manufacturing company are presented in Figure 1.

Legislative regulations provide an impetus to change from non-sustainable to more environmentally friendly operations, but their influence should be not overestimated. The industry practice (especially in the automotive or consumer electronics sectors) shows that closing the loop can be an answer to problems that companies face, namely:

- the increasing cost of energy,
- the increasing cost of raw materials,
- the increasing cost of waste disposal.

This approach also helps to prolong the relationship with customers after the sale by the application of the used products collection program, "give old-get cheaper new" actions or refund policy. It also helps to improve the procurement policy by the distribution of sourcing across traditional suppliers and recyclers. In times of crisis, efficient reverse materials management (re-supply) can be perceived as a new opportunity to lower the raw materials acquisition. In order to gain the advantages of "two-way" economy,

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