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Reverse Logistics and Remanufacturing in the Automotive Sector

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For decades, supply chain management focused on 'forward' activities only. However, environmental issues in this research area are significantly growing. Operations managers are increasingly facing internal and external pressure to apply environment-friendly measures to their daily activities. In particular the automotive industry is facing growing pressure to apply green activities within supply chain management. The Society of Motor Manufacturers and Traders even claim that the automotive industry's long-term success will depend on the sector's ability to work towards a sustainable future (SMMT, 2001). This ability includes environmental as well as social responsibility. Following these trends, academic research investigates issues on product recovery management. This trend in research focuses on reverse logistics, product recovery options, as well as the management of the whole recovery chain (reverse supply chain management).

In a product recovery environment, the process of transporting, handling and returning of used products from the (end-) customer to a processing facility plays a major role. This process is defined as reverse logistics. Reverse logistics is often seen as the most complex activity within product recovery management, as products have to be collected and delivered from many locations (end-users) to one processor (recovery plant).

Remanufacturing is just one of many recovery options. However, in comparison to others, for example recycling, it offers the transformation of end-of-life products and components into products with an 'as good as new' condition through machining, rewinding, refinishing or similar operations (Kerr *et al.*, 2001). It further differs from repairing, re-using, and reconditioning, due to the fact that remanufacturing also recovers the value originally added to the raw material. Hence this type of recovery makes a much greater economic contribution per unit of product compared to recycling. Remanufacturing is therefore often called 'the ultimate form of recycling'.

Remanufacturing activities first emerged during the Depression and further accelerated during the Second World War, when all resources were fed into the military activities. In the United States, the U.S Department of Defence is still the largest remanufacturer in the United States, and automotive parts account for the largest civilian sector within the remanufacturing sector (Lund, 1984). Remanufacturing has played a major role in supplying the aftermarket with

remanufactured replacement parts, ever since. The product range of remanufactured automotive components comprises engines, clutches, gearboxes and fuel injectors, just to name a few.

The management of recovery operations significantly differs from 'conventional' manufacturing operations. One of the main obstacles within the remanufacturing industry is the time lag between the date when the product entered the market for the first time and the date the remanufactured product entered the aftermarket. Car engines, for example, used to have different exhaust specifications than today. Remanufactured engines are therefore upgraded to meet national legislation. A similar development can be observed in the tire retreading industry. Today, tire manufacturers produce tires with smaller aspect ratios (measurement which defines the tire geometry and shape) than they used to produce. Therefore, the remanufactured tires reflect the specifications of several years ago.

Another obstacle lies in the fact that a remanufactured product is often seen as inferior to a new product by the customer, and therefore competes with a new product in the aftermarket. While production costs for new products decrease, which makes them more attractive than remanufactured goods, the market share of remanufactured tires in the aftermarket is decreasing. This is not only due to customer's perceptions as noted above, but it is also due to 'fit problems' as, for example, aspect ratios mentioned above. Hence, the main customers of remanufactured products are those with a high consumption of wear and tear parts: the fleet operators in the passenger market and truck operators in the commercial vehicle sector. As a conclusion, one can say that remanufactured products don't meet the needs of mainstream markets. Even if the product is upgraded during remanufacturing, it will not achieve the same performance as a product, which entered the market at a later date or a new product, which just entered the market. This fact leaves the aftermarket as only option for remanufactured products to be marketed.

In a remanufacturing environment, the used products (so-called 'cores') serve as raw material for the remanufacturing process. There are several issues attached to this dependency on cores. First of all, the core is usually seen as 'trade-in' for a remanufactured product. However, cores can differ largely in quality, depending on the way in which they have been used. A second obstacle in core management is the quantity and timing of returned products. Used products are being returned at any time, however, there are significant differences in the amount of products returned per variant. For some variants, the amount of cores can be quite low. Hence, the remanufacturing plant has to deal with not only one, but two major uncertainties: the supply of raw materials and the demand for remanufactured products. Forecasting has therefore been increasingly difficult. Unavailable parts are replaced with new parts, which results in the product being more expensive. A third challenge is the collection of end-of-life products, in other words, the reverse logistics of cores. Compared to the

conventional supply chain, the remanufacturer is left with a logistics network of 'many to one transportation' or 'many to one distribution points' rather than a distribution of products from one location to a few destinations (Tibben-Lembke *et al.*, 2002).

Concluding, research in the area of reverse logistics and automotive remanufacturing will need to investigate solutions for the obstacles involved in the return-flow of cores, core as well as operations management. It furthermore has to address the problems of marketing recovered products, as for example increasing the consumer's awareness regarding remanufactured products.

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