8. Impact of Multiple Sources

8.1 Tradeoffs Between Recovery and Procurement

Another major characteristic of inventory systems in a Reverse Logistics context as identified in Chapter 6 concerns the presence of multiple, alternative supply sources, namely recovery of used products versus procurement of new ones. In the previous chapter we assumed that the goods return flow directly affects the serviceable inventory and cannot be influenced. Therefore, procurement orders have, in fact, been the only means to control the system. Let us now turn to a more detailed picture of the inbound channel where the recovery of returned products is also a decision variable (see Figure 6.1). To this end, we assume that returned products are collected in a distinct inventory upon arrival. The serviceable stock can then be replenished alternatively by means of procurement or by processing recoverable stock. In addition to lotsizing and safety stock considerations the choice between both sources then becomes an important issue in achieving efficient system performance.

As discussed in Chapter 6 multiple supply sources in traditional inventory systems mainly concern regular versus emergency deliveries. A tradeoff is made between a higher procurement price and a leadtime reduction. However, the reasoning in a Reverse Logistics context appears to be a different one. Rather than a leadtime reduction, it is the restricted availability of the cheaper (recovery) source that calls for an alternative supply source in this case. In contrast, leadtimes are longer for procurement than for recovery in many cases (compare Section 7.6).

It is clear from the discussion in the previous chapter that one may not expect that mathematically optimal solutions to this problem have a simple structure, in general. In fact, we have seen in Section 7.6 that the problem often becomes intractable even under additional simplifying assumptions. When explicitly distinguishing the above two types of inventories an optimal policy structure is only known for the case of negligible fixed costs and equal leadtimes for both sources (Simpson, 1978; Inderfurth, 1997; see also Section 6.3). From a practical point of view it therefore seems more important to come to a good understanding of the major tradeoffs governing the above situation in order to derive appropriate heuristic decision rules.

Assuming recovery to be cheaper and to have the shorter leadtime of both sources, the considerations driving the procurement decision appear to
be very similar to the analysis in the previous chapter. Expecting all available recoverable items to be used before resorting to additional new supply, procurement decisions should depend on the aggregated stock rather than on the two individual inventory levels. Note that this brings us back to the model of Chapter 7. Therefore, one may expect a critical number policy based on the aggregated stock to be reasonable for procurement decisions here. In the next section we illustrate additional effects due to fixed recovery costs. Should the recovery leadtime, indeed, exceed the procurement leadtime substantially one may think of procurement as a kind of emergency supply. In this case the serviceable inventory level may become a more appropriate trigger for order decisions than the aggregated stock. Traditional two-source models may then provide a reasonable approximation. We repeat, however, that a recovery leadtime excess does not seem typical of many Reverse Logistics environments and therefore do not address this case in the remainder of our analysis.

Control of the recovery process deserves some more detailed considerations. Drivers for building up a distinct inventory of returned products rather than recovering them immediately may be twofold. First, fixed setup costs of the recovery process may call for a sufficiently large lotsize. Second, holding costs for the recoverable inventory may be lower than for serviceables due to lower inventory valuation. On the other hand, delaying recovery of returned items implies a loss of responsiveness to demand and may therefore require higher safety stocks. In addition, stock volumes may be larger for this strategy if only a certain fraction of the returned products can actually be recovered, e.g., due to quality limitations which are only identified during the recovery process.

Van der Laan (1997) provides a detailed analysis of different strategies for controlling the recoverable stock. In particular, push versus pull driven strategies are compared. In the first case the recoverable stock is flushed whenever it exceeds a certain trigger level. The recoverable inventory is mainly motivated by economies of scale in the recovery process and therefore has a lotsizing stock character primarily. Note that the model in Chapter 7 can be interpreted as a recovery-push model with a critical lotsize of one (see Section 7.6). In the second case the recovery process is demand driven and is initiated whenever the serviceable inventory drops below a certain trigger level (under the additional condition that the available recoverable stock is sufficient for a certain minimum recovery lotsize). This approach is closer to a 'just in time' philosophy where activities are postponed until actually required. It should be noted that these push-versus-pull considerations are very similar to issues discussed for logistics network design in Section 5.1. They again reflect the role of Reverse Logistics as a link between the market forces on the supply and demand side. In contrast with conventional supply chain philosophy Reverse Logistics processes are not entirely demand driven. Instead, exogenous factors on the demand and supply side need to be matched. Delineating the