So what if remanufacturing cannibalizes my new product sales?

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“You’re ruining us—remanufactured product sales are stealing new products sales” is a phrase that almost every manager of remanufacturing operations at original equipment manufacturers (OEMs) has heard from sales and marketing managers at their firm. Many new product sales teams firmly believe a remanufactured version of a product is a potential devil, cannibalizing market share from new products.

Remanufacturing operations involve taking used products, bringing them back to as-new condition, and selling them again, often with exactly the same warranty as a new product. Cannibalization in our setting is when the purchase of a remanufactured version of a product displaces the sale of a new product. At most of the OEMs we’ve collaborated with over the last dozen years, there is little factual knowledge about the potential for market cannibalization, and most managers are more than willing to hide behind “common wisdom.” One manager (at a global computer manufacturer) confidently informed us that for every 4 remanufactured products sold, 1 new product sale was cannibalized. This confidence was despite the fact that no marketing studies had been conducted at her firm.

In fact, managers frequently equate maximizing new product sales with maximizing profits, and this is simply not true. There are many scenarios where offering remanufactured versions of new products creates greater profits. Internal resistance to remanufactured products from sales and marketing groups can, and often does, doom efforts to create additional profits despite the fact that remanufacturing is technically feasible at many OEMs. The marketing aspects of remanufacturing are largely unexplored by academic research and to our knowledge no company has formally examined market cannibalization from remanufactured products.
Cannibalization is not a major concern when remanufactured versions are perfect substitutes for new products. A perfect substitute means the end product (remanufactured or containing remanufactured components/parts) is indistinguishable from a new version by a consumer. This allows the OEM to use remanufactured components and parts, significantly reducing materials costs, and does not require the firm to offer a lower selling price. Therefore, a firm in this situation can benefit from lower (re)manufacturing costs and higher profit margins. From an economics point of view, remanufacturing is attractive when the cost of remanufacturing is less than the cost of new production and the larger this differential the more attractive it becomes.

The Kodak line of single use cameras is an excellent example of perfect substitution. Kodak’s design allows for the parts to be reused multiple times, including reuse of the polymer to cast new parts. Film is the only guaranteed new material in each camera. Consumers only care about the film and readily accept the cameras with new and recovered parts and materials. In fact, most consumers have no idea their camera contains remanufactured parts, even though it is stated on the packaging. There are very few perfect substitutes currently on the market, and in consumer goods they are all basically “container” products—i.e., goods that hold something a consumer uses, such as film in a single use camera or propane fuel in a refillable cylinder.

Xerox uses recovered modules and parts blended with new modules and parts to offer newly manufactured versions of their products. These blended products allow Xerox to offer updated versions of older models at a lower selling price, while providing their customers with state-of-the-art imaging equipment. Blended capital goods, such as Xerox’s high-end imaging equipment, are usually leased by the OEM to control what happens to the product at the end-of-use, or end-of-life. This allows the firm to better manage the supply of used products that serve as input to the remanufacturing process, a key ingredient to the profitability of the latter. Xerox is confident that it can manage cannibalization issues and that remanufacturing is a profitable business strategy.

Cannibalization becomes a concern when remanufactured and new products are differentiable to customers. This is the case when a firm offers a remanufactured version of a product at a different price point than the new version of that same product. The sales of remanufactured products may then reduce the sales of new product. For many consumer goods OEMs, current generation products are returned to resellers and in an effort to recover some of the costs of consumer returns, many OEMs (Hewlett-Packard, Bosch Tool, Black & Decker, and Electrolux USA) turn to remanufacturing. This is especially where sales and
marketing departments cry wolf and claim new product sales will be heavily cannibalized.

Even in cases where the economics of remanufacturing may be marginal (or perhaps negative), there are several strategic reasons to consider offering remanufactured products. Lower-priced remanufactured products may prevent low-cost competitors from establishing market share. Additionally, if there is a market for remanufactured versions of an OEM’s products, then somebody will be offering them. Allowing an independent third-party remanufacturer to take this opportunity may lead to damage to an OEM’s brand name and a loss of control of the intellectual capital embedded in the product design. We’ve had conversations with many managers at OEMs who were convinced that remanufacturing was not profitable, yet we knew their products were being routinely remanufactured by third-party firms.

Essentially a remanufactured product is similar to a low-end product in an OEM’s product portfolio. Thus, cannibalization from a remanufactured product should be similar to that from a low-end product. OEMs do have a clear understanding about the market segments that their low-end product targets. However, certain features of a remanufactured product make remanufacturing decisions more complex. It is very important to make a clear distinction between remanufactured products and low-end new products. A remanufactured product is quite different from an ordinary low-end new product because of:

- **Quality Perception**—An OEM usually has a firm grasp on the objectives and perceived quality of low-end products, while this is not true for remanufactured products. With a remanufactured product, the functional quality is essentially the same as a new product, but consumers may perceive quality differently. For remanufactured products, willingness-to-pay is determined by consumer perceptions. For example, retreaded Michelin tires are just as good as new ones, but many customers would not necessarily believe this or would not want to be seen with tires marked “retreaded” on their high-end car.

- **Supply Constraints**—Remanufactured product supply depends on new product sales, since the latter determine the quantity and timing of used product returns to a large extent. Cannibalizing new product sales reduces the supply for remanufacturing in the future. This is not the case with low-end products. Further, an OEM can determine the production capacity or the market availability of a low-end product; this is not possible for remanufactured products. This is because remanufactured product supply depends on external factors—e.g., how long the product stays with a customer, the intensity of use, and the condition of the return, which can be beyond the OEMs control.

- **Competition**—The presence of a low-end OEM product in the market is under direct control of the OEM. In other words, if the OEM decides not to offer a low-end product, it will not exist in the market. However, with remanufactured products, even if the OEM does not offer the remanufactured products, somebody else will. If the OEM allows an independent
So what if remanufacturing cannibalizes my new product sales?

third-party to collect, remanufacture and sell its used products, it essentially creates competition with its own products and poorly remanufactured products may damage the brand. An OEM with a strong brand reputation can also use a remanufactured version as a low-priced product to compete against low-end manufacturers.

Finally, it should be recognized that remanufacturing can contribute substantially to a firm’s commitment to corporate social responsibility. Remanufacturing extends a product’s life and as a direct result reduces the need for new materials and energy for manufacturing and a corresponding reduction in greenhouse gas emissions. However, our focus here is on remanufacturing as a business proposition and we do not explicitly examine the potential environmental benefits and impacts.

The purpose of this article is to show how and when remanufacturing can create additional value to an OEM, as opposed to the often-heard claim that it would cannibalize new product sales and therefore negatively affect profits. Optimal use of remanufacturing requires understanding of how the customer values remanufactured products, and proper pricing. It is necessary to understand the supply constraint, i.e., the link between new product sales over the life cycle and corresponding product returns which constitute the input for remanufacturing. Finally, it necessitates the careful analysis of the competition from independent third-party competitors or low-cost imports.

Remanufacturing Basics

Remanufacturing is the process of restoring used products, components, and parts to like-new quality and other standards. It forms one of the foundations for sustainable production and is an integral part of a closed-loop supply chain. There are several activities that are unique to supply chains with remanufacturing. Specifically these are:

- **Product Acquisition Management (PrAM)**—getting the right quantities of used products in the right condition (quality), at the right price, and at the right time;
- **Reverse Logistics**—transporting the used products to a remanufacturing facility;
- **Test, Sort, and Disposition**—selecting the appropriate product recovery option, e.g., remanufacturing, recovery of components or disposal;
- **R**emanufacturing; and
- **Remarketing and Sales.**

Our focus here is on remanufacturing as a competitive strategy, but we believe an understanding of a remanufacturing environment is useful for managers not familiar with closed-loop supply chains. While all these activities are critical components of a remanufacturing environment, the key component that differentiates the remanufacturing environment from a new production environment is PrAM. Product Acquisition Management is a key component because
So what if remanufacturing cannibalizes my new product sales?

It is focused on managing the supply of used products to support remanufacturing activities throughout the product life cycle. The uncertainty with respect to the timing of returns and the condition of the used products must be carefully managed. The time a product spends with a customer can be highly variable; single use cameras average 2 weeks and a diesel locomotive may be in use for 20 years. Leasing products can remove most, if not all, of the timing uncertainty. However, leasing is not required for a firm to successfully engage in remanufacturing. In cases where leasing is not an alternative, PrAM can help managers remove much of the uncertainty by using financial incentives for returning used products.

The condition of the used product can, and often does, vary dramatically. The condition (or grade) of a used item determines the amount of parts, materials, and labor that are required to remanufacture. Used products that are of higher quality (better condition) require fewer materials and labor and are obviously more attractive. However, higher quality returns may require that the OEM invest in product durability in the product design stage. All of these parameters (returns timing, quality/durability) can be influenced.

Once remanufacturable products are acquired, these products will have to be transported back to the OEM’s remanufacturing facility (reverse logistics). The remanufacturing environment is also very different than a typical production environment, due to the fact that product returns can have huge variations in their quality levels and the amount of work needed to bring them to a like-new condition. Once remanufacturing is done, the next decision an OEM has to take is about remarketing these products, where determining price points is a critical issue.

All these activities, when brought together, make remanufacturing-related decision making complex. An OEM has a number of decisions to make in this environment that are not present in a traditional manufacturing setting. Figure 1 provides an excellent example of the complexity of remanufacturing operations and their influence on managerial decisions at Alcatel-Lucent. A variety of factors must be taken into account when making the remanufacturing decision, including: remanufactured product introduction timing, competition, supply constraints, last time buy decisions, and legacy systems.

The factors in the gray box (Figure 1) influence the decision to offer remanufactured products. This figure suggests that remanufacturing should start after sales volumes for new products have peaked. However, many other additional factors could affect this decision. For example, grey market competition from poor quality remanufacturers potentially damaging the OEM’s brand image may be blocked with offering remanufactured products earlier. Additionally, the use of remanufactured products and components will avoid the need to make last time buy decisions, where residual inventory is always a major cost. Remanufactured components and parts may also be used to service legacy systems at a lower price and higher levels of customer service. The figure also shows the challenges of determining the optimal timing of starting to use remanufacturing, especially when remanufacturing replaces production of new products. Indeed,
So what if remanufacturing cannibalizes my new product sales?

given the large quantities of product in the market after new sales volumes peak, meeting future demands with only remanufactured products is a possibility since there are sufficient supplies of products to recover to meet these future demands.

So, how should OEMs approach these problems? Is there a systematic approach that could work for all companies?

They can’t all be right.

Our experiences with a number of OEMs that engage in product recovery have shown there are many strategies for dealing with remanufacturing. We discuss four examples from companies we’ve worked with: two consumer goods OEMs and two capital goods OEMs.

- **Alpha Equipment**—Alpha specializes in the design, marketing, and sales of computer networking equipment. Equipment returns are a result of trade-in credits for customers adopting the newest generation of products or customers wanting to switch to Alpha from a competitor’s brand. Annual return volumes are valued in excess of $800M, and the majority of this used equipment is destroyed. Alpha’s sales and marketing group firmly believes there is perfect market cannibalization when remanufactured equipment is offered. Some of the used equipment is stripped of valuable parts/components by the service and warranty fulfillment group. The fear of market cannibalization drives Alpha’s strategy of not offering remanufactured versions of their products. Product recovery is not viewed as a way to generate additional market share or profits.
• **Xerox**—Xerox leases most of their high-speed imaging systems and employs a variety of reuse strategies. Xerox routinely offers new, newly manufactured, remanufactured, and certified repaired versions of their equipment. Newly manufactured products are composed of a mix of new and recovered parts and materials, which we refer to as “blended.” These blended products are current state-of-the-art and have the exact same capabilities as new equipment, but at a lower manufacturing cost. Remanufactured products are brought back to the original standards of new equipment at the time of manufacture. Certified repaired versions are gone over carefully by Xerox technicians to make certain there are no broken parts or components and the machine meets Xerox standards with respect to quality and performance. Managers believe that these products are clearly differentiated in the market, with the exception of the newly manufactured (blended) units. Xerox in many cases actually ceases new production on a model and offers only newly manufactured ones from a certain point in the product life cycle. Product recovery and remanufacturing are a core part of the Xerox business model and these activities are viewed as valuable ways to expand Xerox’s presence in the market.

• **Robert Bosch Tool, North America**—Robert Bosch Tool offers remanufactured versions of its Bosch and Skil product lines. The company engages in remanufacturing for a variety of reasons, including to recover costs from commercial returns and in order to better understand the use, and corresponding wear, of the products in the field. Remanufacturing is also a way to reach consumers who would not buy new products, but would consider a lower-priced remanufactured version, thereby fending off competition from inexpensive imports. Bosch managers consider remanufacturing to be a core part of the business. Although there are some cannibalization concerns, managers attempt to focus the introduction of remanufactured products to markets where Bosch does not hold a majority share, and they use secondary sales channels.

• **Hewlett-Packard**—The Imaging and Printer Group (IPG) at Hewlett-Packard (HP) has various contracts with third-party remanufacturers and logistics providers to recover some of the costs associated with the substantial volumes of commercial returns from its inkjet printer lines. HP practices product recovery primarily to be a good corporate citizen and as a way to avoid the environmental burden from land-filling the returns. Managers strongly believe remanufactured products cannibalize new product sales. A manager recently summed up HP’s view on remanufacturing as “I don’t think it (remanufacturing) will ever be a profitable business for any company doing returns.”

Can all these companies have the most profitable strategy for dealing with product returns?
Understanding Market Composition

The remanufactured product effectively has the same functionality as the new counterpart, because remanufacturing brings used or returned products to a like-new condition. However, the fact that these products have been used or returned by other customers creates a different image in the customer’s mind. So, how do customers value remanufactured products? What types of customers are there in the market for remanufactured products?

The markets for remanufactured goods are not homogeneous. There are different types of customers and we need a better understanding of these customer profiles. A good way to understand the heterogeneity of the market with respect to remanufactured products is to compare the customers’ willingness-to-pay for remanufactured product with those for the new product. The market for remanufactured products is segmented and there are two basic potential types of customers in the market: newness-conscious and functionality-oriented.

- **Newness-Conscious Customers**—They value “newness” and equate newness with quality. Remanufactured goods have the same functionality as a new product (and many have the same warranty), but this is not the same as newness. These customers therefore value the remanufactured products lower than the new product since these products fail to meet the newness criterion. (Note also that there may be heterogeneity even in this segment, and there may be some customers who never purchase remanufactured products.) Newness-conscious customers are unlikely to be attracted to remanufactured products unless they are offered at an extremely low price compared to the new products.

- **Functionality-Oriented Customers**—These customers value the functionality of the product utmost; they do not equate quality with newness. They care about whether the remanufactured products provide the same functionality or not. Thus, for these customers, the value of a remanufactured product is the very close to a new one. These customers prefer the remanufactured version, given it is offered at a lower price than the new version. This implies that in order to reach the functionality-oriented customers, a firm must be able to offer remanufactured products at a lower price point. When alternatives to new products (e.g., lower-priced competition or remanufactured) are not available, however, these customers may purchase new products. Targeting such segments is indeed a valid business strategy; luxury automobile manufacturers (e.g., Mercedes, BMW) discovered long ago the value-added of offering factory certified pre-owned versions since there is a sizable segment of the market desiring the name brand but not willing to pay the name brand price premium.

The findings from a recent study where new and remanufactured products were auctioned provide some interesting insights into this discussion. This auction study investigated the market behavior for remanufactured products for consumer goods (hand tools) and business-to-business goods (components for network switching equipment). For auctions of new and remanufactured consumer goods, this study found that consumers who bid on new products never
bid on the remanufactured versions and those who bid on remanufactured products never bid on new. Despite the fact that both new and remanufactured versions of the same products (both with the same warranty) were available, consumers clearly did not view them as substitutes. In the same study, business-to-business (B2B) new and remanufactured products were also auctioned, with quite different results. Many customers bid on new products until a certain price point and then switched their bidding to the less-expensive remanufactured versions. In this situation, customers did perceive new and remanufactured products as substitutes.

The purchasing behavior of B2B customers suggests that functionality-oriented customers do exist.\(^{15}\) Most purchasers of the remanufactured version exhibited opportunistic behavior since they bid on new products until the bid price went above their threshold (which resembles the functional consumer behavior we describe above). After this point, their attention (i.e., bidding behavior) turned to the less-expensive remanufactured version. These buyers were clearly functionality-oriented and willing to substitute remanufactured for new, provided the price difference was substantial.

The auction study of consumer goods also provides evidence for the existence of the newness-conscious and functionality-oriented customer profiles. Feedback from customers showed each group was aware that new and remanufactured versions of the products were available, but they did not perceive them as substitutes. Part of the market never bid for the remanufactured products, most likely because they associated newness with quality, i.e., they were newness-conscious customers. The remaining portion bid only for the remanufactured products, most likely because they were cheaper and had the same functionality, i.e., they were functionality-oriented.

There is also potential for a segment of environmentally conscious customers who prefer remanufactured products since they are perceived to be more environmentally friendly. Recent reports show that between 15 and 46 percent of the consumer market are interested in some form of green products.\(^{16}\) For instance, the recent explosive growth in oil prices has greatly increased demands for environmentally friendly (hybrid and fuel-efficient) automobiles. The current awareness of the impact of greenhouse gas emissions and the potentially substantial cost impact of (pending) legislation has caused many firms to actively seek ways to reduce emissions and remanufacturing can provide substantial reductions.

Remanufactured products are of particular interest since they offer the same level of performance as a new product, but sometimes at a lower environmental cost (i.e., lower energy and materials consumption and a lower level of greenhouse gas emissions). This is especially true if the environmental impacts of upstream extraction and production activities related to the new product are much higher than the impact of its use or end-of-life recovery. Our experiences with customers, remanufacturing managers, and corporate sustainability personnel show that most groups are unaware of the potential environmental benefits of remanufacturing. In order to reach the increasing green customer segment,
firms must ensure that everyone is aware of the greenness of remanufactured products.

**Cannibalization Risk and Market Structure**

The previous discussion shed light on the segmentation of markets for different product categories. What do these mean for the potential cannibalization from remanufactured products? How would the differences between market structures affect the attractiveness of selling remanufactured products?

In case of markets behaving like our B2B product example, we see potential for cannibalization. We interpret the opportunistic bidding of a certain group of customers as an indicator of cannibalization risk. However, this is not entirely bad news. The OEMs can indeed transform the potential for cannibalization to a cash cow. If the correct price points are identified for new and remanufactured products, the functionality-oriented segment can be “milked” to obtain higher margins. This was not what the B2B provider in our example did though. The specific functionality-oriented customer group in this case consisted of small IT solution providers that catered to small businesses. These IT solution providers developed turn-key computer network systems at certain price points and were quite opportunistic at obtaining equipment at bargain prices, usually from third-party vendors dealing in remanufactured network equipment. It became clear during the study that these purchasers from small IT solution providers were not considered important by the OEM, which preferred to focus on its big accounts. Each small solution provider only purchases a few pieces of equipment. However, the cumulative effect of these buyers was significant. A quick Internet search for third-party sales of this firm’s recovered products showed hundreds of small firms, each with substantial stock priced considerably less than the new versions. This should be an important consideration for managers at OEMs, since if they are not offering a remanufactured version of their product it’s very likely someone else is.

We see relatively limited potential for cannibalization in the case of consumer goods and interpret the separation of customers in the studies mentioned above as an indicator of low cannibalization risk. We indeed know of several authorized Internet dealers who offer new and remanufactured consumer products side-by-side (e.g., Bosch Tool and Electrolux vacuums), which is likely to imply that the cannibalization concern is insignificant for these product categories. In other words, these managers are convinced that most customers who buy new products will not be interested in remanufactured versions (and vice-versa). These firms realize that by offering a remanufactured version of their products they reach customer segments with a lower budget and that this customer segment is otherwise likely to buy a “no-name” (i.e., inexpensive) competitor’s product. OEMs can win in this situation since their market share is increased at the expense of their competition.

To summarize, we interpret the difference between the consumer goods and B2B goods cases as a difference in cannibalization levels. The B2B products
in this study may be prone to cannibalization due to the potentially large functionality-oriented segments, which seek price differentials between new and remanufactured products. The consumer goods are not necessarily as prone to cannibalization, as there is potential for distinction between functionality-oriented and newness-seeking customers. This suggests that cannibalization is not necessarily a significant factor in all product categories. Clearly, more empirical research is needed to explore how cannibalization differs across product categories.

These findings provide support for our framework, which is useful in the sense that by comparing the willingness-to-pay of customers for the new and remanufactured products, we can decide on how to price new and remanufactured products to maximize profits and minimize cannibalization. To make such decisions, we need to understand when these segments exist and how large they are. If this is well understood, managers can effectively market and price their products so that remanufactured products can become an important part of a sales portfolio that maximizes profits for the firm.

A common criticism of firms offering remanufactured products is that if the firm had refused to offer remanufactured products, then customers would have bought new. This simply is not our experience. Some customers who bought remanufactured consumer products did not have a high enough willingness-to-pay for new versions. Further, these customers stated that if a remanufactured version were not available, they would have substituted a low-priced competitor’s product. For B2B customers, we found that they routinely purchased third-party remanufactured versions of the product since they simply could not afford new versions and remain competitive in their offerings.

**Developing Smart Pricing Strategies**

Ideally, firms should be able to achieve perfect market segmentation by simply selling low-priced remanufactured goods to functionality-oriented customers at high profit margins and by targeting new sales to newness-conscious customers. However, in reality it is not easy to identify and exploit parallel channels. What we advocate is the development of smart pricing strategies based on the composition of the market.

When there are a large proportion of functionality-oriented customers, remanufactured product prices should be set somewhat lower than new products to serve the functionality-oriented consumers at high profit margins and avoid cannibalization of the newness-conscious segment. Our experience from the auction study shows that the average customer buying a remanufactured consumer product has a 15 percent lower willingness-to-pay. B2B purchasers demanded less of a discount for remanufactured products with only a 10 percent lower willingness-to-pay on average. These customers, interestingly enough, did not come at the expense of new product sales. Every buyer of a remanufactured consumer good (via the auction study) we were able to reach, explained that they wanted the brand name, but were unwilling to pay the premium the brand name commanded. Further, none of them would have purchased the new
brand-name product if they had not had the remanufactured version available, they would have substituted another brand in their price range. In the end, the pricing strategy should focus on market segmentation. The critical segment for cannibalization consists of functionality-oriented customers.

If there are many functionality-oriented customers in the market, the remanufactured product can easily expand market share and profits. This means that the remanufactured product may be priced higher, but still below the new product price, to get the most revenue from the functionality-oriented customers. By pricing the remanufactured product high, the cannibalization of the newness-conscious segment is also avoided since the price differential is not sufficient for the newness-conscious segment to purchase the remanufactured product.

On the other hand, if the size of the functionality-oriented segment is small compared to the newness-conscious segment, remanufactured products should be priced low to attract low-end newness-seeking customers. While the margin from the functionality-oriented segment would be low in this case, the profit from remanufacturing would be obtained from the low-end newness-seeking customers and the new product can be sold to high-end customers at a higher price.

**Product Life Cycle Effects and Supply Constraints**

*you can’t sell it if you don’t have it*

The management of the supply of remanufacturable used products significantly affects the potential for profitable remanufacturing. Many capital goods OEMs lease their products and, as a result, know exactly when and how many used products will be available. Xerox removes units at the end of the lease life, even if the lease is renewed, and replaces them with newly manufactured, remanufactured, or new products. When a remanufacturing OEM does not lease their products, then used products will need to be sourced in the right quantities for the right price using product acquisition management techniques. In either case, used products will not be available until some time has elapsed after the initial sale or lease of the new products.

There must be sufficient quantities of remanufacturable products available before remanufacturing can start (see Figure 1). Early in the new product life cycle there will be few used products available for remanufacturing. Late in the product life cycle, the supply of used products may well exceed the demand for remanufactured versions. Since new products and new technology are rapidly replacing the older technology at this late stage of the product life cycle, it may tightly constrain the demand for remanufactured older versions of the product (e.g., the glut of used analogue mobile telephones when digital technology became widespread). In fact, there is a point in the product life cycle where a firm will only offer remanufactured versions of the (older) product.18

Firms normally offer a range of products and each product must be evaluated on its own merits. It is perfectly reasonable that a firm may aggressively
So what if remanufacturing cannibalizes my new product sales?

FIGURE 2. Product Remanufacturing Matrix

remanufacture and market one product and decide not to offer a remanufactured version of another product. There may also be situations where OEMs are well advised to collect the remanufacturable products from the market and not remanufacture them.

A simple way to match supply and demand for remanufactured products is shown in Figure 2. This figure was developed and is used by a remanufacturing business manager to help understand the impact of availability, but it does not consider key elements such as price points and competition. If we consider two factors, the market demand for the remanufactured product and the availability of used products, then products fall into one of four quadrants. The “No Action” quadrant is when there is neither sufficient market demand nor a sufficient supply of remanufacturable products. The product is not a candidate for remanufacturing at the present time. The “Monitor” quadrant is when there is sufficient market demand, but an insufficient supply of remanufacturable products available. The situation should be carefully watched since this is a potentially profitable market and third-party remanufacturers will be attracted. Steps should be taken now to secure stable supplies of remanufacturable products. The “Act” quadrant is where there are both market demand and sufficient quantities of remanufacturable products available. Remanufacturing should be initiated as soon as possible. The final quadrant, “Recycle” is when there are sufficient supplies of remanufacturable products, but no market demand. The best choice in this situation is to obtain some revenue via materials recycling.

Source: This matrix was developed from one developed by Don Olson, Business Manager Remanufactured Products at Alcatel-Lucent. The actual product names have been disguised.
Putting the Factors Together

Remanufacturing starts when there are sufficient products in the market to provide a reliable supply of remanufacturable units and will continue until the factors in Table 1 no longer favor remanufacturing, or when the firm no longer sees a strategic advantage to offering remanufactured products. The decision to stop remanufacturing a product is a function of many factors, including the presence of third-party remanufacturing, age of the technology, the availability of replacement parts and components, and a need to retire legacy systems.

Table 1 shows a simple decision process for remanufacturing that considers the following:

- If remanufacturing costs are high (i.e., close to new production), remanufacture only if the functionality-oriented segment is large and there are sufficient quantities of used products available (e.g., the Act quadrant in Figure 2).
- If the remanufacturing costs are low, remanufacturing is profitable in three scenarios, but if the supply of used products is limited and there is a large functionality-oriented segment, remanufactured products should not be offered, (e.g., the Don’t Act quadrant in Figure 2).

When the supply of used products is low, and these products arrive late in the product life cycle, remanufactured product sales will be limited since both supply and demand are constrained. The best scenario for profitable remanufacturing is when there is sufficient supply of used products throughout the product life cycle, and the functionality-oriented segment is large. This is exactly the situation at many consumer goods OEMs where commercial product returns are a stable percentage of new product sales for the majority of the new product life cycle. As can be seen in Figure 3, product returns volumes for inkjet printers are a predictable percentage of new product sales time-lagged by 2-3 months from the initial product introduction. In this case, many remanufactured products can be sold at a high price, and thus at high margins. Previous studies have shown that remanufacturers have an average profit margin of 20 percent. Late in the product life cycle, however, product returns often surge, creating excessive returns relative to demand. Our experiences with HP and Bosch Tool showed the importance of managers recognizing the changing dynamics of profitable product recovery.

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<tr>
<th>Remanufacturing Costs</th>
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<tr>
<td>Size of Functionality-Oriented Customer Segment</td>
<td>Low</td>
<td>High</td>
<td>Low</td>
<td>High</td>
<td>Low</td>
<td>High</td>
<td>Low</td>
</tr>
<tr>
<td>Remanufacture?</td>
<td>Yes</td>
<td>No</td>
<td>Yes</td>
<td>Yes</td>
<td>No</td>
<td>No</td>
<td>No</td>
</tr>
</tbody>
</table>
So what if remanufacturing cannibalizes my new product sales?

One undesirable scenario for remanufacturing is when the profit margins are small because the remanufacturing related costs are high, the functionality-oriented segment is small, and there is limited supply of used products. Here, since the functionality-oriented segment is small, the remanufactured products should be targeted at the low-end functionality-oriented segment at a low price. However, the OEM would also like to sell the remanufactured products at a higher price due to the limited supply. This conflict would make the pricing of remanufactured products less efficient, resulting in lower profit opportunities from remanufacturing for the OEM. However, offering remanufactured products may still serve as a deterrent to low-priced competition and undesirable third-party remanufacturing.

Another problematic scenario is when the margins are low, there is a large functionality-oriented segment, and there are limited quantities of used products available. While the functionality-oriented segment seeks the remanufactured product at a low price, the constrained supply will force the OEM to increase the price of the remanufactured products, resulting in lower sales of remanufactured products and lower profits. In such a situation, the most reasonable approach seems to be waiting for remanufacturable product returns to accumulate and then targeting the functionality-oriented segment. Alcatel-Lucent routinely evaluates its telecommunications products in the field to help determine when (if ever) remanufacturing will be attractive (Figure 2). Pitney-Bowes
also closely monitors its supply of used products coming back from lease and carefully plans the introduction of remanufactured equipment only after sufficient quantities are available.20

The Influence of Competition

The last important factor to consider in our analysis of the viability of remanufacturing is competition. Competition can take many forms. New products compete with similar products from different companies, e.g., in consumer power tools Bosch Power Tool’s Skil line versus Black & Decker. Bosch and Black & Decker also compete in the professional tool markets under different brand names. Brand name products that command a premium also compete with “no-name” competition where the same function is offered at a lower price point. Firms may not have a product line that competes in the lower-priced markets and remanufactured products offer the ability to compete in these markets without having the additional cost of a brand extension, or the risk of diluting the brand name by going too far into the low-end market. It is also likely that the remanufactured brand name products are perceived as being of higher quality than the low-cost products they are competing with, and this may be indeed be the case since remanufactured products were not designed to be low-end products initially.

Third-party remanufacturers also play a role in the competitive landscape. It is a safe bet that someone is offering remanufactured versions of your firm’s products if there is residual value in your products and your company (presumably the OEM) is not offering remanufactured versions. Managers at many OEMs have a strong desire to find ways to keep third-party remanufacturers from getting their products. Managers at Xerox detailed horror stories about poorly remanufactured versions of their products that Xerox (not the remanufacturer) takes the blame for. If (when) there are third-party remanufacturers, OEMs have a limited number of choices: collect their remanufacturable products from the market and remanufacture them, enter into a partnership with third-party remanufacturers to ensure that quality standards are being met, or collect their remanufacturable products and destroy them.21

We already discussed many of the pitfalls for the first option. Outsourcing remanufacturing to a third-party remanufacturing partner has its own risks. Outsourcing remanufacturing activities is when a firm engages in a contractual agreement with a third-party to do authorized remanufacturing of the OEM’s products. We are aware of several firms that outsource all, or part, of their remanufacturing activities. The printer group at Hewlett-Packard outsources all of its product recovery activities since the decision was made long ago to outsource all manufacturing. Their intellectual capital and brand name are carefully protected with contractual agreements and quality standards are carefully enforced. Pitney-Bowes practices a hybrid model of product recovery, keeping the majority of remanufacturing activities in-house but outsourcing selected parts and components to partners with the expertise to remanufacture a special-
ized part or module. Both firms’ marketing of the remanufactured products is in-house.

The decision to collect and destroy remanufacturable products is also not without risk.22 Lexmark has a long history of fighting with third-party cartridge refillers. Over the years, Lexmark has offered pre-bates to customers who promise to return the cartridges to Lexmark and more recently installed a smart chip that fuses moving parts so the cartridge cannot be refilled. However, the public perception of the waste generated by this practice is quite likely negative. Kodak’s single use camera was initially designed to be disposed of at the photo finisher. The amount of waste inherent in such a design quickly became public knowledge; in fact, the camera was at one point named the most environmentally offensive product of the year.23 Kodak promptly changed the design of the camera to facilitate reuse of the shells, but it was a very expensive lesson. Kodak competes today with third-party remanufacturers who put their own label on the Kodak shell and load it with inexpensive film. Losing new product sales to your own remanufactured version (cannibalization) is obviously not ideal, but losing market share to your own brand name remanufactured by a third-party remanufacturer is simply intolerable.24

If an OEM is not offering a remanufactured version of a popular product, chances are the remanufactured version is being offered by an independent third-party competitor. We’ve seen this phenomenon many times for a wide variety of products. Mobile phones are recovered and remanufactured in large volumes and all by third-party remanufacturers (some OEMs use remanufactured mobile phones to fulfill warranty demands, but do not sell the phones on a secondary market). The larger the market share enjoyed by a product, the more desirable the product is to customers and the larger the potential market for remanufactured versions. Our experiences also show that it is very difficult for OEMs to enter the remanufacturing market after it becomes dominated by independent third-party remanufacturers. American automobile manufacturers have tried on a number of occasions to regain control of the after-market parts business, only to be blocked by well-established third-party remanufacturers.

OEMs with very successful products must also deal with lower-priced products from competitors. These products commonly offer almost all of the high-priced performance for a substantially lower price. In the course of following up with those customers in the auction study who purchased remanufactured tools, we learned that they preferred to buy a remanufactured brand name power tool (the Bosch Skil brand in this case) rather than “no-name” import.25 These functionality-oriented customers told us that they wanted the Skil brand name, but were unwilling to pay the premium. In the event that an inexpensive remanufactured brand name was not available, they would have purchased the low-priced no-name product. This example illustrates how offering remanufactured products targeted at the functionality-oriented customers may help block low-priced competition from getting a foothold in the market. It is important for managers to be aware of low-priced competition, especially when their own product lines do not compete in the lower price segment.
There is also a strong argument to be made for offering remanufactured products in markets where the OEM has a smaller market share. Randy Valenta of Bosch Tool NA shared this strategy with us several years ago and our research confirms his intuition was correct.26 Offering remanufactured versions of your product where your firm does not have a majority share will cannibalize your competitor’s market share faster than yours.

**Were they all right?**

Do managers at the firms from the cases discussed earlier all have the right strategy for remanufactured products? When their situations are considered after taking into account the concepts presented, it appears that some of these OEMs are missing opportunities to add substantial value.

- **Alpha Equipment**—It seems that managers at Alpha may be missing an opportunity to create additional value by adding remanufactured products to their portfolio. A quick investigation on the Internet for third-party sales of used Alpha equipment revealed hundreds of sites; a strong indication there is a sizable market of functionality-oriented customers. It is apparent that despite Alpha’s attempts to remove all their used equipment from the market, a substantial amount is leaking into third-party sales (i.e., there are sufficient quantities of used products available). This robs Alpha from revenues that could have come from remanufactured equipment sales and allowed them to control their name brand image. In any event, Alpha should continue to collect as much of their product from the market as possible to block access by third-party remanufacturers. Alpha may also be well advised to explore the use of remanufactured components and parts to penetrate into new market segments and support legacy systems no longer in production.

- **Xerox**—Xerox managers have a thorough understanding of remanufacturing as a marketing strategy. The strategy of offering newly manufactured (blended) products reduces the cost of subsequent generations while allowing Xerox to offer continuously updated equipment. Leasing allows almost complete control of used products and removes timing uncertainty from the planning process. By offering a variety of classes of equipment, newly manufactured, remanufactured and certified used, Xerox has product pricing strategies that target various customer segments and expand their overall market shares.

- **Robert Bosch Tool**—Managers at Robert Bosch Tool consider remanufacturing as a core competency of their business. They effectively leverage value from commercial returns and protect their name brand and intellectual capital. Their strategic use of remanufacturing as a marketing strategy allows them to offer products at a lower price point and reach a substantial functionality-oriented market segment and to block low-priced competition.
Some Final Thoughts on Remanufacturing as a Marketing Strategy

It should be clear that remanufacturing does not always cannibalize new product sales. Even if cannibalization does occur, it is not always bad. Remanufacturing is still attractive, provided the additional profits outweigh the cannibalization costs. Managers—who understand the composition of their markets (functionality-oriented, newness-conscious, and perhaps green customers), the proper use of pricing strategies, the competition, and the supply of remanufacturable products over the product life cycle—should be able to minimize the potential for cannibalization and create additional profits. This is not a static decision. It needs to be re-evaluated over the entire product life cycle. Managers have a responsibility to maximize profits for the firm and this is not always equivalent to maximizing new product sales. A portfolio that includes remanufactured products may make it possible to reach additional market segments and help block new low-priced competition and independent third-party remanufacturing.

Notes
2. Third-party remanufacturing is very common and widespread when products can be easily remanufactured. The remanufactured automotive parts market is dominated by third-party remanufacturers, as is the remanufactured mobile phone market. Randy Valenta at Bosch Tools reports that Bosch treats the possibility of unauthorized third-party remanufacturing as a serious threat since it can be done very easily (and very poorly in many cases).
3. The potential environmental benefits from remanufacturing are well documented by R.T. Lund, Remanufacturing: The Experience of the United States and Implications for Developing Countries (Washington, D.C.: World Bank, 1984); V. Smith and G. Keoleian, “The Value of Remanufactured Engines: Life-Cycle and Environmental and Economic Perspectives,” Journal of Industrial Ecology, 8/1 (January 2004): 193-222. We should also note that in some instances extending a product’s life may be detrimental to the environment, e.g., extending...
the life of a low energy efficiency engine when more efficient models are available. Many firms (e.g., GE Transportation’s diesel locomotive works) practice modernization in conjunction with remanufacturing to provide comparable levels of newer production energy efficiency for older platforms.

4. See the seminal work by Lund [op. cit.]. There are other terms (e.g., refurbishing) used with very similar meaning in various industry sectors.

5. Closed-loop supply chain management is the design, control, and operation of a system to maximize value creation over the entire life cycle of a product with dynamic recovery of value from different types and volumes of returns over time.


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10. Don Olson, Business Manager for Remanufactured Products at Alcatel-Lucent, provided this figure based on his experiences.


12. Secondary marketing channels are separate (parallel) from the primary channels (e.g., the Internet) and are thought to help minimize the risk of offering remanufactured products to quality conscious customers.


15. Ibid.


17. One way to avoid this problem is to design products that can be blended with new parts and components (as Xerox does), but this still does not eliminate the problem of the introduction of disruptive technologies that result in huge amounts of obsolete equipment.

18. Xerox, Alcatel-Lucent, and Pitney-Bowes all serve certain market segments only with remanufactured version of their products. For example, the monochrome printing market is rapidly shifting to full-color printing as the costs of such equipment drops. Xerox still offers remanufactured monochrome printing equipment as a way of reaching customers that cannot afford to operate full-color printing.


20. Pitney-Bowes designs, manufactures, and markets document handling systems and mailing systems (e.g., scales and postage meters) in cooperation with the U.S. Postal Service. There are many instances when managers know that there will be large-scale returns of products due to upgraded requirements from the postal service.
21. A firm has a number of options for collected used products. They can remanufacture the entire product, selected components, and/or parts. Used units may also be sold to material recyclers for a salvage value. If there is no residual material value, then the used products must be landfilled.

22. Collect and destroy can be in two forms. One is shredding products and recycling the materials. The second is to shred the products and landfill the resulting waste. The first option ignores any remaining value-added in the used products (mostly likely from a fear of market cannibalization). The latter option simply ignores any remaining value-added or material value (there may also be a lack of recycling infrastructure in some cases).

23. Kodak quickly redesigned their line of single-user cameras to facilitate product reuse and materials recycling. It is one of the best examples of a blended consumer product today. See <http://wwwau.kodak.com/AU/en/corp/environ.shtml> for a brief overview of Kodak’s commitment to environmental stewardship.


