

Remanufacturing – An American Perspective

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ABSTRACT

Remanufacturing is the process of restoring non-functioning, discarded, or traded-in products (cores) to like-new performance. Over a period of thirty years, the authors have studied remanufacturing and have issued reports on various aspects of the industry. This paper will describe some of what we have learned during three decades of research on the topic: industry structure and scope, patterns in inputs and costs, forms of organization of remanufacturing enterprises, beneficial aspects of remanufacturing, and implications for other countries.

Remanufacturing provides a number of important benefits: greater availability of products and lower prices to customers, employment and industrial skills training to workers, and conservation of material and energy resources to society. Remanufacturers tend to enter remanufacturing, however, in the same pursuit of profits that motivates other entrepreneurs.

Key words: Remanufacturing, rebuilding, recycling, materials cycle, industrial ecology

1 INTRODUCTION

Remanufacturing as an industrial activity has existed in the United States for at least a century. Remanufacturing of electric motors, for example, was being practiced (although it did not bear that name) at the start of the 20th century. Remanufacturing has proliferated and is now a well-established, but almost unnoticed, activity. We began research on this subject thirty years ago, starting with Lund's work at MIT, and continuing at Boston University to the present.

This paper presents some of our general findings about the industry in the United States and a few observations about how this experience might apply to other countries, particularly to those countries endeavoring to develop a domestic industrial base. For more details of our findings we would refer you to our website, www.bu.edu/remman, where a bibliography is available.

2 OUR DEFINITION

Remanufacturing is the process of restoring a non-functional, discarded, or traded-in product to like-new condition. The key term in this definition is *like-new*. From the viewpoint of the producers, this represents the remanufacturers' intent, their claim for the product, and their ability to live up to that claim. From the customers' viewpoint, the *like-new* term represents the customers' expectation for the product sold as remanufactured. Both in performance and appearance, the product must meet at least

the specifications of the product when it was new. It may also incorporate upgrades to reflect improvements that have occurred since the product was originally made. [1]

3 THE INDUSTRY IN THE U.S.

The United States Department of Commerce maintains a Census of Manufactures, but it gathers no separate data on remanufacturing. An official count of remanufacturers, therefore, is unavailable. Such a count is made even more difficult because there are remanufacturers in many different product areas and the determination of what activity constitutes remanufacturing is not officially established.

Various parts of the industry use different terms to label the work we have come to recognize as remanufacturing. We have identified at least ten terms other than remanufacturing that are used as equivalent. [2] Further confounding a precise count is the gray boundary that exists between repair and complete remanufacture. Often, we have found, remanufacturers also engage in service and repair, and even collect used equipment for sale *as-is*.

Research by Lund in 1994-1996 attempted to estimate the size of the U.S. industry. [3] The results, we have since determined, were much too optimistic. We relied on membership lists of trade associations representing various sectors of the industry: automotive components, electrical apparatus, industrial valves, and others. It turned out that these memberships included a great many firms whose products could only be considered as remanufactured by a very liberal definition of the term. What further distorted the estimate was that the trade association directors gave us much too high estimates of the numbers of remanufacturers in their sector that were *outside* their memberships.

We still regard the industry in the United States as a significant economic activity, but we hesitate to make any new estimates of its size. Our database currently contains 3,844 establishments that we have confirmed by website, search engine, or telephone-call to be remanufacturers. An additional 2,434 establishments are possible remanufacturers, but we have not confirmed their status. We continue to discover new firms, but for several years our database count has been relatively stable at about 6,000 confirmed and possible firms.

We have consistently underestimated the scope of remanufacturing in the United States. We now know of 113 product areas in which remanufacturing occurs. A product area might contain many individual products. For example, one large American remanufacturer of automotive components, a single product area, advertises 45 different product lines. In the United States the major product areas, based on the number and size of firms in each area are motor vehicle parts, electrical motors and generators, pumps, transformers, laser toner cartridges, industrial machinery, tires, industrial valves, and office furniture.

Remanufacturing enterprises exist in a number of different forms. We have found it convenient to use three categories to encompass all forms. *Conventional* firms purchase *cores* (the name universally applied to the units that are to be remanufactured), remanufacture them and sell them to new owners. *Contract* firms agree with the owner of a product to remanufacture it and return it to the owner. *Original*

Equipment Manufacturers (OEM) are manufacturers of a product who also remanufacture their product for resale. OEMs typically sell their remanufactured products through their dealer networks. Conventional remanufacturers may sell directly to individual customers, through distributors, or through retailers (including retail chains). Contract remanufacturers may provide products to individual owners. They may sell to customers with fleets, such as trucking companies (tires), airlines (engines), or banks (printers).

Remanufacturing activities are located in every one of the 50 states, in both large and small cities. Small firms tend to be located near their markets; the larger firms tend to locate where there is ample labor and low overhead cost. In large measure, U.S. remanufacturing is a *domestic* industry. There is little in the way of export, and only a few firms are exploiting lower labor costs that can be found in Mexico, China, or other countries.

The price of a remanufactured product normally is between 45% and 65% of the price of a comparable new product. In virtually every case, the price of the new product establishes a ceiling under which the remanufacturer must operate. Only when availability (in time, in place, or in scarcity) governs the transaction does the new product price ceiling disappear. The remanufacturer not only competes with other remanufacturers, but is increasingly in competition with lower-priced new products, often imports. Foreign-source competition in electric motors, for example, has made it uneconomic to remanufacture any standard motor of less than five horsepower.

4 INDUSTRY DATA

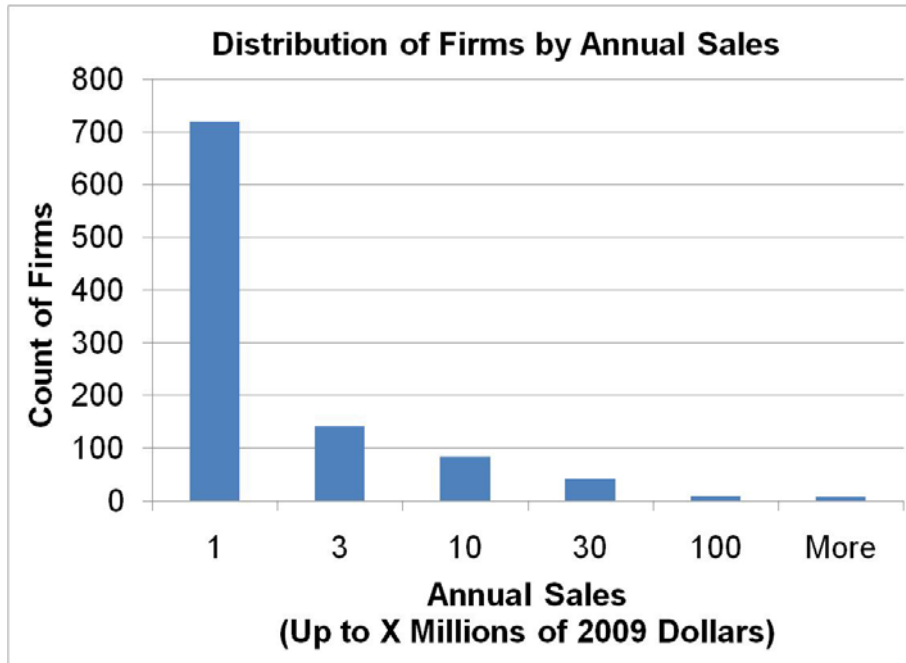


Figure 1

In our 1996 and 2003 reports we presented information gained from surveys of sample populations of known remanufacturers. Remanufacturing companies in the United States are small to medium in size. Even the very largest would still be considered modest in size. Figure 1, the distribution of firms by 1996 annual sales revenue, shows that over 70% of the 1003 firms in the sample had sales of \$1,000,000 or less. [4] As would be expected from the relatively low level of revenues, employees in a typical company are few. In the same study, we reported that median employment was five and the average number was 24. Average annual sales per employee were about \$155,000 (in 2009 dollars).

The 2003 study showed that larger firms had much higher levels of productivity. Revenues in small firms (\$500K to \$1M in annual sales) were \$90,000 per employee, whereas revenues in mid-sized firms (\$2M to \$5M in annual sales) were \$130,000 per employee. At revenues above \$25M, sales were \$312,000 per employee.

In virtually every product category, labor is the major factor in remanufacturing, ranging from 34% to 45% of product cost. Labor in tire retreading is relatively lower, at 28%, because of the high cost of the replacement rubber tread. Over all product sectors, half the workforce is classified as skilled labor, 30% are semi-skilled, 10% are unskilled, and 10% are salaried (or professional). Office furniture remanufacturing requires the fewest skilled workers: automotive parts and electrical apparatus sectors require the highest proportion of skilled employees.

The cost of cores is an important cost factor, but it is, for most companies, lower than the cost of replacement parts and other materials needed to bring products to like-new condition. Our 2003 study reported average core costs at 14% of product cost, with sector-to-sector variation from 8.7% (automotive) to 26% (furniture).

The principal sources of cores include trade-ins by customers buying newer units, units provided by customers requesting remanufacture and return of their own property, salvage operators and core brokers, rental units returned at the end of lease, and items found defective during an initial warranty period. Wide variation exists in importance of each source among the sectors.

5 TRENDS

We sense two trends occurring today in American remanufacture. The first is a decline in the volume of certain products that have traditionally been important in the industry. In tire retreading, for example, only truck tires and off-the-road tires are currently retreaded. Automobile tires now last much longer, and new replacements are low in price. Auto engines, too, are replaced less frequently because of increased durability.

The second trend is a reduction in the number of remanufacturing companies. In addition to the normal attrition of small companies, there has been a tendency toward consolidation of firms within a product area. Successful firms are acquiring competitors to expand markets and take advantage of volume efficiencies. Many toner cartridge remanufacturers, for instance, have discontinued cartridge production and are, instead, selling units they purchase at wholesale from high-volume remanufacturers.

6 WHY REMANUFACTURING HAS BEEN GOOD FOR THE UNITED STATES, AND WHY IT MAY BE GOOD FOR OTHER COUNTRIES

Remanufacturing provides benefits to the remanufacturers themselves in terms of income, but it has major benefits to the society as a whole. First, by introducing a healthy measure of competition, it makes products more broadly available at lower prices. Second, it makes an obvious contribution to conservation of materials and energy, and it reduces the need for capital investment in plant and equipment. Third, it provides employment income while training people in industrial skills that can lead to higher-paying jobs. This acquisition of skills also occurs at the level of the firm as a whole. Remanufacturing develops expertise in product technology, process technology, and supply chain logistics. This knowledge can lead to additional opportunities for repair, remanufacture, or manufacture of similar or different products. Fourth, though we lack data to prove the point, remanufacturing is probably less cyclical than manufacturing as a whole. We observe that many remanufactured products are used as replacement parts. These parts sell into an established equipment base that tends not to contract as rapidly as the sale of new products. In addition, in times of economic stress, the lower price of remanufactured parts may make them especially attractive.

The entire remanufacturing system in the United States is based on private companies. It includes not just the remanufacturers, but also the suppliers of cores and specialized replacement parts, distributors and sellers of finished goods, and supporting

legal, accounting, and consulting services. The firms in this system receive no subsidies. They pay taxes. This contrasts with the recycling system where the public bears a substantial portion of the costs, especially as relates to the collection of waste materials.

Remanufacturing can be similarly beneficial to other industrialized countries. Especially important in today's global economy, a remanufacturing industry tends to stay at home, a domestic industry that provides local employment and training. All industrial countries are aware of the need for conservation of energy and materials. Remanufacturing makes minimal demands on a country's resources while providing positive returns. We have seen significant growth of remanufacturing in Europe, and we are aware of an awakening interest in remanufacturing in China.

For countries striving to develop an industrial base, remanufacturing can offer unique benefits. Countries that engage in the remanufacture of capital equipment, such as industrial machinery, farm equipment, construction equipment, refrigeration, water treatment facilities, or transport vehicles, can gain access to product and process know-how through the disassembly, restoration, and assembly of cores imported at low cost from industrial countries. In so doing, the capital equipment base of the developing country can be expanded at low investment cost, while at the same time its labor force learns new skills and finds new employment opportunities. [5]

REFERENCES

- [1] **Hauser, W. M. and Lund, R. T.** (May 2008) Remanufacturing: Operating Practices and Strategies, Boston University. Available through www.bu.edu/reman
- [2] **Hauser, W. and Lund, R. T.** (May 2008) Remanufacturing: Operating Practices and Strategies, Boston University, p. 2. Available through www.bu.edu/reman
- [3] **Lund, R. T.** (January 1996) The Remanufacturing Industry: Hidden Giant. Boston University. Out of print
- [4] Value of sales has been adjusted from 1996 survey data to 2009 levels by applying the U.S. Producer Price Index for machinery.
- [5] **Lund, R. T.** – (January 1985) Remanufacturing: The Experience of the United States and Implications for Developing Countries, World Bank, UNDP Project Management Report No. 2.