

REMANUFACTURING

An American Resource

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Welcome to a slide presentation of some of our research findings over the past 25 years on the remanufacturing industry. Visitors to this site who are remanufacturers may find little new in what they see. If, however, you are a visitor for whom remanufacturing is unfamiliar territory, we hope you will gain some insight into this important and little understood sector of our economy.

If you have questions, feel free to contact either of us.

Bill Hauser

Bob Lund.

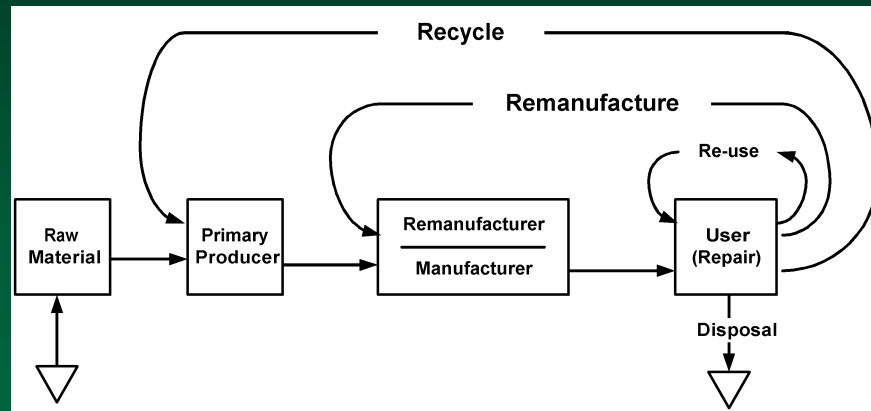
Remanufacturing Defined

- A worn-out or discarded product is disassembled
- Parts are cleaned, inspected, refurbished or replaced as necessary
- Product is reassembled and tested to perform like new

In remanufacturing, products that are known to be worn, defective, or discarded are brought to a manufacturing environment, where they are disassembled. All components are cleaned and checked. Those that can be reused are brought up to specification. Those that cannot be reused are replaced. When the product is reassembled and tested, it is ready for a second life, performing as new.

In many cases, improvements in a product may be made to increase its reliability, improve ease of maintenance, or add more sophisticated controls. In other cases, especially in electronics, remanufacture includes reconfiguration and reprogramming to match new customer applications.

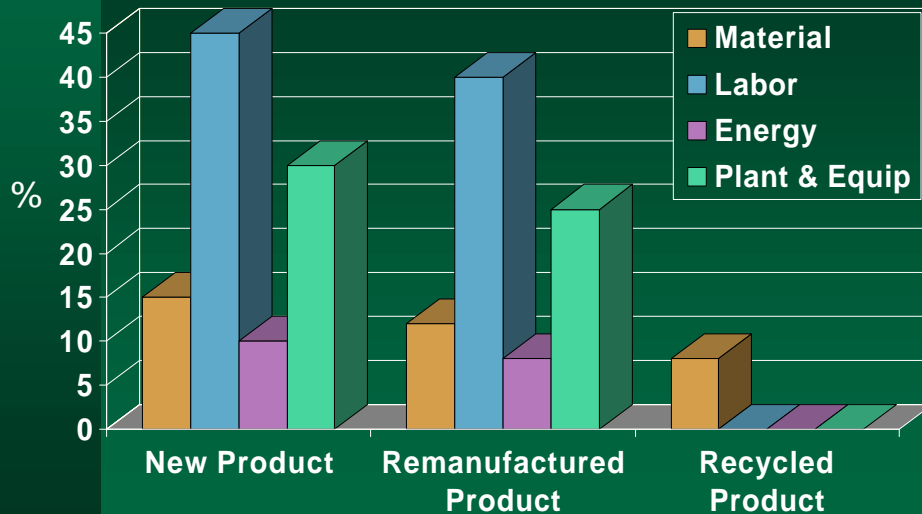
Materials Flow



This diagram describes the flow of materials through the cycle of manufacture, repair, reuse, remanufacture, and recycling of durable products.

Among the alternatives of repair, reuse, remanufacture, or recycling, the larger the loop, the greater are the costs to society and the less “conservative” is the option.

Remanufacturing/Recycling Economics



This chart illustrates conservation of value in a product that is remanufactured versus one that is recycled. The relative costs of material, labor, energy, and the contribution of plant and equipment to a product in its manufacture are shown on the left. Remanufacturing preserves much of this value while adding a second life to the product. In contrast, recycling shreds the product in an attempt to recover only the material value. Little or none of the other residual values in the product are retained.

Percentages show in this chart are illustrative only. Actual percentages vary with product type.

Remanufacturing's Contributions

- Materials Conservation
- Energy Conservation
- Plant & Equipment Conservation
- Employment in the Domestic Economy
- Industrial Skills Training
- Lower Prices Broaden Product Markets
- Safe Disposal of Hazardous Material
- Pays Taxes, Requires No Subsidies

As was illustrated by the preceding two slides, remanufacturing conserves materials, energy, and manufacturing plant and equipment. As a domestic industry, it provides employment to American workers, and, for those lacking in industrial skills, it provides both introductory training and advancement “ladders” as skills develop.

By providing like-new products at prices that typically range from 45% to 65% of comparable new products, remanufacturers can attract new buyers into a market where new product prices have been prohibitively high for them. The overall size of the market is increased.

In the process of disassembling products, remanufacturers are able to segregate toxic or hazardous materials and safely dispose of them.

Remanufacturing is profitable, private industry. The firms pay property and income taxes. Their employees pay income taxes.

Remanufacturability Criteria

- Technology exists to restore product.
- Product is made up of standard interchangeable parts.
- Cost of core is low relative to savings in product cost achieved through core reuse.
- Product technology is stable over more than one life cycle.
- Sufficient market demand to sustain enterprise.

These are the general criteria that must be met if a product is to be successfully remanufactured and sold.

It must be technically possible to disassemble and rebuild the product. Attempts are frequently made by original equipment manufacturers (O.E.M.s) to thwart attempts at remanufacture. As in most manufacture, parts must be standard, so replacement parts can be made, bought, or obtained from other discarded units ("cores"). Savings in product cost realized through core reuse must be significantly greater than the cost to acquire the core.

Products in an area where there is rapid technological change (such as personal computers) are poor candidates for remanufacture.

A real or potential market for the remanufactured product must exist. Most remanufactured products find markets in commercial and industrial sectors. In the automotive sector the repair or service technician often represents the customer in the purchase.

Remanufactured Products Areas

Sector	Product Areas
Automotive & Other Transport	12
Compressors	2
Electrical Apparatus	14
Machinery	42
Office Furniture / Equipment	1
Tires	1
Toner Cartridges	2
Valves	1
Other	8
Total	83

We have a remanufacturing database containing the names of over 12,000 remanufacturers. These firms are producing products in 83 different product areas (a product area is defined by a four-digit Standard Industrial Classification code). Automotive parts, for instance, are listed in SIC code 3714. We do not believe our list is complete, but it does include all the major sectors.

Remanufacturing Studies

The Remanufacturing Industry: Hidden Giant (Lund), 1996

Remanufacturing Enterprise for the Inner City (Hauser, Lund, Ling), 2000

The Remanufacturing Industry: Anatomy of a Giant (Hauser, Lund), 2003

Bob Lund has been studying the remanufacturing industry since 1978. Bill Hauser has been working with him for the past five years. These are three recent reports on the remanufacturing industry published by them.

Hidden Giant is the first attempt to define the size and scope of the remanufacturing industry.

Enterprise for the Inner City describes research into the possibility of introducing medical equipment remanufacture into the economically disadvantaged inner city of Boston.

Anatomy of a Giant examines the inner workings of companies across the breadth of the remanufacturing industry. A two and one-half year survey effort, it involved the cooperation of hundreds of executives of large and small companies.

How Big is Remanufacturing?

Number of Firms 70,000

Employment 480,000

Annual Sales \$53 billion

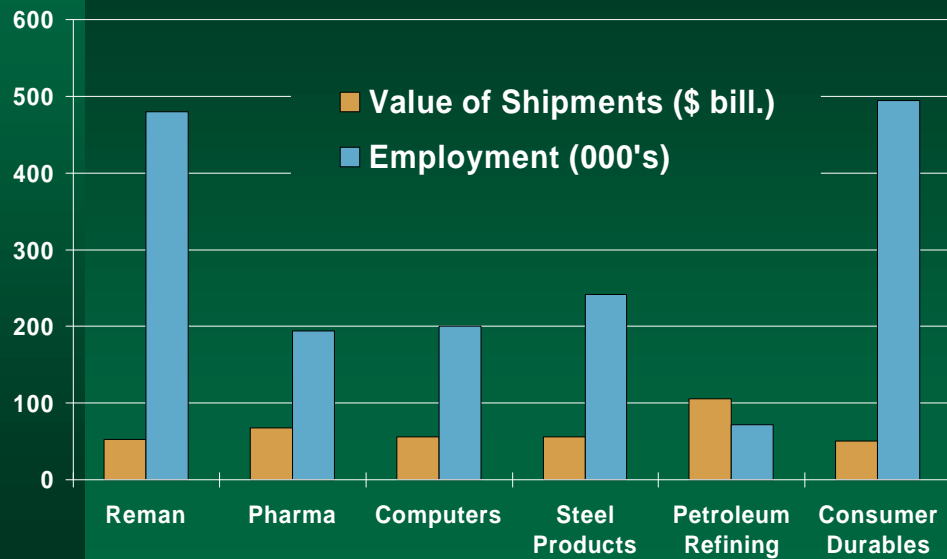
These findings are from *The Remanufacturing Industry: Hidden Giant*.

The industry is made up of thousands of companies, most of which are small, 20-person or less firms. Even the very largest remanufacturers would be classified as medium-sized firms.

Direct employment by these firms, however, is impressive. And if one were to add all the people not directly employed by remanufacturers – suppliers, distributors, retailers, installers, service people – whose incomes are dependent on remanufactured products, the total number would be in the millions.

The total estimated annual sales volume of these companies is very large. Remanufacturing deserves to be considered a major industry in this country.

Industry Comparisons

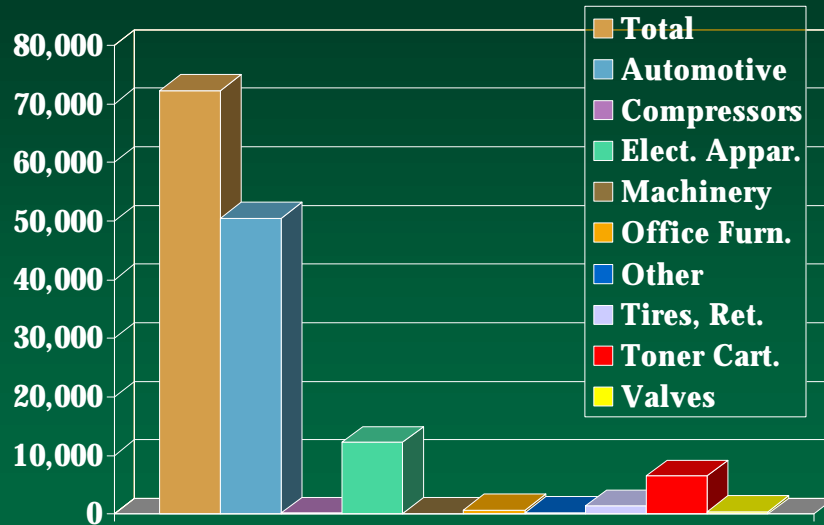


Using figures from government publications available in 1996, we compared the size of the remanufacturing industry with that of some of America's major industries.

In terms of value of shipments (sales), remanufacturing is comparable to the pharmaceutical, computer, steel products, and consumer durables (appliances) sectors. Yet only the consumer durables sector employs as many people.

The petroleum refining industry ships twice as much value in terms of sales, but it employs only one-sixth the number of people.

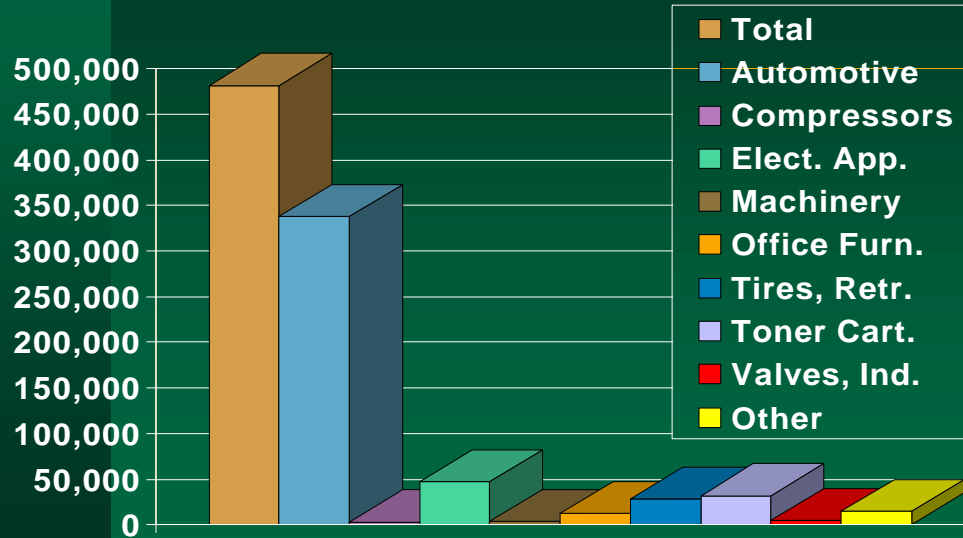
Sector Sizes - Number of firms



By grouping firms into sectors according to the type of products they remanufactured, we were able to estimate the economics of the various product areas.

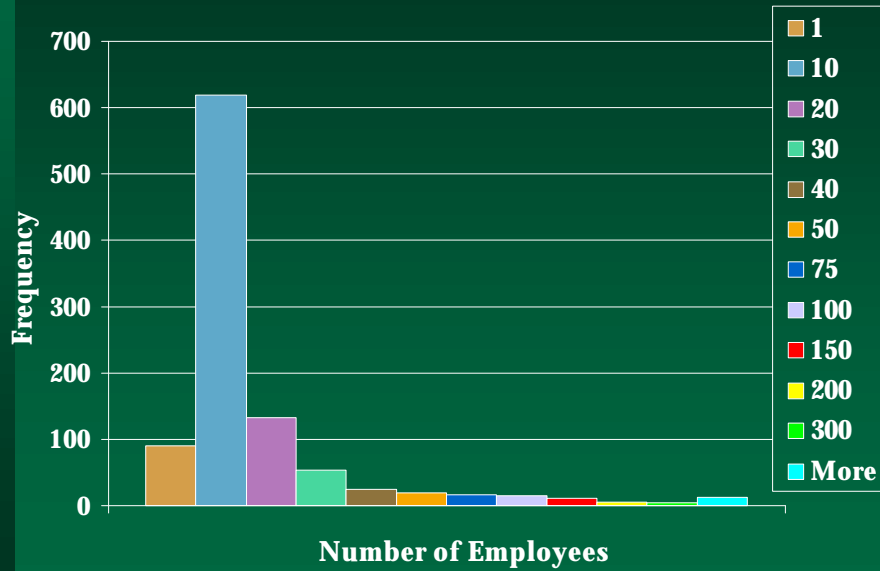
In terms of number of firms, the automotive sector is the largest, at slightly more than 50,000. The electrical apparatus sector is next, with approximately 13,000 firms. Toner cartridge remanufacturers, the sector experiencing the most explosive growth in the 1990s, was estimated at 6,500 firms, but the extent of consolidation in this area in recent years may have reduced this number significantly.

Employment by Sector



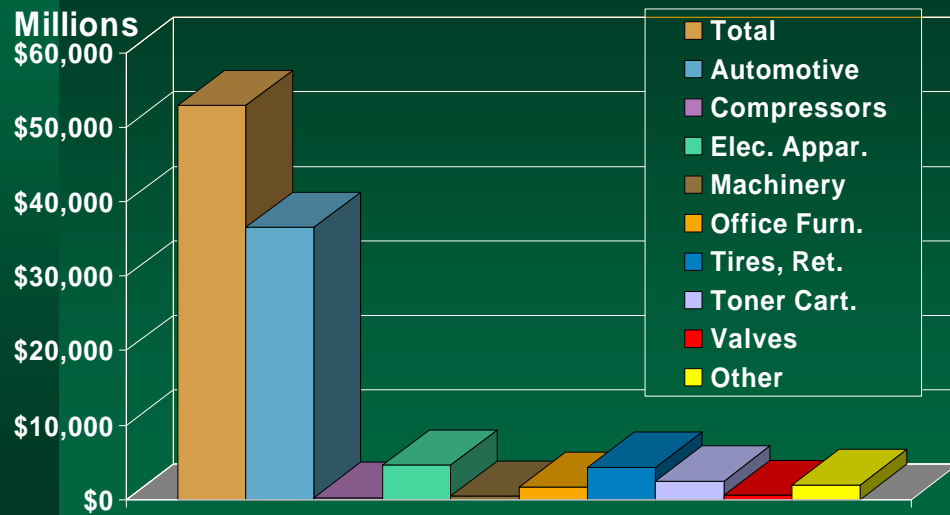
As might be expected, the automotive sector employs the most people, approximately 330,000. Electrical apparatus firms employ nearly 50,000, toner cartridge firms 30,000, and tire retreaders slightly less than 30,000.

Firm Size by Number of Employees



This chart emphasizes the relative sizes of the 1000 firms that were in our 1996 survey. Over 80% of the firms fell into the 20-employee or less category.

Annual Sales by Sector



Sales of the automotive sector, at \$36 billion, dominate the sales picture. Electrical apparatus is estimated at \$4.6 billion, tire retreading at \$4.3 billion, and toner cartridge remanufacturing at \$2.5 billion.

Expectations

- Industry growth: profit opportunities/ greater product acceptance
- Increased participation of O.E.M.s
- Consolidation, emergence of larger firms
- Slow recognition of remanufacturing by state and federal policy makers

Evidence from our most recent study indicates that firms in the industry continue to grow, even during a time of recession in the economy.

Original equipment manufacturers are becoming increasingly aware of the profit opportunities afforded by remanufacturing. In addition to the profit potential, remanufacturing provides feedback on product failure modes and durability, and it permits the firms to maintain brand reputation.

There is efficiency of scale in the industry, so we see larger firms emerging, buying up smaller firms or becoming wholesale suppliers to these smaller firms, who become retail resellers.

The wide dispersion, diversity of products, and small size of the players in this industry have made the industry virtually invisible to the public, and to policy makers who might provide encouragement to this industry.

Remanufacturing's Potential

- Sales of remanufactured products - \$53 Billion
- Value of shipments of new products in remanufacturing areas --\$1.4 Trillion



There is plenty of opportunity for greater utilization of remanufacturing in the United States.

At the time of our estimate of the size of the remanufacturing industry, the value of shipments of manufacturers of new products in areas in which remanufacturers operated was **26 times** greater.