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## Management Review

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# The Profit-Making Allure of Product Reconstruction

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# The Profit-Making Allure of Product Reconstruction

Whether it involves recycling, refurbishing or remanufacturing, product reconstruction can offer attractive consumer prices, high-quality goods and a host of profit opportunities.

BY JOHN A. PEARCE II

IN THE FACE of a global recession and a recovery that could take years, minimizing the costs of raw materials and supplies is becoming a higher priority among manufacturing-company executives. "Product reconstruction" in particular — the recovery of used goods, their processing and their resale — looms as an excellent way for a company, perhaps your own, to enhance revenue, profits and market share.

Reconstruction, which covers a continuum of activities from recycling to refurbishing to remanufacturing,<sup>1</sup> allows companies to sell goods at lower prices than if they were to assemble nearly identical new products. In most cases, the prices of remanufactured products are 50 to 75% lower than those of new ones.<sup>2</sup> Despite lower prices, however, reconstruction provides customers with high-performance goods.



## THE LEADING QUESTION

Does your company have what it takes to succeed at product reconstruction?

## FINDINGS

- ▶ **Product reconstruction — recycling, refurbishing or remanufacturing — allows for higher profit margins (typically, 20%) than the creation of new equipment (3 to 8%).**
- ▶ **The appropriateness of product reconstruction for a company depends on the nature of its customers — six kinds in particular make for the best fit — and its specific core competencies.**
- ▶ **Federal and state governments are encouraging the product-reconstruction trend through legislation and public/private programs.**

## SUSTAINABILITY

## ABOUT THE RESEARCH

The author performed quantitative and case-based research to determine the conditions under which each type of product reconstruction — recycling, refurbishing and remanufacturing — yields its best results. The findings were verified by financial indicators from individual companies and by research conducted by or for various divisions of the U.S. government.

Based on this analysis, the author constructed a model that encompassed the three types of product reconstruction, provided assessments of the barriers to entry and identified the levels of technical expertise required. The model took into account the numerous products made by profitable reconstruction companies, the nature of the reconstruction processes they use and the reasons why each company has been particularly effective in its approach — its key lessons of success. This information has been distilled into a set of findings that are useful to executives for better assessing the appropriateness of each product-reconstruction option, given the markets in which their companies compete.

Product reconstruction also allows for higher profits than the manufacture of new equipment. The average profit margin for product-reconstruction activities is 20%,<sup>3</sup> whereas margins in the manufacturing industry typically range from 3 to 8%. By beginning the reconstruction process with components that retain much of their original value, a company eliminates many of the costs that would be incurred if the manufacturing process were to start from scratch.

Additionally, product reconstruction within a larger corporation can provide a new revenue source, allowing the company to profit multiple times from its initial investment. It can use product reconstruction to leverage its knowledge base and manufacturing facilities.

If, as described in this article, your business serves the kinds of customers most interested in recycled, refurbished or remanufactured products; if it already possesses or can readily acquire the necessary core competencies; if it can specialize as needed to address the complexities of particular materials or products; and if the company is willing to make the marketing efforts required to prevail against multiple competitors, product reconstruction can be a highly appropriate and rewarding endeavor. (See “About the Research.”)

### The Different Kinds of Product Reconstruction

Product reconstruction ranges from the nominally simple to the complex. Whereas recycling entails the recovery of materials alone, refurbishing and remanufacturing involve the recovery — and sometimes the addition — of value-added material.

*Recycling* is the process by which a used product is broken down into its constituent parts, which are then used in the manufacturing of new products. A wide variety of materials — aluminum, glass, paper and rubber, for example — are widely known to be recyclable, and many product groups, such as batteries and computers, have active recycling operations as well. According to the most recent estimates, the recycling industry in the United States has 56,000 facilities and 1.1 million employees, and it reports \$236 billion in annual revenue.<sup>4</sup>

*Refurbishing* is the process by which a product is restored to its original condition, without modifi-

cation, so that it can be used for the same purpose as initially intended. Refurbished products, which typically undergo a thorough cleaning process followed by the replacement or reconditioning of component parts, include medical devices, office furniture and industrial electronics.

Laser-printer toner cartridges are an especially popular item for refurbishing. When the cartridge is spent, it can be returned to the manufacturer or a refurbisher — often, free of charge. During the refurbishing process, cartridges are disassembled, worn components are replaced, all sections are cleaned, toner is added and the cartridge is resealed. These refurbished products are equivalent in performance, print quality and page yield to new ones. They meet the standards and specifications of the original, yet they sell for only 40% of the original’s price, and the cycle of refurbishing and resale can be repeated multiple times.

*Remanufacturing* is the process of completely disassembling a used product, repairing or replacing worn or obsolete components and adding enhancements. Remanufacturing includes all aspects of refurbishing, but it also substitutes upgraded components to improve the performance characteristics of the product and to match the capabilities of the best new products on the market.

There are many corporate success stories in the product reconstruction industry, but one of the best involves Springfield Remanufacturing Corp. An investment of \$10,000 in the Missouri-based company in 1983, when it was begun in a plant purchased from International Harvester Co., was worth \$12 million in 2008. Equally impressive, in the 25 years since it opened, the company has not had to lay off employees.<sup>5</sup> Overall, remanufacturing businesses in the United States employ an estimated 480,000 people.<sup>6</sup>

### Is Product Reconstruction For You?

Product reconstruction may open new markets for companies in meeting the needs of one or more of six kinds of customers:<sup>7</sup>

**1. Customers who need to retain a specific product because it has a technically defined role in their current processes.** When customers have to replace a unique type of machine within a production line and they decide on a new one that does

not quite match the original equipment, they face an expensive and time-consuming procedure. To maintain the sequence and result, many customers find that the better alternative is to have the original machine refurbished or remanufactured.

**2. Customers who want to avoid the need to re-specify, reapprove or recertify a product.** Some equipment is reconstructed in order to maintain adherence to the original specifications. This requirement is common, for example, among municipal transportation authorities with respect to the motors that power transit cars. These authorities must adhere to guidelines specifying that the equipment may not be altered. If it is, then lengthy, complicated and expensive reapproval processes must occur.

**3. Customers who make low utilization of new equipment.** Often the buyer of a reconstructed item, which is less expensive to purchase than original equipment, does not use the product frequently enough to justify the high investment cost that a new item would demand. For example, building contractors who only sporadically need to transport wet cement to foundation sites may prefer the cost-saving purchase of remanufactured cement mixers to the substantial expense of similarly equipped new models.

**4. Customers who wish to continue using a product that has been discontinued by the original manufacturer.** Reconstruction enables consumers to extend the service lives of such goods, perhaps indefinitely. With new or restored parts, the overall product can continue to be used “as new.”

**5. Customers who want to extend the service lives of used products, whether discontinued or not.** Many consumers make major purchases of reconstruction services and reconstructed parts, especially of products’ main components, to gain the benefits of longer-term usage and avoid having to buy the products anew.

**6. Customers who are interested in environmentally friendly products.** Remanufacturing relieves companies of the need to use the high levels of energy and virgin materials characteristic of replacement products. Annual energy savings resulting from remanufacturing activities worldwide are estimated at 120 trillion BTU, or the equivalent of eight nuclear power plants.<sup>8</sup> And for every pound of new material used in remanufactur-

ing, five to nine pounds of original material are conserved. As a result, while waste cannot be eliminated altogether (see “Options for Financing Waste Disposal,” p. 63), remanufacturing reduces the amount of discarded material that would otherwise enter the waste stream.<sup>9</sup> Moreover, emissions of greenhouse gases and other environmental threats that accompany manufacturing activities are diminished.<sup>10</sup> When products are made in an environmentally friendly manner, whether by choice or by government mandate, they are attractive to environmentally sensitive industrial and household consumers.<sup>11</sup>

### What Does It Take to Seize the Opportunity?

Despite its significant appeal, recycling, refurbishing or remanufacturing is not for everyone; companies need to have not only the right kinds of customers but also the appropriate expertise and

#### ELEMENTS OF PRODUCT RECONSTRUCTION

All product reconstruction is not alike. This chart describes the major approaches on the reconstruction continuum — recycling, refurbishing and remanufacturing — and identifies some of the principal ways in which they differ.

	RECYCLE	REFURBISH	REMANUFACTURE
<b>Definition</b>	The process by which a used product is broken down into constituent parts, which are converted into <i>different</i> products or used as raw material.	The process by which a used product is returned to “like-new” condition.	The process by which a used product is made “better than new” through complete refurbishing plus an upgrading of parts.
<b>Synonyms</b>	Reorganize, rearrange	Recondition, restore, reuse	Reengineer, reinvent, rebuild
<b>Required expertise with initial product</b>	Usually low, occasionally high	Medium	High
<b>Barriers to entry</b>	Usually low, occasionally high	Medium	High
<b>Example</b>	Used plastic soda bottles are melted down and reformed into park benches, fleece clothing or plastic lumber.	A used commercial battery is restored to its original condition.	A 20-year-old passenger jet is made “like new” and also retrofitted with updated electronics.

**SUSTAINABILITY**

**MAKING IT (SORT OF) NEW**

Product reconstruction opportunities are increasing — not least because government incentives and design changes are making it easier and more cost effective to disassemble goods for eventual reuse either as a whole or in parts. However, even under prior circumstances there have been numerous successful efforts at building product reconstruction into a business. Some examples:

COMPANY	PRODUCTS	PROCESS	WHY ITWORKS
<b>Alcoa Inc.</b>	Aluminum	Scrap metal is melted and reformed into sheets and rods and then sold to a wide variety of industries.	The ready availability of used and inexpensive aluminum products, especially beverage cans, promotes recycling.
<b>American Rubber Technologies Inc.</b>	RubberStuff® Playground Surfacing, REBOUND®, PERMA-FLEX®	Tires and other scrap rubber are shredded and then ground into “crumb rubber” for alternative uses such as rubber asphalt, recreation and landscaping.	There is a large supply of inexpensive rubber material.
<b>Smurfit-Stone Container Corp.</b>	Container board, corrugated containers, cartons and specialty and bag packaging	Discarded paperboard is retrieved at disposal sites, mixed with water to create slurry, spread on racks and pressed dry to produce container board products.	Abundant discarded paperboard is available for little more than the cost of retrieving it. Highly efficient transportation operations and processing plants are key.
<b>Lehigh Technologies</b>	Rubber powder	Scrap tires are pulverized into a very fine powder.	The powder can be used in a variety of products that benefit from the durability of rubber (paint, UV-resistant plastics and elastic sealants). Scrap tires are readily available and contain a high level of base material.
<b>CartridgeWorld North America Llc</b>	Replacement cartridges for laser and inkjet printers	Disassembles, refills and reassembles cartridges of various printer manufacturers.	Most printer manufacturers do not currently compete in this market; low-cost materials; ability to offer “like-new” quality alternatives for 20-50% of the price of original products.
<b>5r Processors Ltd.</b>	Electronic components	Used electronic equipment is disassembled into components, which are sold as recycled or restored parts.	Requires only moderate expertise; there is a large supply of inexpensive retired electronics and parts that are salvageable.
<b>Herman Miller Inc. Steelcase Inc.</b>	Office furniture	Makes cosmetic alterations, involving some degree of repainting and refinishing, to renew used products.	Extends the service lives of customers’ purchases; lowers raw-materials costs; gives Herman Miller an additional income stream.
<b>Milacron Inc.</b>	Injection molding machines	Milacron uses its repair service in Mexico to source molding machines, strip them down and refurbish them to like-new condition.	The remanufactured molding machines are sold with a one-year warranty on parts and 90 days on labor, at one-third the cost of new machines.
<b>Caterpillar Inc.</b>	Caterpillar engines	Used engines are reconditioned through expert cleaning, repair or replacement (sometimes upgrading) of engine parts.	Caterpillar can utilize its highly trained employees and product knowledge; provides competition for competitors’ new products.
<b>Detroit Diesel Corp.</b>	Commercial generators, air compressors, alternators, starters, turbochargers, Reliablit® engines and electronic components	Skilled company technicians recondition its used engines and engine parts.	The process utilizes currently employed and highly skilled welders; remanufactured goods compete against new products.
<b>Traction Motor Service Inc.</b>	Motors and generators for airport “people movers,” metro rapid transit cars and industrial cranes	Overhauls and rebuilds components of motors and generators.	Most original equipment is manufactured outside the United States, and U.S. domestic servicing is hard to find; the company’s expert knowledge may be applied.
<b>Case Construction Equipment</b>	Wheel loaders, rough-terrain forklifts	Remanufactures used military equipment to mission-capable standards.	Initial equipment is costly; company has expertise in determining reliability of components; sourcing within the military is convenient.

RECYCLE

REFURBISH

REMANUFACTURE

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resources. “Elements of Product Reconstruction” suggests the characteristics needed for each of the three product reconstruction methods, and “Making It (Sort Of) New” offers examples of specific companies that pursued them successfully.

**Recycling** Recycling activities serve two different functions for a company. They can reduce raw-material costs, and they can ease concerns about the quality and dependability of raw-material deliveries. Alternately, recycled materials can provide a new revenue source when they are sold in their raw-material state to other manufacturers.

Three particular core competencies often prefigure the success of recyclers. First, companies that undertake recycling must be intimately familiar with the manufacturing process that initially created the product. Consider, for example, companies that recycle rubber tires and use the resulting material to produce a variety of marketable goods. Competitors in this industry need a thorough understanding of the chemical processes that give rubber its physical characteristics; fortified with such knowledge, the companies may successfully change scrap tires into the forms required to produce recycled products.

Second, low entry barriers to an industry and copious supplies of materials leave the door open to many new players that compete for resources and market share; they drive the supply of finished goods and available services up and the prices and profit margins down. In the absence of a priori contracts with consumers of its recycling output, extensive and time-consuming sales efforts may be needed for a newly formed company to develop profitable end-use markets.

Continuing our example of the tire-recycling industry, which is complex, highly competitive and fragmented, much of its dynamism stems from three large and distinct markets. New competitors face the challenge of achieving market share in tire-derived fuel, crumb rubber (asphalt modifications and molded products) and civil engineering applications (such as in the construction of highway embankments). Customers in each of these recycled-tire markets tend to be more local than national, with needs that are typically smaller and more varied than efficiency-

## OPTIONS FOR FINANCING WASTE DISPOSAL

It is in society’s best interest to minimize waste, both through reducing the resources needed in manufacturing and extending products’ useful lives. Yet despite these efforts, some waste, however lowered in volume, is still inevitable. It must therefore be disposed of, and someone must pay for it. Recent legislation suggests that the cost will be borne jointly by the consumer and the manufacturer, giving consumers an incentive to recycle and manufacturers an incentive to design products for reduced waste generation and increased ease of reconstruction.

Three major options for paying for waste disposal are:

**1 Extended Producer Responsibility.** This option is meant to impose accountability on the manufacturer over the product’s entire life cycle, from the production process through final disposal.<sup>i</sup> Producers must either fund the disposal of products that they originally manufactured or implement their own take-back programs. The European Union’s WEEE Directive, the Netherlands’ ICT-Milieu and the state of Maine’s LD 1892 legislation are examples.<sup>ii</sup>

**2 Advanced Recovery Fees.** This option obliges producers to collect a disposal fee at the time the consumer purchases the product. The fees are usually set by a government agency and later dispensed to pay for the collection, transportation, recycling and disposal of the waste materials. Examples include the Netherlands’ Disposal of White and Brown Goods Decree and the state of California’s Electronic Waste Recycling Act.

**3 End-of-Life Fees.** This option enables consumers to dispose of products at the end of their useful lives, as long as they pay a nominal fee — which often is subsidized by the manufacturer or retailer — to cover a program’s expenses. Examples include Hewlett-Packard Co.’s mail-back option and Best Buy Co.’s take-back program.

mind manufacturing companies prefer. Relationship marketing trumps mass marketing, specialized bests standardized, and price leadership is critical; these are not the most comfortable conditions for newcomers in most industries.

Third, while the sheer volume of readily available discarded materials may grab the attention of entrepreneurially minded companies, and they may envision a new application or a new market, companies must also be able to recover recyclable materials economically, along with the resources, facilities and personnel for processing them. Because the recycling of particular materials varies greatly in complexity, time requirements, predictability, capital and labor characteristics and expense, recycling facilities tend to be specialized.

**Refurbishing** A company that refurbishes products for resale must be knowledgeable about the design and features of the original product, be intimately familiar with the product’s market, and possess the capability to disassemble, repair and reassemble it. As in the case of recycling, the required type and level of expertise vary with the particular product.

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Consider Reconditioned Systems Inc., based in Tempe, Arizona, which operates in the office furniture industry by selling refurbished workstations, cubicles, chairs, desks, work surfaces and connecting parts. Because consumers of refurbished office furniture demand choices similar to those available with newly manufactured furniture — such as a choice of fabrics, work surface laminates and moldings — RSI's refurbishing process for workstation dividers, for example, includes stripping fabrics, applying

look and function like a new product; because the associated activities are labor-intensive, the ability to employ a skilled and competitively paid work force is essential. Finally, resale obliges the refurbisher either to establish its own distribution system or to contract with a wholesale or retailer.

**Remanufacturing** On the product-reconstruction continuum, remanufacturing usually requires the highest level of product knowledge and expertise. The entire product is refurbished and critical modules are overhauled, replaced or upgraded. For example, a diesel locomotive may be rebuilt, with excellent results. By reusing the frame, engine and other large and high-value-added components, and by incorporating improved technology, the remanufactured engine can provide better performance, higher fuel economy and lower exhaust emissions than the original, and at a substantial discount to the price of a new, equivalent engine.

Similarly, remanufacturing processes may be used to restore and improve other capital goods, such as airplanes, machine tools and medical equipment. Consumer durable goods can also be recovered for remanufacturing activities, as is done, for example, with computers, office equipment and auto parts. In each case, the company doing the remanufacturing must be knowledgeable in retrieving the given product; reengineering it; disassembling, sorting, reassembling, inspecting and testing it; and marketing it.

Because remanufactured products are both refurbished and enhanced by new technologies, original equipment manufacturers have significant advantages over independent remanufacturers in industries that have high price tags or are characterized by rapid technological advancements. For example, Xerox Corp. not only saves \$200 million annually by remanufacturing copiers returned at the end of their lease contracts, but it also inhibits competition by placing state-of-the-art remanufactured copiers back into service against competitors' higher-cost new models.

### How Will Product-Reconstruction Opportunities Evolve?

In the past, products have rarely been designed with ease of disassembly in mind. As a result,

### LEGISLATION ENCOURAGES PRODUCT RECONSTRUCTION

If the United States follows the lead of Western Europe, soon there may be limits on the disposal of scrap materials. For example, the German Recycling and Waste Control Act mandates that no person or company may discard more than 15% of a scrap vehicle. In 2015, that limit will drop to 5%.<sup>iii</sup> Such legislation gives companies incentives to engage in product reconstruction, as they want to minimize their downstream obligations for disposal and to profit directly from recovery efforts that produce valuable resources.

Some U.S. state governments are already implementing laws and guidelines that benefit companies engaged in product reconstruction. A New York State law requires purchasers of durable equipment to consider remade products before opting for new equipment. The same law restricts state agencies from purchasing products from companies that inhibit the remanufacturing or recycling of their products. Texas, Connecticut and California have also passed legislation to promote the purchase of reconstructed products by state agencies.<sup>iv</sup>

Moreover, California's Electronic Waste Recycling Act restricts the use of six hazardous materials — lead, mercury, cadmium, hexavalent chromium, polybrominated biphenyls and polybrominated diphenyl ether — found in electrical and electronic products. Twenty-eight other states have recognized the potential hazards of electronic waste as well, and they have introduced legislation to manage electronic waste while banning it from landfills.<sup>v</sup> In general, such legislation stimulates the development of e-waste recycling and program funding mechanisms.

new fabric covering, sanding, painting connecting parts and laminating work surfaces to restore them to like-new condition. The company must be able to execute such diverse and skilled functions while competitively pricing its products some 30 to 50% lower than similar new furniture and up to 80% lower than the new-product manufacturer's list price.<sup>12</sup>

Successful refurbishers especially need to excel at acquisition, conversion and resale activities. First, they must be able to acquire used items efficiently, a process that may involve retrieval, customer drop-off or mail-in collection. Second, conversion requires that the company refurbish the item to

product disassembly is typically time-consuming, expensive and requires high levels of skill. Product-reconstruction readiness has recently started to improve, however, as more and more manufacturers are beginning or accelerating efforts to reconstruct their own products — often prompted in part by their desire to prevent others from doing so and reaping the profit.

Governments, both at the federal and state levels, are promoting this trend, in part through legislation. (See “Legislation Encourages Product Reconstruction,” p. 64.) Meanwhile, public and private programs are being developed. The U.S. Environmental Protection Agency, for example, is forming partnerships with companies, including Best Buy, AT&T Wireless, Sony, Panasonic and Sharp, to encourage and facilitate the reconstruction of used electronic equipment.<sup>13</sup> The EPA has also created a Climate Leaders Program to work with large corporations to reduce the intensity of their greenhouse-gas emissions through product-reconstruction initiatives.

The private sector has launched its own initiatives in this regard. Perhaps the best known is the Dow Jones Sustainability World Index, which recognizes the top 10% of sustainability-driven companies worldwide, based on assessments of economic, social and environmental criteria and with a strong focus on long-term shareholder value. Among 58 industry groups across 24 countries, 318 companies met the standards for listing on the index in 2007-2008.<sup>14</sup>

Such participation, which involves a major commitment of resources, requires the promise of strong financial returns. Product reconstruction, in the forms of recycling, refurbishing or remanufacturing, offers the possibility of such returns; reconstructed products, after all, are considerably less expensive than their new counterparts. In addition, the growing public sentiment favoring ecological sensitivity and resource conservation is apt to greatly enhance the appeal of reconstructed products while bestowing further rewards on the corporations that provide them.

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