

Leasing: A Step Toward Producer Responsibility



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PART I

Overview and Findings

Bette K. Fishbein, INFORM, Inc.

Historically, manufacturers' profits have depended on increasing the number of goods produced and sold. This has given companies an economic incentive not only to increase market share but also to design goods with built-in obsolescence. Producers have had little incentive to focus on the end of life of products (i.e., after consumers have discarded them), because managing this has been the responsibility of government. In other words, factors such as the amount of waste generated by a product and the cost of recycling or disposing of it have not been included in the bottom line of companies that make the product. Yet it is these companies that have the capacity to improve the economics and efficiency of materials use through product redesign, by manufacturing products that are less wasteful and more reusable, remanufacturable, and recyclable.*

This report examines the practice of leasing products, rather than selling them, as a strategy for increasing resource productivity, particularly by preventing waste generation and moving to a pattern of closed-loop materials use. Traditionally, the pattern of materials use in industrialized societies has been linear: materials are extracted from the earth and manufactured into products that are used and then sent to disposal facilities. A closed-loop system mimics natural systems, in which materials are continually reused so that waste from one application becomes the source of materials for another. In the case of products, this can be accomplished through reuse, remanufacturing, and recycling.

This report first describes the basic concepts of product leasing and servicizing (selling the function of a product or the service it provides, rather than the physical product). It then explores the ways in which leasing and servicizing can affect product ownership, management at end of life, and closing of the materials loop through product design for a variety of companies and products. The case studies focus on office equipment, carpets, cleaning equipment, and computers.

The product-service continuum shown in Figure 2.1 (page 17) illustrates relationships among different types of business transactions, with leasing falling midway between direct sales of a product and sale of a service. In practice, these distinctions are often blurred. For example, lessors may offer comprehensive service contracts. In this introduction and in the findings relating to management of products

* See Appendix A at the end of Part III for definitions of these and other end-of-life management terms.

at end of life, servicizing can be considered similar to leasing, with effects on materials use much like those of operating leases. However, a manufacturer's involvement with its products, and its incentive to improve materials use efficiency, may be even greater under servicizing arrangements than under leasing, since servicizing also tends to provide much more producer involvement in the use stage of the product life cycle.

I. The Imperative for Increased Materials Efficiency

At the dawn of the twenty-first century, world population and consumption continue to grow to levels unprecedented in human history. We began the twentieth century with a global population of about 1.5 billion; now world population exceeds 6 billion people, and is headed to 10 billion in the next 50 years. At the same time, standards of living are rising in both the industrialized and developing countries, increasing pressure on our global ecosystem, which serves as both a source of materials and a sink for our wastes.

Due to the rising population and standards of living, resource consumption has increased dramatically. World production of primary materials more than doubled over the past 30 years, adding pressure on the world's natural systems. Resource productivity may need to increase by a factor greater than five, and even as much as ten, for human activity to achieve a sustainable course.

The term "sustainability" is subject to much debate. The commonly used definition is that coined by the Brundtland Commission in 1972: "...to meet the needs of the present without compromising the ability of future generations to meet their own needs." But this is subject to interpretation. In their 1999 book *Natural Capitalism*, Paul Hawken, Amory Lovins, and L. Hunter Lovins discuss sustainability in terms of "natural capital," which they define as "the sum total of ecological systems that support life." They argue that this capital provides income or services that constitute a valuable subsidy: "to maintain income [from natural capital], we need not only to maintain our stock of natural capital but to increase it dramatically in preparation for a possible doubling of population that may occur in [this] century."¹ They also reason that investing in natural capital requires a change in patterns of production and consumption that, in turn, requires a change in economic incentives. While there are disagreements on the implementation strategies needed for sustainability, there is general agreement that strategies to protect the earth's ecological systems need to be economically viable and equitable with respect to the distribution of resources.

Finding a path toward sustainability involves multiple approaches: this report explores ways to achieve much more efficient materials use. For the United States and other industrialized countries, which consume materials vastly out of proportion to their populations, learning how to use material resources more efficiently is especially crucial. Decreasing the amount of material needed to perform a given function and creating a closed-loop pattern so that virgin materials, once extracted, are continually reused, remanufactured, and recycled can conserve resources. This also reduces waste and the need for waste disposal facilities. Even more important, it can reduce the enormous environmental impacts of materials extraction from logging, mining, and drilling that pollute our land, air, and water.

2. Strategies for Sustainable Materials Use

In the last decade, countries and companies around the world have begun to implement strategies aimed at moving toward sustainability, in part by closing materials loops. One such strategy, which originated in Europe, is extended producer responsibility (EPR). This requires that producers take back their products when consumers discard them, manage them at their own expense, and meet specified recycling targets. By internalizing waste management costs for products, so that the manufacturer of the product pays for waste collection and recycling and/or disposal, this policy provides companies with incentives to produce products that are less wasteful and more reusable, remanufacturable, and recyclable.

The need to close materials loops is particularly pressing in the United States. It has the largest economy in the world, generates more than 200 million tons of municipal waste per year, and continues to introduce new throwaway products. With less than 5 percent of the world's population, the United States consumes more than 25 percent of the world's resources. Yet it is unique among the industrialized countries today in not having any national EPR policy.

With strong opposition to mandatory EPR, particularly from industry, interest is growing in the United States in finding alternative ways to achieve EPR's objectives of preventing waste generation and preserving resources by closing materials loops. Product leasing has frequently been discussed as such an alternative. In fact, Ray Anderson, chairman of Interface, Inc., a major carpet producer, gained much publicity by advocating that companies, instead of selling their products, lease them or sell them as a service in order to move toward environmental sustainability. This led to his being named co-chairman of the President's Council on Sustainable Development. Anderson reasoned that if companies leased products (such as carpet) or sold them as a service (such as keeping the customer's floors covered), manufacturers would retain ownership throughout the product life cycle and would therefore have an incentive to maximize and, ultimately, recapture the end-of-life value of their products, thereby reducing the need for virgin materials.

3. INFORM's Report

This report looks at leasing of several product types to assess whether, in practice, leasing does achieve EPR's goal of increased resource efficiency. To what extent does leasing result in producers owning and managing their products at end of life? Does leasing increase reuse, remanufacturing, and recycling? Does it lead to design changes that facilitate closed-loop materials use? What is its relationship to corporate environmental goals and programs directed at enhancing and recapturing the value of end-of-life products, and to corporate structure?

To answer these questions, INFORM looked at the leasing of personal computers, other office machines, carpet, and cleaning equipment. We also sought to gain an understanding of how the effects of leasing may vary by product type. This report presents selected in-depth case studies to illustrate our findings.

We focused on the personal computer industry (Part III) because computers are posing an increasing waste problem, with more than 20 million becoming obsolete in the United States each year and only 11 percent being recycled.² Discarded computers, along with the huge number of obsolete computers stored in attics and basements and the ever-shorter lifetime of these products, will exacerbate the waste problem in years to come, not only by squandering resources but also by causing a major increase in the quantity of toxic materials entering disposal facilities. Furthermore, there has been a huge increase in leasing activity in the computer industry in recent years, so it is an interesting model to examine with respect to the questions posed above.

Case studies in this report also include the Asset Recycle Management program at Xerox, the Asset Recovery Services and Environmentally Conscious Product programs at IBM, and the efforts of Interface to lease carpet (which have proved very problematic), as well as programs of a variety of other manufacturers. Partly as a result of Ray Anderson's publicizing of leasing as a strategy for sustainability, it is often assumed that leasing means that the manufacturer retains ownership of the product through the end of the life cycle and is therefore responsible for managing it at end of life. INFORM has found that this is sometimes, but not always, true.

4. Ten Key Findings

1. **Only operating leases, not capital leases, increase the likelihood that the manufacturer will retain ownership of the product at end of life and have responsibility for managing it.**

There are two main categories of leases: capital and operating. Capital leases are basically finance arrangements and are treated as loans for accounting purposes. Under such leases, ownership passes to the lessee automatically by the end of the lease term. End-of-life ownership of the product is no different under a capital lease than if the product were sold directly to the customer.

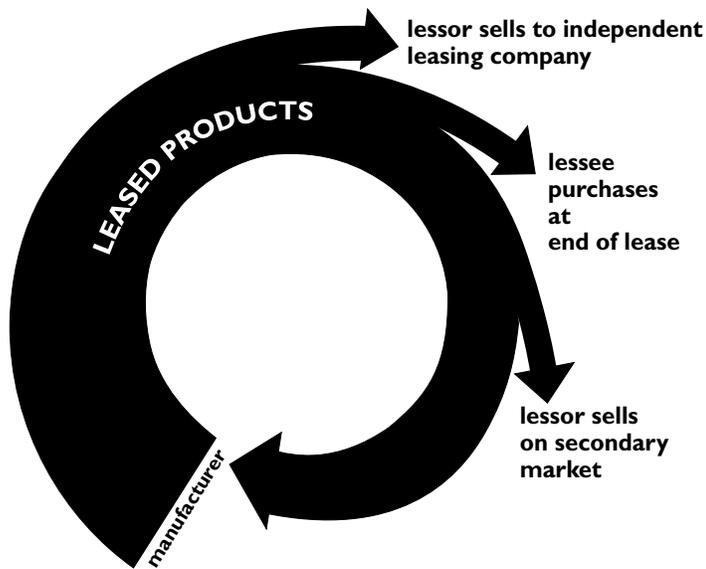
Under operating leases (also called "true leases"), on the other hand, ownership is typically retained by the lessor to the end of the lease term (although the lessee is able to purchase the product at the end of the lease for its fair market value).

2. **Although operating leases increase the likelihood that the manufacturer will own the product at end of life, there is significant leakage in the ownership/responsibility loop depending on what company acts as lessor and how the product is handled at the end of the lease term.**

Figure 1.1 illustrates how this leakage occurs. First, the nature of the company offering the operating lease affects whether the product will come back to the manufacturer. If the lessor is an independent leasing company, rather than the manufacturer or a leasing subsidiary of the manufacturer, the product will not revert to the manufacturer.

Even when the manufacturer offers the lease, it may not retain ownership of the equipment to the end of its life. As Figure 1.1 shows, the lessee may purchase the leased equipment for its fair market

Figure I.1 Ownership/Responsibility Loop Under An Operating Lease*



* Figure is illustrative and does not represent actual percentages.

value or the lessor may sell the equipment on the second-hand market at the end of the lease.

Products such as computers and office equipment may thus go through several use cycles. Selling the product during any of these cycles breaks the link with the manufacturer so that end-of-life ownership becomes the same as for a product that was originally sold. In other words, the owner at end of life will be the last purchaser, rather than the manufacturer, even though the product was originally leased.

An operating lease offered by the manufacturer or its leasing subsidiary increases the likelihood that the manufacturer will own the product at end of life and be responsible for managing it as waste, but only if the product is continually leased throughout its life and never sold.

3. Manufacturer ownership and responsibility for end-of-life management create incentives to increase reuse, remanufacturing, and recycling.

Despite leakage in the materials recovery loop, many leased products are returned to the manufacturer. Some nonleased products also come back through trade-ins, production surplus or defects, and take-back programs. It is product ownership at end of life that impacts producer behavior, and leasing can be an important means of increasing the probability of manufacturer ownership.

INFORM's research indicates that the probability that equipment will be reused, remanufactured, or recycled is greater if it comes back to the manufacturer at end of life. Leasing bears some similarity to product take-back under EPR: a manufacturer that gets its products back, and must pay to dispose of them, has an incentive to reduce disposal costs and recapture the residual value of the product, provided the costs of doing so do not exceed the disposal costs.

Xerox has an exemplary program for managing end-of-life equipment. The company traditionally leased copiers, got them back, and then had to pay to warehouse and, ultimately, dispose of them. Economics drove the decision to develop the Asset Recycle Management program aimed at avoiding the costs of warehousing and disposal and recapturing the end-of-life value of products. As

described in Part II, reusing, remanufacturing, and recycling its copiers have been very profitable for Xerox.

IBM is another company for which leasing appears to be a driver of environmental initiatives. With a long history of leasing and getting products back, IBM, too, has its own recycling programs, a worldwide network of recovery centers, and a well-designed program for asset recovery.

For many companies, the end of life of their products is not on the radar screen. They view end-of-life management as the responsibility of municipal waste systems. Companies that get back large amounts of products through their leasing systems have an increased awareness of the costs of managing these products as waste, of the potential for enhancing and recapturing end-of-life value, and of the manufacturing processes that can facilitate remanufacturing and recycling.

4. Operating leases can extend the useful life of the product even if the product does not revert to the manufacturer at end of life.

Leasing, even for only the first use cycle, may increase the likelihood that a product will be reused and its life extended through later cycles, instead of being stored or discarded. That is, leasing generally keeps the equipment in a commercial channel in which its service life is more likely to be extended. For example, when computers are discarded, they are often stored in closets or attics, where their value depreciates rapidly over time. Leased equipment is less likely to be stored. It reverts to a commercial entity that is more likely to refurbish it for resale, sell it for spare parts, or send it to a recycler.

5. Motivations for initiating a leasing program vary, but the impact of leasing does not depend on the motivation.

Leasing was employed as a marketing tool at Xerox, not an environmental strategy. Yet it ultimately became the driver of the company's asset recovery program described above. Although not instituted to achieve environmental objectives, leasing at Xerox has been very successful in doing so. The well-developed program for end-of-life products at IBM was also fostered by a long tradition of leasing and getting products back.

As computer leasing increases, even a company like Dell, with a strong focus on cutting costs, is beginning to implement initiatives to redesign its products to enhance end-of-life value. This may be motivated in part by the fact that the company is starting to get products back through its leasing program, but other drivers are the desire to qualify for European eco-labels and the knowledge that take-back and recycling of computers are likely to be required in Europe. Gateway, another computer manufacturer, is only beginning to receive returned equipment under its new financing program and has not provided any information to INFORM as to how the returned computers will be handled.

Interface presents a different model from these computer and office equipment companies. Its chairman, Ray Anderson, became committed to sustainability and zero waste after reading Paul

Hawken's book *The Ecology of Commerce*. At Interface, leasing has not been a driver of sustainable initiatives as at Xerox and IBM, but rather a mechanism the company selected to achieve them. Interface pioneered the concept of using leasing as a strategy to close materials loops; however, it has not yet been successful in implementing this strategy, because of the difficulties of creating an operating lease for carpet, as discussed in Part II. Nevertheless, Interface continues to work on product redesign and new recycling technologies to reduce waste and close the materials loop.

INFORM finds that leasing can therefore be a driver of environmental product management or it can be employed as a tool to accomplish this, but in either case the results are similar when the manufacturer owns the product at end of life.

6. Design changes that make products less wasteful and easier to reuse, remanufacture, or recycle are dependent on organizational characteristics, as well as on product ownership and responsibility for end-of-life management.

Product design is key to closing materials loops and improving the efficiency of resource use. Many countries are mandating take-back programs to encourage companies to make such design changes. INFORM's case studies indicate that operating leases may encourage environmental design changes but are not sufficient to do so. Additionally, such organizational characteristics as corporate awareness of the role design can play in augmenting recaptured value, corporate commitment to closing the materials loop, and extensive interdepartmental communication and collaboration are essential.

A good example of the impact of leasing on product design is the program at Xerox. Because the company leased many of its products and got them back, it began to focus on their end-of-life value. Xerox aimed to recapture this value and then went a step further and linked end-of-life management with product design to increase the residual value that could be recaptured. The specific design initiatives are outlined in Part II. They range from reducing the number of parts and materials used in products to designing for commonality so parts from one type of product can be used in remanufacturing another.

Xerox also made structural organizational changes, such as having its asset recovery engineers work directly with product designers, developed a hierarchy of options for managing end-of-life products that puts reuse and remanufacturing ahead of recycling, and built end-of-life factors into criteria for new product design. All of these initiatives have parallels at IBM, which brings its product designers to its recycling centers and has included end-of-life factors in its design for environment criteria (see Table 3.9).

All companies that lease and/or take back products do not necessarily make the connection between end-of-life management and product design. Pitney Bowes, for example, leases and gets back products, has made several design changes, and has stated its commitment to putting reuse and remanufacturing ahead of recycling. But INFORM did not find evidence that it has made the types of organizational changes noted above. For example, there appears to be little interaction between the managers of end-of-life products and new product designers. The impact of this is

reflected in Pitney Bowes' statement that contamination by inks is a barrier to recycling copiers. Xerox, which also encountered this problem, developed a design initiative to solve it: it reformulated its inks using a powder base so they can be easily removed from recovered machines.

Interface continues to pioneer environmental design changes even though it has not been successful in leasing carpet. It is driven by the environmental vision and goals of the company's leadership.

Comparing the design of leased products and products that are sold does not provide insights into the impact of leasing on product design. Generally, it is not economical for companies to have different designs and production lines for the same product, depending on how it is marketed. Thus, when design changes are made, they are generally made for the entire product line. This may create design conflicts. For example, leasing may provide an incentive for a company to make its products more durable, which may conflict with the marketing drive for obsolescence of products that are sold. Electrolux, profiled in Part II, has raised this issue with respect to leasing and selling the function of cleaning and other equipment. How a company resolves this conflict may depend on how many products are leased compared to the number sold.

It is also important to note that there are other factors impacting design for environment initiatives. As noted in Part III, computer companies – which often sell products worldwide – are very cognizant of the emerging mandates for product take-back in Europe, and have an incentive to improve the economics of recycling through product redesign. They are also driven by eco-label programs, such as Germany's Blue Angel, which require specific design criteria to facilitate recycling and prolong product life.

7. Product characteristics affect the viability of operating leases.

Some products are not suitable for operating leases for a variety of reasons. For example, they may be very cheap or they may be consumed during ownership, so that little value remains at the end of a lease. The large carpet manufacturer Interface, Inc., pioneered the concept of using operating leases as a strategy for sustainability, as described in Part II. However, when it applied this strategy to its own product, it encountered serious problems.

The intent was for Interface to lease carpets, take them back at the end of the lease, and ensure that the materials would be used again and not go to disposal, thereby closing the materials loop. However, it makes no sense to lease carpet for two to three years, remove it from the lessee's floors, and then re-lease it to another customer. But if the lease term is longer, coinciding with the carpet's life span (about ten years), it violates some of the requirements of an operating lease (i.e., that the lease term be less than 75 percent of the estimated economic life of the product and that the product have significant residual value at the end of the lease term). Failure to meet these requirements affects how the lease is handled for accounting purposes and the ability to get outside financing for the leasing program.

Unlike the other products examined in this study, carpet does not readily lend itself to several use cycles, which is fundamental to a classic operating lease. However, Interface is currently exploring

newly designed carpet materials and recycling technologies that would allow leased carpet to fulfill the requirements of an operating lease by retaining sufficient residual value (for recycling) at the end of the lease term.

8. Companies exhibit differing levels of awareness of the connection between end-of-life management and product design.

The following hierarchy describes five tiers of corporate awareness with respect to responsibility for end-of-life products and design promoting closed-loop material use, with Tier 1 being the highest level.

Tier 1. The company acknowledges its responsibility for end-of-life products, sets environmental criteria for managing them (i.e., places reuse and remanufacturing ahead of recycling), and includes end-of-life factors in product design criteria.

Tier 2. The company sets environmental criteria for managing end-of-life products (i.e., places reuse and remanufacturing ahead of recycling) and includes end-of-life factors in product design criteria.

Tier 3. The company manages end-of-life products but uses end-of-pipe thinking, focusing on managing the waste that exists rather than changing the quantity and characteristics of that waste through product redesign.

Tier 4. The company exhibits some sporadic/nonsystematic concern with product end of life; for example, it shows some interest in recycled content and/or recyclability.

Tier 5. The company shows little awareness of or concern about product end of life, seeing this as a government responsibility, and may continue to design and market throwaway products.

It should be noted that there is room for improvement at most companies, regardless of where they fall on the hierarchy. Even companies at Tier 1, for example, have not implemented programs to take responsibility for *all* their products at end of life or to manage them all in an environmentally sound manner.

Examples of companies at Tier 1 are Xerox and Interface. They acknowledge responsibility for their products at end of life, have hierarchies for managing them, and use design to enhance residual value. IBM is at Tier 2. Its programs have characteristics similar to those at Xerox and Interface, but it does not acknowledge responsibility for its products at end of life. Pitney Bowes is closer to Tier 3. It has some environmental criteria for managing product end of life and has made some design changes, but it has not made a strong connection between product design and end-of-life management. Most companies in the United States do not get their products back and manage them at end of life, and would be at Tier 4 or 5. The companies profiled in this report tend to be at a higher level because they are actively involved in leasing and/or servicing, and are therefore getting products back and managing them.

The verdict is out on the computer manufacturers. They do not take responsibility for their products at end of life and actively oppose take-back requirements. However, because of the growth of leasing, they may become more involved in end-of-life management and may therefore start making design changes that can make this more economical. Dell has begun to do this with its OptiPlex product line.

9. Operating leases (in contrast to sales) offer both benefits and challenges.

Benefits of operating leases include the following.

- Operating leases create an ongoing relationship between manufacturers and customers that can be a big advantage for manufacturers in enhancing brand loyalty and future marketing.
- By bringing more products back to the manufacturer, operating leases can help close materials loops and provide the manufacturer with a continual, predictable flow of post-consumer feedstock for its remanufacturing and recycling activities, which can, in some cases, be very profitable as well as environmentally beneficial.
- Operating leases give manufacturers greater control over the resale market, which is important because it can impact the volume of sales and pricing of new products.
- Operating leases can have accounting and tax advantages for some customers by shifting costs to the operating budget from the capital budget, conserving cash, and preserving credit lines.
- Operating leases for products like computers make it easier for customers to upgrade to the newest technology and reduce their expenses for managing end-of-life products.

Challenges presented by operating leases include the following.

- When a product is sold, the manufacturer typically gets payment at the point of sale, while under an operating lease offered by the manufacturer or its subsidiary, payment is spread over the term of the lease. The manufacturer must finance the leasing arrangement and assume added risk because the customer could go out of business or default on its payments before the end of the lease.
- The costs of an operating lease often seem high to customers. A computer lease, for example, usually includes the costs of taking back the computer and processing the used equipment so it can be re-leased, resold, or reclaimed. Customers frequently do not understand these product life-cycle costs and compare the lease costs to the costs of buying, which do not include the added services provided under a lease.
- If a company both sells and provides operating leases for its products, it may experience a conflict because the durability desired when products are leased (or when functions or services are sold) may not be consistent with marketing objectives when the same product is sold. Electrolux, for example, cited this as an issue.

10. Product take-back under operating leases differs from take-back required by EPR legislation.

When manufacturers take back their own products at the end of a lease, the system is similar to voluntary take-back programs but different from those mandated by EPR. The major difference is that mandatory programs generally include recycling targets, definitions of what counts as recycling, and reporting requirements.

In contrast, when a company gets a product back at the end of a lease, it may choose to send the product to a landfill or incinerator, or it may claim to be recycling a product that it sends to a waste-to-energy facility. Economics generally determine how the lessor handles the product: it is likely

to reuse, remanufacture, or recycle only if these options cost less than disposal. The mandated EPR programs developed in Europe set targets irrespective of the economics and assume that if manufacturers incur added costs, they will pass these along to consumers through higher product prices.

Leases do not generally include guidelines on how end-of-life products should be managed. In some cases, companies or trade associations may set some guidelines and define what counts as recycling and what management options are acceptable. For example, Interface states that no carpet it takes back will go to the landfill. However, leases and voluntary take-back programs rarely set specific recycling targets.

The matrix below compares some characteristics of product sale, lease, and EPR take-back options. These reflect general cases but, in practice, there can be exceptions. For example, a lease or voluntary take-back program could set collection and recycling targets, although this is not generally the case.

Comparison of Sale/Lease/Take-Back Options

	Sale	Operating Lease	Voluntary Take-Back	Mandatory EPR
Manufacturer gets product back	No	Maybe	Yes	Yes
Collection and recycling targets	No	No	No	Yes
Definition of recycling	No	No	No	Yes
Reporting required	No	No	No	Yes

5. Analysis of Findings

In the following discussion, leasing refers only to operating (or true) leases, not to capital leases.

Does Leasing Close the Loop?

A fundamental goal of a sustainable society is to move toward a pattern of closed-loop material use so that materials, once extracted from the earth, are continually reused, remanufactured, or recycled. The key question addressed in this report is: can leasing be used as a tool to accomplish this objective? INFORM's analysis shows that leasing can be a useful part of an overall strategy but will not alone lead to a closed-loop pattern of material use. To achieve this, additional supporting policies are needed.

Following are eight characteristics of a leasing program that would lead to closed-loop materials use.

1. The lease is an **operating lease**.
2. The **lessor is the manufacturer** of the product or a captive leasing company.
3. The **lessor gets the product back** at end of life.
4. The manufacturer (lessor) follows a **hierarchy of waste management options**, putting reuse and remanufacturing ahead of recycling, as well as guaranteeing that the product will not be sent to an incinerator or landfill.

5. New **product design criteria** include elements to facilitate end-of-life management and increase recapture of value.
6. The company makes **structural and organizational changes** to increase communication between managers of end-of-life products and new product designers and to give strong management support to product end-of-life issues, particularly product design.
7. The company sets **guidelines** for amounts of products to be collected and reused, remanufactured, or recycled.
8. The company **reports on product end-of-life programs** (i.e., amounts collected, reused, remanufactured, recycled, etc.) in its environmental reports.

As the findings in this report indicate, leasing can increase the probability that a company will own and be responsible for managing its products at end of life and internalize the costs of doing so. This, in turn, provides incentives for it to focus on end-of-life issues by making products less wasteful and easier to reuse, remanufacture, and recycle. And it creates incentives to redesign products to enhance recovery of their residual value. It was ownership of large quantities of used products (in large part due to leasing) that led Xerox to develop an economically and environmentally successful asset recovery program linked to product design.

However, three of INFORM's findings point to major limitations that must be kept in mind when considering leasing as a strategy for sustainability. First, operating leases are not adaptable to all product types; second, operating leases do not ensure that the manufacturer will own the product at end of life; and third, leases do not generally include requirements on how products should be managed at end of life. This means that companies can send their products to disposal facilities and are likely to do so when this is the cheapest option. If a manufacturer sends its products to a landfill, the materials loop is not closed. But this is still preferable to the direct sale of a product, since the fact that the manufacturer must pay the costs of disposal creates incentives to produce less waste.

Is Leasing an Alternative to Mandated EPR?

Leasing is a step in the direction of accomplishing the goals of mandated take-back programs required by EPR legislation but does not go nearly as far. EPR programs generally mandate the amount of products to be taken back and the amount to be recycled, and specify what counts as recycling and how results are to be reported. Leasing is closer to voluntary take-back programs than to mandatory ones. It cannot, alone, ensure that products will not end up in an incinerator or landfill, particularly if these options are cheaper than materials recovery. It is a step in the direction of EPR in that it increases the likelihood of manufacturer ownership and responsibility for products at end of life.

Leasing cannot be considered as an alternative to EPR for many product types. EPR was originally mandated in Europe for packaging, which accounts for about one-third of the waste stream. A directive is now being circulated in the European Union (EU) that would require the take-back and recycling of all electric and electronic products. Operating leases cannot be used to address these waste streams. It is not practical to lease coffee cans, cereal boxes, or inexpensive electric and electronic products such as clocks, small battery-operated appliances, and toys. Leasing can only be

considered an alternative to EPR for relatively high-value products. Furthermore, this study indicates that even for a relatively high-value product such as carpet, leasing can be problematic despite the best intentions.

Leasing as an alternative to EPR is particularly interesting to examine with respect to personal computers. These are creating a mounting problem in the waste stream due to the large amounts being discarded and their toxic constituents. The EU directive would require producers to take them back and recycle 70 to 90 percent of them. In the absence of such policies in the United States, leasing has been considered as an alternative. For example, the US Postal Service has considered procurement guidelines that would specify that its personal computers be leased rather than purchased. Similar guidelines have been considered by states and school districts around the country. This report indicates that leasing could help address the problem of computer waste. It extends the producer's responsibility for its product, keeps the product in a commercial channel in which it is less likely to be stored when it becomes obsolete, increases the probability that the manufacturer will own the product at end of life, and makes manufacturers more aware of the problems and costs of managing their products at end of life.

Leasing computers does not accomplish all the goals of mandatory EPR and is not likely to achieve recycling rates of 70 to 90 percent. However, it is preferable to direct sales. The trend is toward a shorter useful life span for computers, which means they will generate more and more waste. Even if only some manufacturers are responsible for managing some of their computers, this could increase awareness of the impacts of this growing waste stream and lead to initiatives to reduce it. A greater impact may come from EPR mandates abroad. Computers are marketed globally and requirements for take-back and high recycling rates in Europe are likely to have a substantial impact on computer design in the United States.

How Can Leasing Be Encouraged and Supported?

Given the absence of EPR legislation in the United States, leasing can be used as a strategy to begin to move toward sustainability. Government and corporate procurement guidelines can be revised to encourage the leasing rather than the purchase of certain products. The guidelines could also specify how products should be managed at end of life. For example, government agencies and companies with strong environmental goals could specify that vendors bidding for computer contracts provide lease and take-back options, as well as a guarantee that the returned equipment will not be disposed of in an incinerator or landfill. There is a precedent for such policies in the United States. Procurement guidelines in three states (Delaware, Washington, and Oregon) require that contractors take back used carpet for reuse or recycling whenever they install new carpet.

Additionally, government guidelines could remove obstacles to the procurement of remanufactured equipment. Currently, for example, 26 states have procurement guidelines that restrict the purchase of office equipment with reprocessed parts, and state procurement guidelines in Delaware and Tennessee even require products to contain only new components.

Removal of such restrictions would support remanufacturing initiatives. Similarly, state taxes on leasing of reusable pallets and containers need to be removed. Some progress is being made on this, and related legislation providing tax incentives to promote such activities has been introduced in the US Congress as part of the Landfill Reduction Act of 2000.

Other actions that would lead manufacturers to recover the value of their products instead of disposing of them are landfill bans, landfill surcharges, and reductions in subsidies for virgin materials. Under mandatory EPR, companies must take back and recycle their products even if this is not economical. Under leasing and voluntary take-back initiatives, economics are a powerful driver and the products can be sent to disposal when this is cheaper. Making surcharges and subsidies compatible with sustainability can be an important determinant of the amount of materials diverted from disposal.

6. Conclusion

In the absence of legislation aimed at closing materials loops by requiring companies to take back their products and then manage them environmentally, other strategies can be pursued that at least increase the likelihood that producers will have responsibility for their products at end of life and will internalize the costs of waste management. Encouraging operating leases can be such a strategy for some types of products. Policies that remove obstacles and improve the economics of material recovery can be used to support a leasing strategy.

PART II

Introduction to Product Leasing and Selected Case Studies

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This section explores how leasing and selling functions can provide incentives for extended producer responsibility and resource conservation. It first discusses the concepts of leasing and servicing (selling functions and services, rather than products), materials recovery, and design for the environment. Then, through case studies, it examines the equipment leasing, materials recovery, and environmental design programs of four companies: Xerox, Pitney Bowes, Interface, and Electrolux. Finally, based on the information obtained from these case studies, it identifies several characteristics of leasing/materials recovery programs that seem helpful in closing the materials loop.

I. Introduction

The traditional producer-customer* relationship is often characterized as one of competing interests: the producer wants to sell as many goods as possible at the highest price possible, while the customer wishes to minimize the cost of goods purchased. In order to maximize revenue in such a system, manufacturers have an incentive to convince customers that they need a large number of products and/or to design for obsolescence. This incentive can threaten the natural environment by increasing resource use in the name of business growth.

Furthermore, manufacturers traditionally relinquish responsibility (and often consideration) for their products as soon as they are sold to the customer. At the point of sale, the purchaser becomes responsible for the product until the end of its useful life, when responsibility shifts to the municipality for disposal or recycling. This continuous transfer of responsibility masks a substantial waste of resources as well as opportunities for savings by all parties.

The linear transfer of resources and responsibility throughout the economy often discourages responsible product design, because manufacturers bear no responsibility for their products at end of life. In the current system, original equipment manufacturers (OEMs) have little incentive to design for ease of reuse, remanufacturing, or recycling, as any end-of-life value such design creates is rarely recaptured by the original producer.

* The term “customer” may be used to refer to individuals, businesses, and government/institutions. The case studies in this section apply primarily to business and government/institutional customers; however, the principles discussed may apply to individual consumers as well.

Changing this producer-customer relationship through innovative methods of meeting customer demand can reverse the economic incentives that result in high levels of resource consumption. Such methods recognize that customers often desire the functions that products provide rather than product ownership itself. The Tellus Institute has described the selling of functions or product-based services as “servicizing.”³ In addition, these methods recognize, and capitalize on, the economic value retained by products at the end of their “useful” lives. When the value of resources circulating in the economy is more fully utilized, fewer raw materials may be needed to fuel economic prosperity and meet the demand of customers.

The concepts of selling functions rather than products and recovering used equipment are not new. Both product leasing programs and secondhand materials recovery systems have been developed to capitalize on them. However, combining and refining these concepts may allow both manufacturers and their customers to benefit from resource savings. If manufacturers retain ownership of products at end of life, they may close the loop in materials use by recovering their equipment and capturing residual value through design for reuse, remanufacturing, and recycling, thereby reducing both the resources necessary for new production and the amount of material sent to landfills and incinerators. Customers may be given the choice to lease or purchase the function of products where appropriate, sending used equipment back to manufacturers rather than to disposal facilities at end of life. In such a scenario, the needs of customers and manufacturers may be aligned, with both benefiting from products designed for durability and reuse, and value determined by the function or utility provided by the product.

Under the current system, if an appliance manufacturer designs a refrigerator to be more durable, customers will need to purchase fewer refrigerators and secondhand equipment dealers – rather than the manufacturer – will benefit from the reuse value of refrigerators that customers do replace. In other words, the manufacturer generally will not benefit from increasing the durability of the refrigerator and, therefore, has little incentive to redesign the product. If, however, the customer paid the manufacturer for the function of the refrigerator for a specified period, the manufacturer would earn higher revenues from a more durable product, which could be used for a longer time. The manufacturer would also be able to recapture any residual value at the product’s end of life.

Unless manufacturers remain connected to their products through the end of life, the linear resource stream typical of our current economy will not be replaced by a closed materials loop.⁴

2. Leasing, Materials Recovery, and Design for the Environment

Closing the materials loop requires that manufacturers:

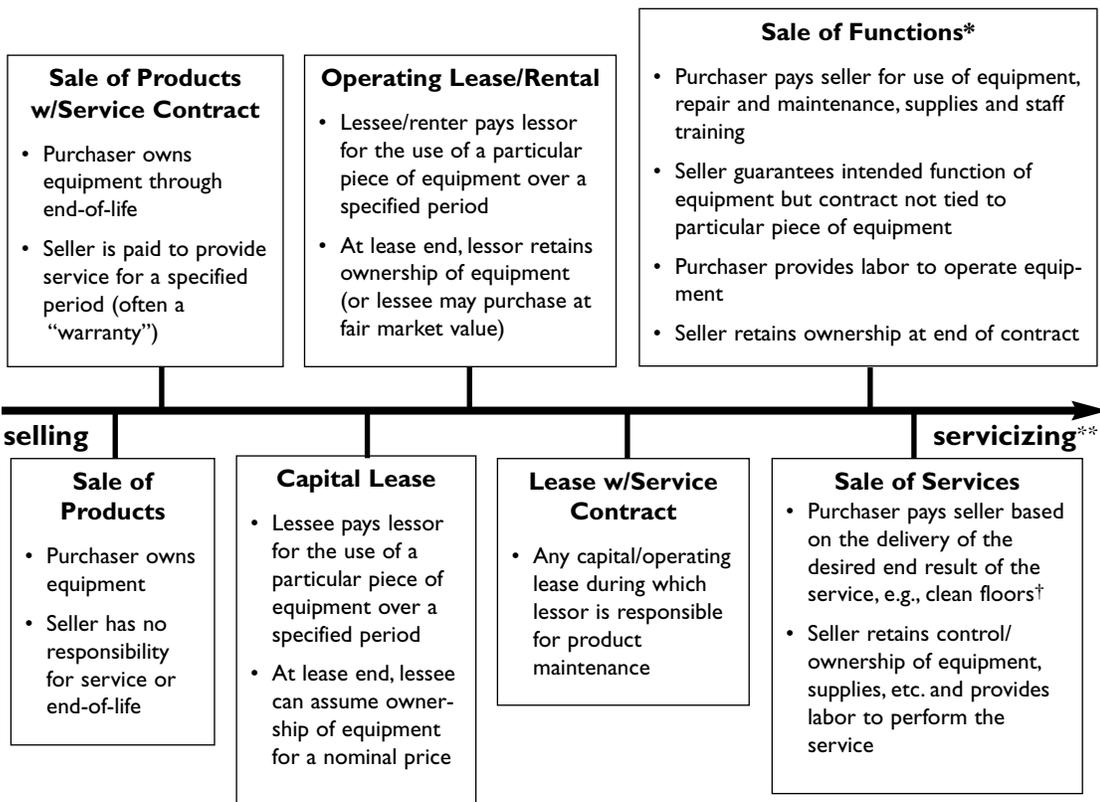
1. Have a method of receiving products and equipment when the customer no longer wants them.
2. Have processes for recovering materials from the returned products and equipment.
3. Design products or equipment that make use of these recovered materials.

There are a variety of ways in which such systems can be created.

The Product-Service Continuum: Leasing and Servicizing

Manufacturers offer a variety of methods for meeting consumer demand. These range from traditional product sales in which customers acquire equipment from the manufacturer in a one-time purchase to the selling of services in which customers purchase the specific results they desire (e.g., the cooling function of a refrigerator, the clothes cleaning of a washing machine) from a service provider, with a variety of intermediate possibilities. Figure 2.1 illustrates the business transactions on the product-service continuum: product sales, sales with service contracts, capital leases, operating leases, leases with service contracts, function purchases, and service purchases. (The various types of leases are explained in more detail in the next section.) Manufacturers or finance companies may offer programs that fall between these categories; the continuum is intended to describe general business practices and trends. Transactions focused on the sale of physical products are located near the left end of the continuum, while those involving more service-based exchanges are grouped at the right.

Figure 2.1 Business Transactions in the Product-Service Continuum



* This means that the *function* of the machine is being sold, not the machine itself.

** Servicizing is described by the Tellus Institute as the "extended and/or deepened" involvement of the manufacturer or service provider in "phases of the product lifecycle." (See Allen White, Mark Stoughton, and Linda Feng, *Servicizing: The Quiet Transition to Extended Producer Responsibility*, Tellus Institute, 1999.)

† Purchase of services may also be called "outsourcing." However, outsourcing is not restricted to the purchase of an end result, and can refer to *any* activity contracted to an outside party. Outsourcing can therefore fall at several places on the continuum. For example, under a lease with a service contract, the activity of cleaning floors would be performed in-house, but the repair of the floor-cleaning machine would be outsourced to the lessor. Purchase of services refers strictly to the purchase of an end result.

The concept of leasing has been common in business transactions for many years. People have long recognized that the ability to use an asset is often more important than owning it and have executed leases in many forms. By leasing equipment to customers rather than selling products outright, lessors are able to retain ownership of products than can pay for themselves over time, often reducing the total amount of resources needed to produce profits. Customers, in turn, often obtain financial and other benefits from leasing rather than purchasing equipment.

Additionally, customers may find it economically desirable to pay for a function or service, rather than purchasing or leasing a product. For example, a small business might hire a cleaning service rather than buying a vacuum cleaner and other cleaning equipment and assigning a staff member to use it. In such a case, the customer's desire for a vacuum cleaner is not for the product itself, but for its function – cleaning. In some cases, however, consumers derive value from ownership. For example, they may prefer to buy a home because of the status and stability that home ownership provides, as well as the potential increase in economic value over time, rather than obtaining the basic function of housing through leasing (rental).

In May 1999, the Tellus Institute (a not-for-profit research and consulting organization that promotes equitable and sustainable resource management) published a report entitled *Servicizing: The Quiet Transition to Extended Producer Responsibility*. It describes the growing importance of “product-based services,” with manufacturers becoming more involved with their products throughout the life cycle and shifting toward providing a product function or service, as opposed to a “product in a box.” The Tellus Institute reports that many manufacturers “have begun a process that shifts their focus away from product manufacture toward service delivery” – a shift in which leasing can play a significant though not a singular role.⁵ According to the report, servicizing involves measuring value by the function a product provides, with “the product increasingly becom[ing] a means of delivering this function rather than an end in itself.”⁶ On the product-service continuum, servicizing is depicted as the movement away from outright sales of a product in a box and toward the selling of functions and services that the product provides.

Equipment Leasing

Leasing is a widely used business strategy in the United States, with 80 percent of all US companies leasing some or all of their equipment and an estimated \$226 billion worth of equipment leased in the US in 1999.⁷

There are two basic kinds of leases. Under an *operating lease*, or “true lease,” the lessor retains ownership of the equipment throughout the lease term and the lease contract certifies that the equipment will retain substantial residual value at the end of the lease. A *capital lease*, on the other hand, acts more like a financing tool by transferring equipment ownership to the lessee at the end of the lease term. In this section, the term “lease” will refer to an operating lease unless otherwise specified. Table 2.1 lists the details of operating and capital leases.

Table 2.1 Definitions of Operating and Capital Leases

Operating Lease	<p>A lease that is treated as a true lease (as opposed to a loan) for accounting purposes. As defined by the Financial Accounting Standards Board in its Statement of Financial Accounting Standards 13 (SFAS 13), an operating lease must have <i>all of</i> the following characteristics:</p> <ol style="list-style-type: none"> 1. Title: Ownership is retained by the lessor during and after the lease term. 2. Term: Lease term is less than 75 percent of estimated economic life of equipment. 3. Value of Payments: Present value of payments is less than 90 percent of equipment's fair market value (FMV). 4. Purchase Options: Lease cannot contain a bargain purchase option (i.e., less than FMV).
Capital Lease	<p>A lease that must be treated as a loan for accounting purposes because it meets <i>at least one of</i> the criteria outlined in paragraph 7 of SFAS 13. The four criteria are:</p> <ol style="list-style-type: none"> 1. Title: Title passes to lessee automatically by the end of the lease term. 2. Term: Lease term is greater than 75 percent of estimated economic life of equipment. 3. Value of Payments: Present value of payments is greater than 90 percent of equipment's FMV. 4. Purchase Options: Lease contains a bargain purchase option (i.e., less than FMV).

Source: "Leasing Terminology," www.steamgenie.com/leasing.html, 6/16/99.

A manufacturer may lease equipment through one of its own divisions (a "captive" finance company) that leases only the products of the parent company, or through a third party (an "independent" leasing company) that may handle the equipment leasing of various manufacturers. According to the Equipment Leasing Association (an industry association), most leasing is currently conducted through third-party leasing companies.⁸

Customers can benefit from operating leases in a variety of ways. Financially, they obtain 100 percent financing. For accounting purposes, they can consider an operating lease an operating expense, rather than a long-term debt or liability. For tax purposes, they can treat an operating lease as overhead, rather than a purchase, and can write it off immediately. Additionally, they obtain the flexibility of adding to or upgrading their equipment, the ability to customize the loan structure to meet their cash flow and other needs, and the ability to upgrade technology rapidly and return outdated or unneeded equipment to the lessor.⁹

The equipment lessor may benefit from operating leases through direct financial gain and customer loyalty. The lessor can profit directly from the ability to re-lease or resell the equipment after a completed lease, thus receiving revenue over the product's life greater than the revenue from a one-time sale. For instance, if a machine has a useful life of 15 years but the original lessee requires only a five-year lease, the lessor can lease the machine to other customers for an additional ten years, usually earning a profit greater than that from a single sale. In cases where the manufacturer retains ownership of the equipment throughout the lease, any residual value that can be recaptured

at end of life also adds to the profit margin of the manufacturer. In addition, leases foster a close manufacturer-customer relationship that encourages repeat business, through both the signing of subsequent leases and the purchase of related consumables from the manufacturer.¹⁰ Although equipment lessors do assume risks associated with leasing, such as reduced residual value from technological obsolescence and dependence on the continued financial viability of the customer, manufacturers from diverse industries engage in equipment leasing and presumably find it profitable.

Servicizing

The Tellus Institute describes servicizing as the “extended and/or deepened” involvement of manufacturers or service providers throughout the product life cycle, leading to the selling of functions and services rather than products.¹¹ On the product-service continuum in Figure 2.1 (page 17), transactions to the right of operating leases may be considered servicizing arrangements, with the most significant differences between them being the extent of the service provided and who actually uses the equipment. A key characteristic shared by these more service-oriented arrangements is that the equipment is retained by the lessor/manufacturer at the end of the lease or service term. Operating leases, function purchases, and service purchases reflect customer interest in the function of the equipment rather than in equipment ownership itself, and allow manufacturers to retain ownership at end of life. However, the customer’s role in using the equipment and the service provided differ depending on the type of agreement.

- An operating lease with a service contract guarantees the customer that the particular piece of equipment leased will be maintained in working condition throughout the term of the lease. Leases give lessees the responsibility for operating the equipment.
- Sales of functions guarantee the function that a certain type of equipment is intended to perform, with the seller reserving the right to replace the particular piece of equipment over the term of the agreement. Function sales give purchasers the responsibility for operating the equipment.
- Sales of services assure the customer that some kind of equipment provided by the seller of the service will produce the desired end result. The customer has no interaction with the equipment itself and the service seller provides the labor to produce the end result.

Despite their differences, leases, sales of functions, and sales of services all connect equipment manufacturers to their products throughout the life cycle more fully than outright sales or capital leases, in which ownership of equipment is automatically transferred to the customer. By providing a means for manufacturers to profit by selling the function of their products, rather than by maximizing the number of products sold, leasing and other service-oriented arrangements encourage the production and use of long-lasting equipment and products. They have the potential to “divorce economic growth from growth in...throughput and environmental degradation.”¹²

Recovering Materials, Recovering Value

Because leasing encourages the return of equipment to the lessor, it may facilitate the re-lease and resale of products, allowing equipment to be fully utilized until its end of life. However, leasing alone cannot lead to the substantial reduction in resource use that sustainability demands unless it is coupled with materials recovery, the second characteristic of systems that close the materials loop.

When an end user can no longer utilize a product (e.g., at the end of the lease or at the end of the product's useful life), several options exist for end-of-life processing.¹³

1. **Reuse:** Equipment is utilized by another user in "as is" condition.
2. **Remanufacturing:** Equipment is disassembled and restored to "as new" condition with replacement parts and cleaning.
3. **Recycling:** Materials from old equipment are reprocessed and used as feedstock in the production of new equipment.
4. **Downcycling:** Materials from old equipment are reprocessed and used as feedstock in the production of new products of lesser value.
5. **Conversion of Waste to Energy:** Materials are burned to recover energy.
6. **Landfilling:** Materials are buried in the ground under earth cover.
7. **Dumping:** Materials are discarded directly to the environment through littering or dumping.

The US Environmental Protection Agency (EPA) has established a hierarchy that recommends, first, reducing waste at the source (including reuse); second, recycling and composting; and last, disposal in combustion facilities and landfills.¹⁴

The materials value of products is recovered through reuse, remanufacturing, recycling, and downcycling. These processes not only avoid the need for space in municipal and private landfills but also reduce the need to exploit depletable natural resources, thereby reducing the environmental impacts of extraction, materials processing, and production, as well as conserving natural resources. (It is important to note that recycling does not always produce net environmental benefits, particularly when the recycling process is energy-intensive and/or when the materials used to make a product are in abundant supply.)

Reuse

Reuse is defined as "redistributing materials from one who no longer needs them to those who can still find use in the item(s)."¹⁵ Reuse is considered environmentally beneficial because it both reduces the amount of natural resources used in new equipment production and diverts materials from the solid waste stream. In contrast to remanufacturing and recycling, equipment reuse captures 100 percent of a product's materials plus the value added during manufacturing, and it requires no end-of-life processing other than the transport of the used equipment to a new user.

The Reuse Development Organization (a not-for-profit group promoting materials reuse) has estimated that between 2 and 5 percent of the municipal solid waste stream would be reusable "if the items [were] collected in a manner which encourages reuse and if there [were] an infrastructure in place to manage the items."¹⁶ Products suitable for reuse are generally durable and involve mature technologies, since reusing products that make use of rapidly changing technologies may be economical only for not-for-profit organizations that cannot afford to buy new equipment. Nevertheless, if equipment collection were to facilitate reuse and if manufacturers were to develop

an infrastructure to manage reusable goods, some 11 million tons of reusable materials could be recovered from the solid waste stream annually.*

Remanufacturing

According to the Remanufacturing Institute, a product is remanufactured if:¹⁷

- Its primary components come from a used product.
- The used product is dismantled to determine the condition of its components.
- The used product's components are thoroughly cleaned and free of rust and corrosion.
- All missing, defective, broken, and worn parts are either restored to functionally good condition or replaced with new, remanufactured, or functionally good used parts.
- The product is put in sound working condition.
- The product is reassembled and will operate like a similar new product.

There are some 73,000 remanufacturing firms in the United States, employing 480,000 workers and generating annual sales of \$53 billion. The industry includes remanufacturers of motor vehicle parts, office furniture, electric and electronic equipment, and vending and gaming machines, among other major manufactured goods.¹⁸

Remanufacturing makes a much greater economic contribution per unit of product than recycling, according to Robert T. Lund of Boston University (a leading expert on remanufacturing), because it recaptures the value added to raw materials by the manufacturer – specifically, the costs of labor, energy, and manufacturing operations, which are typically greater than the value of the raw material constituents of the product.¹⁹ Because remanufacturing preserves entire equipment components instead of returning them to raw materials (as recycling does), it allows processors to preserve the original value added by the manufacturer. For example, a 1981 study conducted by the Massachusetts Institute of Technology found that remanufactured automobile components retain approximately 85 percent of the energy used in their original manufacture, saving remanufacturers the value-added cost of producing new components.²⁰

Thus, if manufacturers can reclaim equipment from end users at the end of lease or end of life, they may recapture the value added in the original manufacture of the equipment, thereby capturing profits currently enjoyed by independent remanufacturing firms and saving resources in the production of new equipment. It is important to note, however, that remanufacturing may be inappropriate for some product types and may also involve substantial disassembly and reverse logistics costs.

* Based on the US Environmental Protection Agency's figure of 220 million tons of municipal solid waste in the US in 1998, and the Reuse Development Organization's estimate that up to 5 percent of the municipal solid waste stream is reusable.

Recycling

The National Recycling Coalition defines recycling as a “series of activities by which discarded materials are collected, sorted, processed, converted to raw materials, and used in the production of new products. Recycling does not include the use of these materials as a fuel substitute or for energy production.”²¹

Closing the Materials Loop: Design for End of Life

Leasing, which allows manufacturers to retain ownership of their equipment at end of life, combined with recovery of valuable materials through reuse, remanufacturing, and recycling, can encourage manufacturers to reduce their use of virgin materials and can reduce post-consumer waste. However, the value obtainable from materials recovery programs is limited unless products are specifically designed with end-of-life processing in mind. Design for end of life is the strategy that can close the materials loop.

Design for end of life maximizes the residual value of equipment returned to manufacturers by ensuring that components and materials can be recovered and used in the production of new equipment, creating a closed-loop system of materials use. It reduces the impact of industrial systems on the natural environment, specifically those resulting from the extraction of natural resources and materials processing.

Design for end of life is one aspect of design for environment, whose purpose is “to minimize or eliminate, during design, the anticipated waste generation and resource consumption in all subsequent life cycle phases,” including production, use, and disposal, according to the Pacific Northwest National Laboratory (an environmental science and technology lab working on national security, energy, and human health issues).²² Key considerations in this design process include materials selection and extraction, production, transport, distribution, packaging, energy use, and end-of-life treatment.

Designing for end of life means products are designed from their inception to be reused, remanufactured, or recycled, thereby creating a closed-loop system of materials use. It may include:

- Increasing ease of disassembly.
- Using parts and materials common to several products (i.e., commonality).
- Reducing the number of parts and materials used.
- Reducing the amount of toxic materials used.
- Increasing the use of recyclable materials.
- Increasing the durability of products, parts, and materials.
- Labeling materials (e.g., plastic resins) for ease of identification.

By incorporating end-of-life considerations into the product design phase, manufacturers can both reduce the environmental impacts of product disposal and increase the value of products taken back at end of life.

Design for end of life involves everything from materials selection all the way through product take-back and processing; hence, implementation necessitates extensive communication between the purchasing, logistics, process engineering, product design, and other key divisions of a manufacturer. Furthermore, designing for end of life may involve an overhaul of traditional production processes and logistics.

3. Case Studies

INFORM interviewed many people in the course of investigating whether leasing has the effect of closing the materials loop and chose four companies to describe in depth. Each of these four companies is multinational, with global markets. Each is involved with the leasing and/or sale of functions or services. Each has stated that its goals include a commitment to reducing the end-of-life impact of its products. Furthermore, the companies selected enabled us to look at how the impact of leasing may vary with product type and how other factors may influence what happens to products at end of life.

- **Xerox** was selected because it is reputed to be a model in the use of leasing as a springboard for designing for end of life.
- **Pitney Bowes** was selected as a contrast to Xerox. It, too, manufactures copiers and has stated its commitment to recovering value from returned products, but it has not yet addressed designing for end of life as comprehensively as Xerox has.
- **Interface** was selected because it has been a pioneer in popularizing the ideas of leasing and selling functions instead of products, and because it manufactures carpets, which create very different challenges to leasing programs and product take-back than does office equipment.
- **Electrolux** was selected because it is exploring the idea of selling services or functions rather than products, and because its business involves a variety of cleaning, refrigeration, and other equipment.

For each company, we examined product take-back, materials recovery, product design, and incentives and obstacles to closing the materials loop, and evaluated the impact of leasing (or of selling a function or service) on the company's accomplishments. The amount and type of information in each case study vary depending on what information the companies were willing or able to provide to INFORM.

The Xerox Corporation²³

“Everything that Xerox delivers to its customers is designed to be returned – whether it’s a machine, a cartridge, a spare, or packaging. All of these items, once returned, are processed for reuse or recycling. The only thing we want to leave with our customers is – THE DOCUMENT.”²⁴

Founded in 1906 as the Haloid Company, the Xerox Corporation states that its goal is to be the “leader in the global document market” with its document-processing products, systems, and services.

Xerox manufactures copiers, printers, fax machines, scanners, desktop software, digital printing and publishing systems, and copier supplies, and provides comprehensive document-management services. A Fortune 500 company, it earned revenues of \$19.2 billion in 1999, with the United States accounting for \$10.4 billion, or slightly over half.²⁵ Xerox states that its core values include product quality and responsible behavior as a corporate citizen, as well as customer satisfaction and shareholder return.²⁶ According to the company, its Environmental Leadership Program is committed to “producing Waste-Free products in Waste-Free factories” and to “protecting the environment and health and safety of [Xerox] employees...over economic considerations.”²⁷

Equipment Leasing

The Xerox equipment manufacturing division produces approximately three-quarters of the corporation's total revenues, with the remainder coming largely from the sale of consumables, such as copier and printer paper and toner. Of revenues produced from Xerox equipment manufacturing, equipment leasing currently accounts for approximately 75 percent while outright equipment purchases account for the remaining 25 percent of revenues.²⁸ Based on these figures, revenues from equipment leasing account for approximately 50 percent of total Xerox revenues.

Leases are conducted through a division of Xerox called the Xerox Business Center. After writing the leases, the business center collects them into a portfolio that is sold once a year to the Xerox Credit Corporation, another division of Xerox. Leases are priced to assume full recovery of production costs plus a reasonable profit margin; that is, prices assume that equipment will have zero value if and when returned to the company and that all profits are the difference between lease payments and costs. Therefore, any residual value that can be recovered from returned equipment increases the total profit earned by Xerox.

All Xerox leases include full-service maintenance, with lease commitments typically ranging from 36 to 60 months. Document processing supplies, such as paper and toner, may be either purchased separately or included in the lease agreement at the customer's request. While standard leases generally consist of fixed monthly payments, Xerox also offers contracts involving equipment meters for per-use charges.

Xerox offers three major types of leases to its customers:

- The **Term Lease** is a capital lease that gives the lessee the option to buy the equipment, at the end of the lease, at a bargain price (i.e., less than fair market value and often as low as \$1.00), trade it in for other Xerox equipment, or extend the lease commitment. The term lease acts as a financing tool when customers acquire the equipment at the end of the lease.
- The **Fair Market Value Lease** is an operating lease that gives the lessee the option to purchase the equipment, at the end of the lease, at its fair market value, trade it in for other Xerox equipment, or extend the lease commitment. Most equipment leased under fair market value leases is returned to Xerox at the end of the lease term.
- The **Rental**, which is cancelable at any time, functions as an operating lease, with the equipment returned to Xerox when the lessee ends its commitment.

Xerox also offers customers a variety of document-management services, with document processing outsourced to Xerox employees both on and off the customer's premises. Document management, or outsourcing, is handled almost identically to leasing, although the fees paid to Xerox by document services customers generally include the staff support and supplies necessary to perform the requested services, as well as equipment usage and maintenance. However, the accounting for both leased and outsourced equipment is conducted in the same manner, and return channels for the equipment are shared.

Product Take-Back

Xerox began its equipment remanufacturing program in 1991 when it recognized both the costs it was incurring in warehousing or disposing of used equipment returned from rentals and leases and the value of the equipment that was occupying its warehouses. The company determined to recover the residual value of the used machines. Currently, Xerox will take back any of its own products, either at the end of outsourcing contracts and leases or from equipment owners who wish to return or trade in equipment. While a significant portion of equipment returned to Xerox comes from outright sales, the large majority is recovered from lease customers and document-management services operations.

- **Document-Management Services:** Xerox operates copy centers where its employees perform document processing on Xerox equipment. Because copy center equipment remains in the possession of Xerox throughout the arrangement, all machinery used in document-management services is readily available for take-back and remanufacturing.
- **Leases:** Customers choosing to lease Xerox products through the term lease, fair market value lease, or rental programs may return equipment at the end of the lease term at no additional charge.
- **Purchases:** Customers who trade in purchased Xerox equipment for other Xerox products are offered trade-in allowances or credits toward new purchases. Those wishing to receive equipment take-back services without purchasing new products are charged an equipment transportation fee. Xerox may also offer to pay customers for allowing Xerox to take back equipment if it is experiencing a shortage of materials for use in remanufacturing.

Equipment returned to Xerox is taken to one of approximately 50 central logistics centers in the United States. Trucks convey inbound equipment to logistics centers on return trips from outbound equipment deliveries in order to maximize the efficiency of transport. From the logistics centers, machines are sent to a central hub in Cincinnati and are then distributed to Xerox remanufacturing facilities in New York and Mexico.

Materials Recovery

Xerox recovers products that were not originally designed for remanufacturing (because they were manufactured before the company began considering end-of-life impacts in product design in the early 1990s), as well as those designed for end of life. Hence, its Asset Recycle Management (ARM) program manages a wide range of returned products in its recycling and remanufacturing operations.²⁹

Service logs maintained for all products enable Xerox to estimate the value of various equipment components and the remaining life of the entire machine. Larger machines are equipped with non-volatile memory, which records the number of prints or copies made as well as how often certain features (e.g., reduction and enlargement) are used. Xerox employees on maintenance or service

calls use laptop computers to log in the details of each call by the serial number of the machine. When products are returned to Xerox, this information is used to guide the next stage of equipment management.

Recovered materials may be used in Xerox's three categories of products.³⁰

- **Newly manufactured** equipment is factory-produced and contains new, reprocessed, and recovered parts that meet product specifications. Typically, previously used materials make up 1 to 2 percent of these products. Xerox offers a three-year warranty on newly manufactured equipment.
- **Remanufactured** equipment is factory-produced by disassembling existing equipment and fully reassembling the product with new and reprocessed parts. The portion of reprocessed parts is typically under 50 percent and can be up to 80 percent of the total. Xerox offers a three-year warranty on remanufactured equipment.
- **Used** equipment is existing equipment that has been cleaned and refurbished. It does not go to the factory. Xerox offers a 90-day warranty on used equipment.

Take-back of valuable goods, such as high-end laser printers, is profitable for Xerox largely because their components retain substantial value at end of life. Such high-end products are not redesigned frequently, because the process requires large capital investments in new production; their components retain their reuse value because many older designs and components are still in use today. However, product recovery represents a cost to Xerox for low-end products, such as fax machines, from which little value can be recovered at end of life.

The labor costs of remanufacturing operations are approximately double the labor costs of new production for Xerox, as remanufacturing involves equipment cleaning, disassembly, rebuilding, testing, and more.³¹ However, remanufacturing reduces the amount and cost of materials used because fewer new parts are needed. Xerox reports that, in 1999, it saved an estimated \$200 million through product remanufacturing and diverted approximately 60 million pounds of waste from landfills.³²

Currently, 25 percent of Xerox production comes from remanufacturing.³³ Its newest market is selling used and refurbished machines to small businesses that often cannot afford newly manufactured machines through warehouse and Internet sales.³⁴ Company managers believe that Xerox customers demand performance rather than simply products, and have stated that the company prides itself on consistently delivering quality and reliability with remanufactured resources by subjecting remanufactured and previously owned machines to rigorous testing and by providing warranties and service on all its products.³⁵

Product Design

Communication. Xerox locates its "asset recovery engineers" with its product designers so they can work together in design teams on the development of new products. Asset recovery engineers aid designers in developing products that can be easily disassembled and remanufactured, weighing the initial cost of production with the total life cost of the equipment. Asset recovery engineers also compile a recoverable parts list for each newly designed machine, detailing how each component can be reused or disposed of at the product's end of life.

To establish the economic viability of a product designed for remanufacturing, design teams estimate the useful life of each of its components (e.g., at what point technological innovation will require an electronic component to be upgraded). As the remanufacturing operation depends on a steady stream of returned products for feedstock, design teams must inform remanufacturers about when new products can be expected to return. Although some Xerox machines have been circulating for 10 to 15 years, changing technology means shorter lifetimes for newer products, making the estimation of useful life a crucial part of product design and teamwork.

Design teams also include environmental health and safety experts who help designers reduce – or, if possible, avoid – the use of hazardous materials (e.g., batteries, toxic chemicals) in new equipment. Where hazardous substances are included in new designs, their location is specified in detailed design plans to permit easy removal and proper disposal at equipment end of life.

Design Programs. Prompted by the challenges of recovering value from the used equipment in its warehouses, Xerox developed its design for environment (DfE) program in 1991 to link new product design with end-of-life processing considerations and reduce potential environmental impacts, particularly those arising at product end of life. As a result, machines are now built with fewer parts, fewer materials, and simple fasteners (which allow them to be taken apart rapidly). Xerox applies an asset management hierarchy to product design: reuse, remanufacturing, recycling, and disposal. By incorporating materials recovery and other end-of-life considerations into product design, Xerox attempts to optimize the end-of-life value of recovered equipment before its machines are ever built.

Xerox has a variety of DfE projects under way.

- **Design for Remanufacturing:** In 1997, Xerox introduced the Document Centre 265 digital copier, comprising 250 replacement parts instead of the 2000 used in an earlier, comparable product.³⁶ Designed with the goal that none of the product family's component parts would end up in landfills, 80 percent of its parts are remanufacturable and 97 percent are recyclable.³⁷ Xerox has stated that 90 percent of the equipment the company designs is remanufacturable, as of 1999.³⁸
- **Design for Commonality:** Design for commonality allows components to be used in various types of equipment. For example, Xerox may design a motor that can be used in both copiers and printers in order to increase its reuse value.
- **Total Life Costing:** Xerox designers weigh the initial production cost of a machine against its total life cost. For example, designers might first consider the end-of-life value of thin, inexpensive aluminum to determine whether using a more expensive material up front might reduce costs and waste over the product life cycle. Recently, Xerox began using gold for electrical contact points, rather than lead, in order to produce parts that can last through several product lifetimes.
- **Copier/Printer Cartridges and Toner Containers:** In 1991, Xerox began accepting used copier and printer cartridges for reuse and recycling; it began accepting used toner containers in 1995. In 1998, more than 1.3 million pounds of cartridges from Xerox's retail division (North America) and more than 5.6 million pounds of cartridges from its office products division (US and Europe) were returned; the cartridge return rate in North America was greater than 60 percent.³⁹

In the same year, 1.94 million pounds of toner containers (more than 3 million bottles) were returned, as were 595,000 pounds of toner (of which 560,000 pounds were processed to manufacture new toner).⁴⁰ Because Xerox pays UPS shipping charges for all returned print cartridges and toner containers, the economic return from these projects varies; some products represent a cost to recover whereas others represent a savings. However, the program has resulted in substantial resource savings.

- **Recycled Plastic:** By the mid-1990s, Xerox was using 100 percent recycled plastic, sourced from within Xerox, in its production of copy and print cartridges.⁴¹ The next goal of this initiative, still in its pilot phase, is to incorporate recycled plastic panels into new and remanufactured machines.
- **Reduced Plastic Resins:** Xerox has reduced the number of plastic resins used in its products from more than 500, which proved prohibitive to plastic recycling, to approximately 50, which requires engineers to design equipment from a limited list of allowable resins. Fewer than 10 of the allowable resins satisfy 80 percent of applications in Xerox machines, allowing Xerox to more easily recycle its plastic components.⁴²
- **Labeled Plastics:** Plastic resins are often difficult to identify in equipment parts, creating a barrier to the recycling of plastic components. Xerox now labels all plastics in its equipment so that the types contained in recovered components can be easily identified. In addition, because paper labels and their adhesives traditionally must be separated from the recycling stream in a difficult (and potentially wasteful) process, Xerox has begun molding labels into the plastic casing itself, using the same type of plastic in both the casing and the label to facilitate reprocessing.
- **Innovative Fasteners:** Metal fasteners such as screws and bolts complicate plastics reprocessing because of high disassembly costs. “Snap-fit” fasteners devised by Xerox allow fewer screws and bolts to be used in equipment and facilitate both assembly and disassembly.
- **Equipment Cleaning and Decontamination:** Xerox has avoided problems with ink contamination in copier remanufacturing by using a powder-based ink for toner that can easily be removed from recovered machines with soap and water. Even persistent paper dust, which presents the greatest cleaning challenge in copiers, can be removed in a process that blasts parts with compressed air and carbon dioxide.

Xerox is also involved in several pilot programs.

- **Plastics Recycling:** Xerox engineers are currently developing a plastic grinding process that will enable ground plastic to be used in newly produced equipment, thereby allowing the company to recover additional value from the plastic components of returned equipment.
- **Efficient Use of Scrap Material:** Occasionally, Xerox’s remanufacturing facilities need specific components from returned machines, rather than the entire machine. In these cases, the central hub in Cincinnati may strip out the needed components and sell the stripped “hulks” to scrap-salvage dealers. To maximize the resource efficiency of this process, Xerox is researching scrap dealers that can grind each hulk to a “flake” from which valuable elements such as aluminum may be recovered and reused.

Incentives and Obstacles

Incentives. Staff at Xerox's remanufacturing division point to a variety of factors that have contributed to the development of the company's leasing and asset recovery program.⁴³

- **Service Variety:** Xerox offers customers a range of product and service options, including outright purchases, leases, and document-management services, allowing the company to focus on maximizing profit by delivering a function to its customers rather than by maximizing the number of machines sold.
- **Repeat Business:** Both leasing and document-management services foster relationships between Xerox and its customers, with the ability to return old equipment encouraging repeat equipment and service contracts (as well as sales of related consumables). (To a lesser extent, purchases also foster relationships through the encouragement of trade-ins and upgrades.)
- **Return Channels:** As Xerox has leased equipment throughout its history, it has efficient and cost-effective return channels for consistently recovering machines for remanufacturing feedstock. Because of this reliable and predictable flow of feedstock, Xerox is able to plan how much remanufacturing it can do to meet consumer demand, rather than producing more newly manufactured equipment than necessary to protect against an uneven flow of feedstock.
- **Residual Value:** By recognizing that its products retain material value at the end of their useful life, Xerox increases its profits by repeatedly using its assets – previously manufactured equipment – rather than selling them for one-time gain or incurring the costs of warehousing or disposal.
- **Product Quality:** Xerox protects its customers from the typical risks of acquiring used equipment by testing used components and providing performance guarantees.
- **Communication and Innovation:** By assembling asset recovery engineers, designers, and environmental experts in design teams, Xerox fosters a spirit of collaboration and communication that allows product end of life to be factored into designs and effectively closes the materials loop.

Obstacles. Although Xerox has derived benefits from the asset recovery program, it also recognizes several obstacles.⁴⁴

- **Government Procurement:** Procurement guidelines and purchasing agents in local, state, and federal government often require the purchase of “new” products rather than remanufactured goods. For example, 26 states have procurement guidelines restricting the purchase of office equipment with reprocessed parts. When bidding for their contracts, Xerox can offer “newly manufactured” equipment but not “remanufactured” equipment (see definition on page 21). Two states, Delaware and Tennessee, have even more restrictive procurement guidelines, requiring products to contain all new components. In these states, Xerox cannot even offer its “newly manufactured” equipment, which typically has only 1 to 2 percent reprocessed parts. Although Xerox provides three-year warranties and service plans with both its newly manufactured and remanufactured goods to ensure performance, such procurement guidelines restrict Xerox's ability to bid on state contracts in these states, creating a significant barrier to competing equally in the large government procurement market.⁴⁵
- **Customer Demand:** Although leasing with asset recovery is profitable for Xerox, the company cannot offer product leases exclusively, because customers continue to demand the option of purchasing equipment outright. In addition, many large customers prefer the flexibility of equipment rental, which is cancelable at any time, thus posing both financial and logistical risks to Xerox.

- **Technological Innovation:** The cost-effectiveness of remanufacturing may decrease over time as technological innovation makes producing equipment from raw materials increasingly inexpensive.

Does Leasing Matter?

Equipment leasing served as the impetus for Xerox to launch its asset recovery program, since the company recognized that the equipment its customers returned had considerable residual value, which could represent substantial cost and resource savings both through reduced warehousing or disposal costs and through the reuse of valuable components. The Xerox leasing program laid a strong foundation for the development of asset recovery, as it provided both an infrastructure for equipment take-back and a steady and predictable flow of used machines. Xerox was able to invest in redesign and reuse, remanufacturing, and recycling, knowing that the feedstock for the processes could be obtained efficiently and continuously. In essence, equipment recovery through the Xerox leasing program sparked the design changes that have made materials recovery both profitable for the company and beneficial for the environment.

However, the continued success of the Xerox program cannot be attributed to equipment leasing alone. Although Xerox expects to recover equipment from operating leases like the fair market value lease and the rental, it has also been successful at recovering equipment from term leases and outright purchases by offering customers attractive trade-in allowances. With its document-management services, Xerox retains ownership and possession of equipment through the end of life. Therefore, Xerox is currently achieving the steady and predictable flow of used equipment so vital to the success of its asset recovery program not only through leasing, but also through equipment purchasing and document services.

Xerox's organizational characteristics have also played a crucial role in its success. By fostering communication among all divisions, Xerox has allowed designers, who create products, to work with asset recovery engineers, who disassemble and remanufacture products, in an effort to consider all aspects of the life of a machine before building it. This intraorganizational communication and teamwork has resulted in innovative designs that effectively "close the loop" through materials reuse, remanufacturing, and recycling. In addition, by rigorously testing all equipment and parts and providing extensive warranties and service contracts, Xerox works to assure customers that the remanufactured equipment will perform as new products do.

Although Xerox continues to encounter obstacles to its program, its efforts to close the loop have been overwhelmingly successful. By capitalizing on the residual value of recovered materials and continually improving its designs to reduce waste, Xerox has created a model for closing the materials loop that has resulted in both increased profit and reduced waste. Spurred by a history of equipment leasing, the Xerox model combines efficient materials recovery with a commitment to product quality, environmental protection, communication, and innovation.

Pitney Bowes, Inc.⁴⁶

“...the greatest recovery of material and energy values is realized through reuse of a repaired product, followed by remanufacturing, disassembly for reuse of durable components, and recycling for material value...”⁴⁷

Pitney Bowes, Inc., was founded more than 75 years ago as a manufacturer of mail meter equipment and is now a leader in mailing systems, fax and copier equipment, business outsourcing, and document management. Pitney Bowes operates in the United States, Europe, Africa, the Middle East, Asia, Canada, Mexico, Latin America, and the Caribbean, with its research, development, and engineering activities consolidated in Shelton, Connecticut. In 1998, its revenues were approximately \$4.2 billion, with revenue growth in 1998 partially attributed to volume increases in the copier and facsimile systems division of the company.⁴⁸

This section focuses on Pitney Bowes copy machines, rather than on mailing systems or other equipment, in order to make it easier to compare the efforts of this company with those of Xerox. Nonetheless, some references will be made to other activities of the company. Pitney Bowes did not provide specific information on the percentage of its revenue coming from copier sales and leasing, or from its management services division, which provides on- and off-site copying services for businesses, among other activities. However, in 1998, its entire office solutions group (which includes sales and leasing of fax machines, as well as copiers, and business support activities such as outsourcing and document management) generated \$1.2 billion in revenues, or about 28 percent of total Pitney Bowes revenues.⁴⁹

Equipment Leasing

Pitney Bowes leases its copier machines through the Pitney Bowes Credit Corporation (PBCC), which serves as its captive leasing company. The Pitney Bowes sales force is responsible for selling leases to customers with the support of leasing managers from PBCC. Leasing is then handled as a third-party transaction, whereby PBCC purchases the equipment from Pitney Bowes and then leases it to customers.

Pitney Bowes encourages the leasing (as opposed to the purchase) of copy machines, because leasing offers the company an opportunity to develop long-term relationships with its customers. For example, the company believes that customers who lease Pitney Bowes copiers are likely to purchase complementary supplies and services from the company, as well as to continue using Pitney Bowes equipment beyond the initial lease term. In addition, equipment leasing provides Pitney Bowes Credit Corporation with tax advantages unavailable from product sales, such as the ability to depreciate equipment over the term of the lease.

Customers may acquire Pitney Bowes copiers through either an operating lease or a capital lease with a \$1 buyout option. PBCC encourages the operating lease, which provides that PBCC retains ownership of the copier at the end of the lease term, at which point it has a residual value of 20

percent. PBCC rarely encourages the capital, or dollar-out, lease, under which the customer may purchase the copier at the end of lease term for one dollar.

Copiers are generally leased for a three-year term, after which the lease may be extended on a month-to-month basis. In addition, PBCC offers a “cost-per-click” program that allows customers to pay on a per-use basis rather than by a monthly fee. The standard lease format does not include services or supplies, but customers may bundle services with the lease for a higher monthly payment. For example, the majority of lease customers purchase (in addition to the lease) an equipment maintenance agreement that covers service calls and repairs on Pitney Bowes copiers.

Pitney Bowes offers document outsourcing services on the client’s premises through its Pitney Bowes Management Services (PBMS) division. PBMS provides the equipment, supplies, and staff directly to the client office space. The company has also developed Pitney Bowes business centers in various locations to accommodate overflow work that cannot be performed at the client site. Customers pay PBMS for the services provided, such as document creation, storage, printing, and consulting.

Product Take-Back

At the end of a lease term, a customer with an operating lease for a Pitney Bowes copier may:

- Return the leased copier to PBCC.
- Continue to lease the copier on a month-to-month lease extension.
- Sign another full-term lease for the same copier, at a cost lower than that of leasing a new machine.

As product take-back represents a reverse logistics expense to Pitney Bowes, PBCC often extends existing leases or re-leases old copiers to the same customer under a new lease rather than reclaiming copiers at the end of the lease term. When customers do choose to return copiers to the lessor, Pitney Bowes outsources the take-back logistics to an independent company.

Most copiers returned to PBCC are coming off lease. However, the company also recovers equipment that was originally purchased, in cases where customers replace old equipment with new Pitney Bowes machines. PBCC has a contract with Pitney Bowes to send reclaimed copiers to the Pitney Bowes manufacturing division for end-of-life processing. The manufacturing division evaluates each recovered machine to determine its salvage value and sends the salvageable parts to a Pitney Bowes remanufacturing facility. The remainder of the equipment is sent to an independent recycling facility for processing.

Pitney Bowes did not provide information on how many copiers are returned annually, or on what percentage of total copier leasing and sales this represents.

Materials Recovery

Pitney Bowes' manufacturing division sends salvageable parts from reclaimed copiers to a remanufacturing facility for end-of-life processing. Based on the salvage value of the machine, each copier produced by the remanufacturing facility is categorized as one of the following:

- **Reconditioned:** Copier retains useful life; machine is serviced, cleaned, and reused "as is."
- **Newly Remanufactured:** Copier is remanufactured using new parts to replace worn ones.
- **Remanufactured:** Copier is remanufactured using refurbished parts to replace worn ones.

These three types of copiers, along with new copiers produced by Pitney Bowes' manufacturing division, are made available to customers for sale or lease. Pitney Bowes provides cost-per-click customers with maintenance and supplies (except paper) at guaranteed costs throughout the contract term through a guaranteed fixed costs agreement. Other customers may purchase a maintenance and supplies coverage agreement that guarantees total service coverage and necessary supplies at an additional cost. Unsalvageable parts from reclaimed copiers are sent to an independent recycler for processing.

Pitney Bowes did not provide INFORM with specific data on copy machines. However, in 1998, it remanufactured 28,155 office machines (a category that also includes fax machines). In that same year, the company remanufactured more than 242,000 mailing systems. For both office machines and mailing systems, Pitney Bowes reused a total of nearly 1.3 million parts and realized a net savings of \$8.2 million from reusing those parts.⁵⁰

Product Design

Pitney Bowes launched its Design for Environmental Quality (DFEQ) program in 1991 "with the goal of minimizing the environmental impact of Pitney Bowes' products throughout their life-cycles," noting that incorporating environmental considerations into the design stage was "central" to its overall DFEQ strategy.⁵¹ The company developed an environmental scorecard to assess the potential environmental impacts of new products at the design stage, and charged an executive-level product launch committee with including environmental considerations in product development decisions.⁵² However, the fact that design and remanufacturing facilities are located in two different states has created an impediment to regular collaboration between the divisions on new product design.⁵³

Pitney Bowes identified several design changes that have been implemented with end-of-life considerations in mind, although it did not identify any specific redesigned products. Design changes include the following:⁵⁴

- Reduction of plated parts in new products
- Reduction of heavy metals used in plating
- Replacement of certain plating processes with the use of painted parts, using low-solvent, water-based paints or powder coatings whenever possible

- Use of more easily recycled plastics
- Labeling plastics by resin type to facilitate recycling
- Design changes that facilitate disassembly and recycling.

Incentives and Obstacles

Incentives. The main incentive for Pitney Bowes to take back, reuse, remanufacture, or recycle products is economic: its recovered products have significant value and therefore can generate additional profits for the company.

Obstacles. Although Pitney Bowes is successfully leasing its products and has established a copier remanufacturing program, its staff identified several factors that may inhibit the company's ability to make a closer connection between product design and end-of-life management.⁵⁵

- **Difficulty of Collaboration Between Designers and Remanufacturers:** These two groups are located in different states, constraining day-to-day communication and collaboration.
- **Remanufacturing Design Challenges:** Several copier components have presented difficulties to research teams working on technologies to increase the salvage value of reclaimed copiers and improve the remanufacturing process. For example, the company states that a program to recycle plastics into remanufactured copiers has been frustrated by ink contamination of used copier parts.
- **Inadequate Corporate Commitment:** Although Pitney Bowes management has expressed a clear commitment to a hierarchy that places reuse and remanufacturing first and has established an executive-level committee to consider environmental impacts in new product decision-making, INFORM could not find evidence of the kind of strong connection between product design and end-of-life management that can effectively close materials loops.

Does Leasing Matter?

Reports from Pitney Bowes state that leasing promotes long-term, profitable relationships with its customers, who are likely to both purchase complementary supplies and services and lease new equipment from the company at the end of the lease term. Leasing also allows Pitney Bowes to take back products for feedstock in the remanufacturing program, which has reduced both costs and materials use. The company states that it recognizes both the economic and environmental value of recovering materials and energy from its used products.⁵⁶

At present, however, Pitney Bowes' remanufacturing division salvages material from reclaimed products rather than exerting substantial influence over how products are designed and built. Despite several design changes resulting from the DFEQ program, it appears that the lack of consistent communication between designers and end-of-life processors may impair the collaboration needed to fully close the loop in copier manufacturing through design for end of life. This disconnect may contribute to technological challenges in materials recycling that Pitney Bowes has not yet been able to overcome.

Interface, Inc.

“At Interface, we seek to become the first sustainable corporation in the world, and, following that, the first restorative company. It means creating the technologies of the future – kinder, gentler technologies that emulate nature’s systems. I believe that’s where we’ll find the right model.” – *Ray Anderson*⁵⁷

Founded in 1973 by current chairman of the board and CEO Ray Anderson, Interface, Inc., is headquartered in Atlanta, Georgia, and is the world’s largest commercial carpet manufacturer. Interface Flooring Systems, Inc., the company’s commercial floor coverings division, is the leading producer of soft-surfaced carpet tile. Manufacturing and selling more than 40 percent of the carpet tile used in commercial buildings today, Interface operates 33 manufacturing sites in the United States, Canada, the United Kingdom, the Netherlands, Northern Ireland, Australia, and Thailand. Its products, sold in more than 100 countries, include commercial carpet tile and broadloom carpet, other flooring products, and floor care products, as well as a network of service providers.⁵⁸ In 1999, Interface had net sales of \$1.228 billion, with floor covering products and related services accounting for \$974 million, or 79.3 percent.⁵⁹ Interface’s goals include redesigning its “processes and products into cyclical material flows where ‘waste equals food.’”⁶⁰

Equipment Leasing⁶¹

In speeches and reports, Interface CEO Ray Anderson popularized the idea of leasing or selling the function of a product as a mechanism to move toward sustainability. He reasoned that instead of purchasing carpet, customers should purchase the service of keeping an area carpeted. The idea was that, as old carpet wore out, Interface would replace and recycle it as part of the lease agreement. Over time, this system would lead to a decrease in the amount of materials needed to keep a space looking freshly carpeted. Anderson’s emphasis on closing materials loops, through this program and others at Interface, led to his appointment as co-chair of the President’s Council on Sustainable Development.

In 1995, Interface attempted to launch a unique leasing program for carpet tile, called the Evergreen lease. The original Evergreen lease was intended to be an operating lease under which Interface would retain ownership of the carpet at lease end. For a monthly fee charged to the lessee, Interface would guarantee the function and appearance of the floor covering by installing, maintaining, and, when necessary, replacing carpet tiles. The concept included the idea of a perpetual lease – for example, leasing carpet to a building’s owner rather than to the transitory tenants, theoretically for as long as the building remained in use.

As detailed in Table 2.1 (page 19), the Financial Accounting Standards Board requires, in its Statement of Financial Accounting Standards (SFAS) 13, that the term of an operating lease be less than 75 percent of the estimated economic life of the product, and that the present value of the lease payments be less than 90 percent of the fair market value of the product (which results in about a 15 percent residual value requirement at the end of the lease), among other specifications. The original Evergreen lease proved to be an unsuccessful initiative, mainly because financial institutions questioned whether the carpet tiles met these requirements and were unwilling to finance the leases.

Questions also arose as to how lessors and lessees would handle such a lease under the accounting rules, and how this would affect tax treatment. Operating leases are designed for products that go through several use cycles and can be re-leased several times. It is not economical to remove carpet from a floor and re-lease it to another customer, so an operating lease for carpet, under present accounting rules, is problematic.

Interface has remained dedicated to the concept of the Evergreen lease and has tried many different approaches. It offered a take-back/recycling provision on its standard capital leases offered through a financing partner. Under this arrangement, the lessee owned the carpet at the end of a five-year lease. If the carpet had additional years of useful life, it could remain on the floor with the understanding that Interface would take it back and recycle it when it reached the end of its life. This would prevent premature removal of the carpet. However, because the added costs of take-back and recycling were built into the price, this scheme did not appeal to customers.

In 2000, Interface developed a new version of the operating lease called the Evergreen Flooring Services contract. By utilizing new recycling technologies, the company intends for the carpet to have 15 percent residual value (for recycling) at the end of the lease term. Interface is planning to finance this lease with its own credit lines so it will not be dependent on financial institutions' acceptance of the residual value estimates.

Interface would like these new leases to be indefinite in duration, with renewal options every five to seven years. It expects to replace the carpet tiles in high-traffic areas during the lease term. Interface will take back and recycle all carpet that is replaced during the lease term or removed at the end of the lease. It is working toward recycling technologies that will convert used nylon into new nylon facing and old backing into new backing. The challenge is to capture enough value in the recycling program so that installed carpet that costs \$30 per yard when new will have a recycling value of \$4.50 to \$5.00 per yard.

Interface is working with the US Environmental Protection Agency and General Services Administration (GSA) to develop this new services contract. If it is accepted by GSA, any federal government agency will be able to acquire floor covering through the contract, paying a monthly rate and obtaining comprehensive services including maintenance, regular cleaning, and ultimately recycling.

Product Take-Back

Interface has been collecting used carpet from its customers for approximately five years through a program called Re:Source Americas, which handles carpet collection. Interface does not limit carpet reclamation to the floor coverings it produces, and will reclaim carpet produced by other manufacturers from areas where new Interface carpet is being installed. In 1998, Interface reclaimed 433,000 square yards of carpet, approximately 2 percent of the 21 million square yards it manufactured in the same year.⁶²

The company currently makes no profit on carpet reclamation, since it charges customers the actual costs of transportation and recycling. These costs are built into the lease agreement for Evergreen lease customers; customers who purchase floor coverings either outright or at the end of other leases may also receive end-of-life take-back services by choosing to pay a specified reclamation fee. At present, however, most customers choose not to pay the reclamation fee because it is higher than the costs of disposal.

Materials Recovery

After Re:Source Americas collects carpet, a program called ReEntry sends the carpet tile and broadloom floor coverings to third-party recycling facilities for processing. Nylon fiber is currently sent to nylon recycling facilities operated by big fiber producers such as Allied (Honeywell) and DuPont, which can recycle old nylon into new nylon face fiber. In addition, nationwide recyclers (such as Wellman) accept used carpet for downcycling into materials suitable for automobile parts. Interface guarantees that no reclaimed carpet will be sent to the landfill and instead routes carpet through one of the following processes, based on the type of floor covering and customer preference.

- **Reuse:** Reclaimed carpet tile that retains some additional use value may be cleaned and donated to a not-for-profit organization for reuse. This is especially common for cushion-backed carpet tile, which is difficult and expensive to recycle.
- **Recycling and Downcycling:** For **carpet tile**, the backing is ground up to be used in the production of new backing by Interface, while the nylon may be either recycled into new nylon for carpets or downcycled into materials used by several auto manufacturers, including Ford Motor Co., in the production of automobile parts. Interface is also in the process of developing its own technology to capture and recycle nylon face fiber from carpet tile. Finally, a recent design innovation has allowed the company to close the loop by making new backing from used backing and new face material from used face material. (See information on Solenium in the Product Design section of this case study.)

Reclaimed **broadloom carpet** is sent to one of several carpet recycling facilities, where it is chopped and baled. Post-consumer broadloom material may be used in the production of carpet padding and industrial matting or downcycled for use by auto manufacturers in making plastic components of new cars.

End-of-life handling of carpet tile is less expensive than that of broadloom because less transport and effort are required for processing, whereas broadloom must travel farther to recycling facilities and undergo a more intensive and costly recycling process.

Since carpet nylon is produced from petroleum products, its manufacture depends on the extraction of depletable natural resources. Interface aims to reduce its demand for these virgin materials by developing new recyclable materials and producing carpet with as much post-consumer recycled content as possible, using pre-consumer (virgin and post-industrial) material only when stocks of reclaimed carpet are insufficient to meet production needs.

Interface currently recovers little economic value from reclaimed carpet, as raw materials are inexpensive and used carpet does not retain high residual value at end of life. However, with the

expected growth of both the new Evergreen Flooring Services contract and the Re:Source Americas reclamation program, Interface hopes to establish a continual and predictable supply of recovered floor coverings. Then, as the risk of uneven material flows for reuse, remanufacturing, and recycling decreases, Interface believes it may become increasingly valuable to invest capital in end-of-life processing technologies.

Product Design

Commitment. Recognizing the importance of product design in producing less wasteful, more recyclable products, Interface claims to design its floor coverings with each stage of the life cycle in mind. The Interface sustainability research team works with Interface designers to modify new product designs for ease and efficiency of end-of-life processing.

Despite the fact that reclamation does not currently represent a profit to Interface, the company claims to have committed itself to responsible end-of-life treatment of its products and is working to make the system profitable. The reasoning at Interface is that the carpet it produces takes thousands of years to decompose in a landfill, where it does not deliver any value either to manufacturers or to consumers. In contrast, closing materials loops recaptures value, as in natural systems.

Design Impacts. Interface claims that its design innovations and waste reduction strategies have significantly reduced the total pounds of materials extracted from the earth per dollar of sales.⁶³ For example, through the changes in product design described below, Interface Flooring Systems has reduced its need for new nylon in carpet production by 2.5 million pounds. Many design changes are profitable as well; the company claims savings of \$143 million since 1994 from its efforts to eliminate waste from Interface products and processes.⁶⁴

Interface identified several successful projects.

- **Solenium Floor Covering:** According to Interface, Solenium resilient textile flooring “combines the aesthetic benefits of carpet with the functional advantages of hard surface flooring.”⁶⁵ Launched in the spring of 1999, Solenium uses 30 percent fewer raw materials than carpet and is also 100 percent recyclable. It is made from a new type of polyester that is durable, yet still recyclable and able to be cleaned. When Solenium is reclaimed, a thermal process allows the face fiber to be entirely peeled off the backing. This allows 100 percent of the face fiber and 100 percent of the backing to be recycled for use in the production of new Solenium. (Standard Interface carpet requires that fiber be sheared off the backing in a process that recaptures only about 75 percent of the fiber material, which can only be downcycled.)
- **Déjà Vu Carpet:** Made from 72 percent recycled material, Interface’s Déjà Vu carpet has some of the highest recycled content in the carpeting industry, with recycled materials making up both the face fiber and the backing. (Standard Interface carpet is made from 12 to 19 percent recycled content.)
- **Renewable Resources:** According to Interface, the company aims to use only renewable resources in its products so that the manufacture of Interface floor coverings is entirely sustainable. It is researching both “biological nutrients” that can return to the organic cycle (such as polymers made from corn or other plants) and “technical nutrients” (such as the feedstock for Solenium) that can be continually circulated in the carpet production process.

Incentives and Obstacles

Incentives. The Interface program has some positive characteristics that may enable it to achieve its goal of a closed-loop system for carpet production, including the following.

- **Commitment to Sustainability:** Interface has a vision of closing the loop on materials use and preventing further resource depletion, and it has stated its commitment to taking responsibility for its products from their inception through end of life. Carpet leasing that facilitates end-of-life reclamation and recycling – and thereby a reduction in the amount of raw materials used – appears to Interface to be an environmentally responsible business strategy.
- **Product Quality:** Interface provides a warranty and maintenance plan on all its products to assure customers that its floor coverings will deliver the desired performance, whether they are made from recycled or virgin materials.
- **Return Channels:** If the company succeeds in developing its new Evergreen Flooring Services contract, it will be better able to predict flows of reclaimed carpet for feedstock in recycling and manufacturing. This will facilitate investment in new technologies for reusing, remanufacturing, and recycling used carpet. Since closed-loop systems depend on a continual flow of post-consumer feedstock, this program, if successful, could provide Interface with the foundation it needs to help it close the materials loop.
- **Communication and Innovation:** Interface designs its products with each stage of the life cycle in mind, particularly the end of life. Designers work with the sustainability research team on the development of new products to ensure that all the environmental impacts of a product – including its content, durability, and recyclability – are taken into account before it is produced. The collaboration on design at Interface has already allowed it to design innovative floor coverings like Solenium, based on a closed-loop system.

Obstacles. Despite Interface's commitment to closing the materials loop in carpet production, its program has encountered the following barriers to success.

- **Challenges to Economic Viability:** Carpet reclamation and recycling at Interface have not yet been profitable, presenting a substantial barrier to the sustainability of the system. The raw materials used in carpet production are currently fairly inexpensive, making carpet recycling more costly than production from virgin materials. Carpet reclamation is more expensive than disposal and customers have not been willing to pay the incremental cost.
- **Problems of an Operating Lease for Carpet:** As noted above, the nature of carpet makes it difficult to create an operating lease under present economic conditions and accounting rules.
- **Who Takes Carpet Back?** In an ideal closed-loop system, a producer would get back its own products, creating an incentive to redesign its products to maximize recovery at end of life. Most carpet take-back programs do not work this way: companies take back old carpet when they install new carpet, so they may be taking back carpet made by a different producer. For example, customers who replace old Interface carpet with carpet from a different manufacturer generally prefer to have the installer of the new carpet take back the old carpet. This can be a deterrent to closing the materials loop unless a system is in place that ultimately directs the carpet to its original producer for reclamation. Otherwise, the manufacturer will not benefit from its sustainable design initiatives.

Does Leasing Matter?

Interface popularized the idea of leasing as a means to achieve extended producer responsibility, with the concept of the Evergreen lease stemming from Interface's goal of becoming a truly "sustainable corporation."⁶⁶ Interface believes that to achieve a closed-loop system, in which used products become the feedstock for the manufacture of new products, manufacturers should be held accountable for the end of life of their products. Despite the problems encountered in implementing the Evergreen lease program, the company continues to work toward leasing (and selling carpeting as a service) as a strategy for attaining a closed-loop materials system, while it also aims to develop materials that are 100 percent recyclable.

Xerox and Pitney Bowes employ leasing as a marketing strategy – to provide customers with alternative financial arrangements. Because these companies get their products back at the end of the lease, they have become aware of the end-of-life value of those products and have moved, in varying degrees, toward closing materials loops to enhance asset recovery. For these companies, leasing has been a driver of initiatives to close the materials loop.

The situation is very different at Interface. This company began with the goal of closing materials loops and extending its responsibility for its products over the entire life cycle. Leasing is being employed as a means to achieve this end. The problems have been substantial, and closing the loop at Interface ultimately may not depend on a successful leasing program. Given the company's commitment, it may be able to close the loop through take-back options for products that are sold as well as leased. A major barrier is the high cost of recycling compared to disposal, which customers are unwilling to pay. Policies such as banning carpets in landfills or taxing carpet disposal might be needed to make carpet recycling economically viable.

Even if Interface cannot market a successful lease program, it deserves credit for publicizing the concept of leasing as a strategy for sustainability. While leasing is problematic for carpet, it may still be a good strategy for other product types.

AB Electrolux⁶⁷

"I believe in responsible and environmentally conscious conduct, and I subscribe to the view that a proactive environmental strategy is essential to strengthen us in a competitive market. The environment knows no borders, and Electrolux is a global, borderless company." – *Michael Treschow*⁶⁸

Formed in 1919 and headquartered in Sweden, AB Electrolux is the world's leading producer of household appliances, including washing machines, dishwashers, refrigerators, and freezers, and also the world's leading manufacturer of vacuum cleaners. In addition, Electrolux produces food and beverage machines for the food service industry, professional and commercial laundry equipment, and lawn and garden equipment. The company sells 55 million units of its products annually in more than 100 countries, and had sales of \$14.3 billion in 1998.⁶⁹ The company's stated environmental strategy is to develop "products and processes with high environmental performance and to actively promote demand for these products."⁷⁰

Selling a Function

In 1995, the Electrolux Euroclean company launched a test initiative to sell the function of its cleaning machines. The initial test involved selling the function of the “scrubber dryer,” an industrial floor cleaning machine, to the largest cleaning company in Sweden for use in cleaning a large supermarket in Stockholm. Following this successful test, Euroclean entered into additional contracts for selling the cleaning function. (Electrolux divested itself of Euroclean in 1998; Euroclean is currently part of the Nilfisk Corporation.) Under the program, Euroclean first evaluated the cleaning needs of each customer to determine which machines and cleaning supplies would be appropriate. Then, for a monthly fee, the program offered customers equipment rental, staff training, supplies necessary to run the machine, a guarantee of nonstop machine performance, and end-of-term machine recycling. The contract allowed Euroclean to replace the machine when necessary or appropriate, ensuring that each customer had a functioning machine at all times, though not necessarily the machine first rented.⁷¹

Euroclean officials expected to achieve both economic and environmental savings by selling the cleaning function. For example, because the company included supplies in its monthly fee rather than selling them separately, it had an incentive to provide the cleaning function of its machines with as few supplies as possible. By decreasing the amount of supplies used, the company could both save money and reduce resource consumption. In addition, because customers rented the cleaning function but not a specific machine, Euroclean could supply customers with used or rebuilt machines as long as the function they performed was equivalent to that of a new machine. As a result, Euroclean could build fewer new machines and could salvage value from used machines through reuse, remanufacturing, or recycling. Essentially, the company could make money by extending the life of its product rather than by designing for built-in obsolescence. Finally, because customer personnel were trained in the use of the machines, Euroclean could ensure that cleaning was accomplished without excess supplies, energy, or machine wear.

This program is no longer in effect at Electrolux since the company divested itself of Euroclean in 1998. However, its experience with selling the function of cleaning equipment may enable Electrolux to develop similar programs for its remaining product lines. Electrolux officials believe that the concept of selling the function may give manufacturers an economic incentive to reclaim equipment at end of life instead of allowing secondhand dealers to capture the value of used machines.

Since the Euroclean experiment, the concept of selling the function has become part of Electrolux’s corporate strategy for the future. At present, the company is trying to establish a closer relationship with its products throughout the life cycle, utilizing service contracts, extended guarantees, and operating leases to move toward a function sales approach. These programs still involve the leasing of a particular machine, as opposed to the sale of a function that is not machine-specific.

In 1999, Electrolux initiated a pilot program to sell the function of cleaning clothes. Each of 50 households on Sweden’s Gotland Island received an energy-efficient digital washing machine for an installation fee of approximately \$55. Electrolux services the machines and will replace them

after 1000 washes (generally after four to five years). The company charges customers a per-wash fee of approximately \$1.12. In theory, this will encourage the households to wash clothes when they have full, rather than partial, loads, thereby reducing the use of energy, water, and detergent. (The European Commission has estimated that use, rather than manufacturing or disposal, accounts for 80 to 90 percent of the environmental impact of washing machines.) It is not clear, however, whether this fee is high enough to alter consumer behavior. When Electrolux reclaims the washing machines, it will either refurbish and resell them through distributors or recycle them.⁷²

Electrolux is considering implementing a function sales program for its commercial food service products and cleaning equipment (e.g., refrigerators, dishwashers) and, potentially, for other consumer white goods. The company would model the function sales program after the 1995 Euroclean pilot program, allowing customers to pay a monthly fee for the function and operation of an Electrolux machine and for supplies and staff training. The customer would provide staff to run the machines and would allow Electrolux to replace equipment as needed.

Electrolux officials predict that function sales will be economically as well as environmentally beneficial because the company will retain ownership of its equipment through the product's end of life. For example, under the current system, a grocery store might purchase a commercial refrigerator with an estimated 15-year useful life. However, after five years, the store might choose to purchase new equipment, sending the old refrigerator to a secondhand equipment reseller. Because the refrigerator retains ten years of useful life at this point, the equipment reseller would profit from the salvage value of the Electrolux product. Under the function sales program, Electrolux would retain ownership of the refrigerator, allowing the company to sell or lease it to another customer after the initial five-year period of use. Realizing that currently "other people are making money on [its] products,"⁷³ Electrolux officials anticipate that function sales will improve the company's ability to capitalize on the salvage value of its own equipment. Company staff also expect that increased involvement with products will lead to better maintenance and increased efficiency, both of which can reduce costs to Electrolux and impacts on the environment.

Product Take-Back and Materials Recovery

Electrolux states that it refurbished more than 4000 damaged or used appliances in Motala, Sweden, in 1999, offering them for sale to customers seeking more inexpensive appliances. The company also refurbished chain saws in North America and vacuum cleaners in England.⁷⁴

Several European countries are currently drafting extended producer responsibility (EPR) laws for electric and electronic products, and Electrolux officials see this take-back legislation as an important driver for recovering its products. They are concerned that governments may pass EPR laws that allow pool systems for product take-back, under which manufacturers are responsible for sharing the cost of take-back programs rather than reclaiming specific products that they manufactured themselves. Under a cost-pooling system, manufacturers are required to take back materials based on their market share, but not necessarily their own products.* Because the incentive to design for

* Product take-back pools are often managed by producer responsibility organizations, or PROs, nonprofit organizations that handle collective take-back and recycling and apportion the costs of these procedures among producers. The German Duales System Deutschland, or DSD, is the prototype of such systems.

end of life relies on each manufacturer recovering its own products, Electrolux is lobbying against a pool system for take-back of electric products and in favor of a system in which the producer makes a point-of-sale commitment to take back its own products.⁷⁵

Product Design

Currently, design for environment (DfE) of Electrolux products focuses mostly on reducing the consumption of water, energy, and other consumables over the life cycle; as noted above, the European Commission has estimated that these account for 80 to 90 percent of a washing machine's lifetime environmental impact.⁷⁶ The company considers modular design (which allows equipment upgrading) to be an essential element of resource savings, though secondary to reducing the use of consumables; it has been a part of the company's DfE guidelines for approximately five years. Although Electrolux did not initially link design to product take-back, it now believes that DfE's end-of-life guidelines are gaining support as take-back becomes an increasingly important consideration for designers.

Incentives and Obstacles

Incentives. The function sales initiatives described above are driven by opportunities for increased profit and by a strong commitment to reducing environmental impacts.

Obstacles. Electrolux has identified several potential obstacles to success in the implementation of a function sales program. INFORM's analysis indicates that these may also apply to leasing.

- **High Apparent Cost of the Function:** The cost of a function sale may seem high to customers compared to the cost of a product purchase. Often, customers do not take into account all the costs of using a machine, such as service, supplies, and training, when making a purchase decision.
- **Unpredictable Flow of Returned Equipment:** When conducted on a month-to-month, rather than a multiyear, rental basis, function sales could result in an unpredictable flow of used machines, with shortages and gluts that introduce volatility into the manufacture of new products.
- **Risk of Customers Not Meeting their Contract Obligations:** Electrolux assumes the risk of equipment ownership in a function sale. When a customer such as a restaurant that has filed for bankruptcy cannot fulfill its part of a function sales contract, Electrolux would have to reclaim its equipment sooner than expected.
- **Indirect Relationships with Some Customers:** The white goods market involves interaction with third-party retailers rather than direct relationships with consumers, which could complicate product take-back.
- **Design Conflicts Between Products Intended for Traditional and Function Sales:** Designing all its products with the durability required for function sales may not be cost-effective if Electrolux also continues its traditional sales program, using the same production line for both markets.
- **Drawbacks of EPR Legislation:** EPR legislation for electric and electronic equipment that permits manufacturers to pool the costs of take-back across the industry, rather than requiring them to take back their own products, will not enable the company to realize the economic benefits of products designed for end of life.

Do Function Sales Matter?

Although Electrolux has so far initiated only pilot function sales programs (washing machines on Gotland Island and the Euroclean test program), the experience has fostered a belief that function sales may be both economically and environmentally beneficial for the company. By retaining ownership of its equipment, Electrolux may be able to serve more customers while producing fewer new machines and to capitalize on the salvage value of machines already in use. In addition, by bundling performance, service, and supplies into a fixed equipment rental fee, Electrolux may benefit from conserving supplies and extending the useful life of its machines.

Nevertheless, Electrolux envisions several obstacles to implementing the program, the most significant being the impact of new EPR laws for electric and electronic equipment manufacturers. Electrolux hopes that new EPR policies will encourage manufacturers to take back their own products, in concert with the function sales model, as opposed to pooling the costs of take-back across the industry.

As Electrolux moves toward the implementation of function sales, the company is already deepening its relationship with its products throughout the life cycle by providing service contracts, extended warranties, and operating leases on equipment. In this way, Electrolux is steadily moving away from selling a “product in a box” and toward its goal of selling performance and extending its responsibility for its products.

The role of selling the function at Electrolux has more in common with that of selling the function at Interface than with the role of leasing at Xerox or IBM (also profiled in this section). Like Interface, Electrolux has a strong environmental focus and vision, and clearly links product design with end-of-life issues. Selling the function is a mechanism for achieving the company’s goal of closing the materials loop rather than a driver of such initiatives, as leasing has been at Xerox and IBM.

4. The Role of Leasing

This section has explored four companies to evaluate whether leasing, selling functions, and/or selling services may play a role in reducing the environmental impacts of products by encouraging producers to focus on product end of life. By assuring manufacturers of the ability to reclaim their own products at end of life, such options may provide them with incentives to design for increased reuse, remanufacturing, and recycling, which allow manufacturers to capitalize on the residual value of their products. Leasing and the sale of products and/or functions may also allow manufacturers to shift some of their focus from purchasing virgin materials for new production to harvesting used materials from end-of-life goods.

Leasing is a widely used business strategy in the United States, with 80 percent of all companies leasing some or all of their equipment in 1999.⁷⁷ Hence, well-designed leasing, function sales, or service sales programs that focus on product end of life could have a considerable impact on the way new products are designed, as well as on how used materials and equipment are handled. The

case studies in this section suggest some characteristics that may affect the extent to which leasing, selling functions, and selling services can achieve the aims of extended producer responsibility.

Lease/Sales Model

Systems under which the manufacturer retains ownership of its equipment throughout and after the customer use phase (operating leases, function sales, and service sales) are most likely to ensure that the manufacturer will have responsibility for the product at end of life. When the manufacturer, rather than an independent equipment dealer or municipal waste handler, controls the end-of-life treatment of its products, it has an incentive to redesign the product in a way that increases the ability to recapture residual value. Furthermore, the company is more likely to get a consistent flow of feedstock for reuse or remanufacturing when used equipment is returned to the manufacturer.

The type of lease and the company involved in leasing are critical factors. Only operating leases, in which ownership is retained by the manufacturer or its captive leasing company, result in the return of products to the manufacturer at the end of the lease.

The companies profiled in this section conduct their leasing themselves or through a captive finance company, or they offer function or service sales. While both Xerox and Pitney Bowes offer capital leases and outright product sales, as well as operating leases and document services (service sales), they also take back purchased equipment for a reclamation fee paid by their customers. Therefore, although only operating leases enable manufacturers to retain ownership automatically at the end of the lease term, manufacturers can often achieve similar results through capital leases (or even sales) with take-back programs.

Organizational Characteristics

Companies that encourage extensive communication among divisions, that foster a spirit of innovation, and that maintain active top-level management support are most likely to be successful in translating product take-back into design for end of life.

Manufacturers that take back their products through leases or other reclamation programs often find it economically viable to salvage materials through reuse, remanufacturing, and recycling. However, consideration of product end-of-life treatment often occurs only after the manufacturer has reclaimed a product, rather than being anticipated in the design phase. The case studies in this section suggest that companies that incorporate end-of-life considerations into product design share three principal characteristics: communication, innovation, and top management commitment to closing the materials loop.

First, implementing a design for end of life program requires substantial communication between product designers and end-of-life managers, as well as other divisions of a company. For example, designers must choose materials that retain value at end of life and they must design products that can be easily disassembled, with readily identifiable parts and materials.

Second, design for end of life requires the ability and the will to innovate. For instance, leases with take-back, function sales, and service sales may represent a substantial departure from a company's

traditional business model, requiring improved logistics for equipment take-back, a revised customer service model, and new accounting procedures. Also, designing products with end of life in mind may require an overhaul of traditional materials, parts assembly, and testing procedures, both in new and in remanufactured production lines.

Finally, since the organization as a whole must be committed to design for end of life, top management must support it before innovation at the design or production levels can be implemented. Competing factors, such as marketing considerations, often come into play when product decisions are made, and end-of-life factors need a strong advocate in order to prevail.

The companies studied exhibit a variety of organizational characteristics. Both Xerox and Interface employ extensive intraorganizational communication, enabling designers to work in conjunction with manufacturers and recyclers to create products that can be easily reused, remanufactured, or recycled. Both have developed innovative products to help achieve these goals, as well as innovative sales and leasing systems to serve customers. For example, Xerox has created a copy machine that is almost completely remanufacturable and recyclable, and has also established a “document solutions” business to provide copying and other services without selling any of its office equipment. Similarly, Interface has developed a floor covering that is 100 percent recyclable and has instituted a carpet reclamation program to promote recycling. Electrolux, whose management is strongly committed to reducing the environmental impact of its products, is testing an innovative function sales program for washing machines.

At Pitney Bowes, on the other hand, certain organizational features may cause it to lag behind companies like Xerox, although it, too, has initiated some design changes for end of life and a document services business. For example, since designers are separated geographically from manufacturers and recyclers, communication between these two groups does not appear to be central to the product design process. In addition, INFORM found no evidence that the stated commitment of Pitney Bowes’ management to putting reuse and remanufacturing first has translated into a comprehensive program of design for end of life.

Product Type

Certain product types may provide greater incentives to design for end of life than others. While this section has explored only a few manufactured products, it appears that design for end of life is more economically viable for products that retain substantial material value after the customer use phase, allowing the manufacturer to reuse, remanufacture, or recycle at least some materials or components. That is, manufacturers can more easily harvest materials from equipment with durable parts (e.g., copy machines, appliances) than from easily worn products (e.g., traditional carpeting).

Products that contain mostly inexpensive raw materials, that employ rapidly changing technologies, and/or that wear easily present a greater challenge to closing the materials loop. Additionally, if the raw materials and production of the product are less expensive than the remanufacturing or recycling of the product or its components, product recovery at end of life becomes a cost rather than a savings for the manufacturer. Mandatory extended producer responsibility programs require companies to bear these additional costs; companies are not likely to volunteer to do so. A notable

exception is Interface, which continues to pursue design changes and new recycling technologies because of strong management support for environmental goals.

* * *

These case studies illustrate some of the features of leases, function sales, and service sales – as well as the products and organizations with which they are associated – that may lead to reduced resource use through design for end of life. Although such anecdotal evidence cannot be extrapolated widely to other organizations or industries, it does suggest areas for further exploration of business practices that may achieve the goals of extended producer responsibility. While leasing and other service-oriented business models may not lead to resource conservation in all cases, the practices described here show that leasing and servicizing can be a step toward closed-loop material use for products.

PART III

Focus on Computers

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Personal computers (PCs) pose a mounting waste management problem. In 1998 alone, more than 20 million PCs in the United States became obsolete, and fewer than 11 percent of them were recycled.⁷⁸ Furthermore, their toxic components (e.g., lead in monitors, cadmium in plastics, heavy metals in circuit boards) create major environmental problems: just 1 percent of landfill contents, principally electronics, contribute 70 percent of the toxics in landfills.⁷⁹

This section examines current leasing arrangements in the personal computer industry to determine if leasing effectively promotes more environmentally sound management of end-of-life computer equipment and accomplishes objectives similar to those of extended producer responsibility policies. In the United States, leasing of personal computers is growing dramatically – by 149 percent between 1997 and 1998 alone.⁸⁰ In 1998, leasing accounted for one-third of all computer transactions.⁸¹

INFORM studied 11 companies, including six personal computer manufacturers or their affiliated leasing groups, four independent leasing companies that handle personal computers, and an electronic recycler specializing in off-lease equipment. (Types of leasing companies are described in the second section of Part III.) This group included the “captive” leasing programs of four of the top five US computer manufacturers: Compaq, Dell, Gateway, and IBM. Table 3.1 provides a snapshot of the leasing companies interviewed for this report (the electronics recycler, Resource Concepts, Inc., of Dallas, Texas, is not included because it does not lease equipment).

This section examines where computers go at the end of the lease term, the extent to which they return to the manufacturer, and how they are ultimately managed. It addresses whether leasing promotes resource conservation and increases the chance that equipment will be properly managed at end of life.

Table 3.1 Computer Leasing Companies Interviewed by INFORM

Company	Annual Lease Volume* (all equipment)	Type of Company
Compaq Financial Services Woodbridge, NJ	Not available	Captive leasing for Compaq Computer Corporation; Compaq Computer established this wholly owned subsidiary in 1997
Computer Sales International, Inc. St. Louis, MO	\$250 - \$500 million	Independent leasing company
Dell Financial Services Round Rock, TX	\$500 - \$600 million	Captive leasing for Dell Computer; joint venture established in 1997 between Dell Computer and Newcourt, an independent leasing company
Gateway North Sioux City, SD	Not available	Financing division of Gateway offers lease options; uses multiple partners to finance leasing programs
GE Capital - Business Asset Funding Bellevue, WA	>\$1 billion	Financial services company serving a wide variety of industries
IBM Global Financing Armonk, NY	\$7 billion (US only)	Captive leasing program for IBM
Leasing Group, Inc. Austin, TX	\$50 - \$100 million	Offers finance programs for major manufacturers such as Gateway; mostly computer leasing
Silicon Graphics Inc. Mountain View, CA	\$0 - \$10 million	Captive leasing for Silicon Graphics, a manufacturer of high-performance computer systems; established in 1997
Stamford Computer Group, Inc. Stamford, CT	\$20 - \$50 million	Independent leasing company; strictly computer leasing

*Equipment Leasing Association (www.elaonline.com, Members Only section); IBM self-reported.

I. The Personal Computer Market

In 1998, 90 million personal computer units were shipped worldwide, with desktop computers accounting for 80 percent, notebook computers for 17 percent, and PC servers for 3 percent. These PCs were the largest segment of the computer hardware industry, making up 68 percent of the world market, by revenues. (Multi-user systems such as servers, mainframes, and high-performance computers accounted for 25 to 30 percent of computer sales worldwide.)⁸²

Desktop and portable units have been seizing a growing share of the marketplace, as these units have become faster and more powerful than their predecessors. As shown in Table 3.2, between 1992 and 1998, sales of personal computers and workstations in the United States increased from 62.4 percent of the market (in dollar value) to 72.4 percent, and portable computers from 6.1 percent to 10.7 percent.⁸³

Table 3.2 US Computer Sales

Computer Hardware	Dollar Value, % of total	
	1992	1998
Personal computers & workstations	62.4%	72.4%
Large-scale computers/mainframes	19.3%	12.1%
Portable computers	6.1%	10.7%
Medium and small-scale computers	12.2%	4.8%
TOTAL	100.0%	100.0%

Source: Electronic Industries Alliance, 1998 *Electronic Market Data Book*, p. 93.

Over the past decade, the PC industry has witnessed a consolidation of market share among the top manufacturers and a shakeout of all but the strongest companies. In 1992, market share by revenues indicated that the top ten manufacturers accounted for about half the worldwide market; by 1994, competition had squeezed out the lower-tier suppliers so that the top ten held 65 percent of the market. By 1998, the top five alone held 40 percent of the worldwide market, by revenues.⁸⁴

Table 3.3 looks at the US and worldwide market share for personal computers by units shipped. In the US, Dell, Compaq, Gateway, Hewlett-Packard, and IBM are the top five PC manufacturers, accounting for more than 57 percent of PC shipments in 1999. Dell surpassed Compaq for the first time in 1999, to take the lead in the US market. Worldwide, the top five account for nearly 45 percent of the market by units shipped, with Compaq holding the number one position and Packard Bell-NEC replacing Gateway in the list of the top five manufacturers.⁸⁵

Table 3.3 1999 Top PC Manufacturers, US and Worldwide, by Units Shipped

Company	US Ranking	US Market Share (%)	Worldwide Market Share (%)
Dell	1	16.6%	10.5%
Compaq	2	16.0%	14.0%
Gateway	3	8.9%	N/A
Hewlett-Packard	4	8.8%	6.7%
IBM	5	7.2%	8.2%
Packard Bell - NEC	N/A	N/A	5.3%
Others	–	42.6%	55.2%
TOTAL		100%	100%

Source: International Data Corporation, press release, January 24, 2000.

Traditionally, computer manufacturers such as Compaq and IBM use middlemen, or distributors (e.g., computer dealers, value-added resellers, and systems integrators), to sell hardware configurations and services to end users. In recent years, distribution strategies have diversified as Dell and Gateway have successfully proven the power of direct sales to the end user, and the mass-market appeal of computer technology has accelerated consumer purchasing through retail outlets.⁸⁶ Now all computer vendors – with the notable exception of Dell – use a hybrid distribution model of direct sales and middleman distribution.⁸⁷

2. Computer Leasing Programs

The volume of leased equipment of all types has been on the rise in the United States since 1988, with leased equipment assets estimated at \$226 billion in 1999.⁸⁸ Table 3.4 shows the breakdown of leased equipment by industry in the United States. In 1998, leasing accounted for approximately 31 percent of total business investment in equipment, with 80 percent of companies leasing some or all of their equipment of all types. However, the volume of leasing has not kept pace with total business investment in equipment, so its market penetration rate dipped from a high of 34.3 percent in 1989 to 28.1 percent in 1995, before moving back up to an estimated 30.9 percent in 1997.⁸⁹

Table 3.4 Leased Equipment by Volume, US, for 1998

Equipment Type	% of All Leased Equipment
Transportation	38.2%
Computer	18.8%
Construction	10.1%
Industrial/Manufacturing	4.2%
Office Machines	3.9%
Other*	24.8%
TOTAL	100.0%

*Each of the equipment categories included in "Other" accounts for less than 3.9% of the total.

Source: Equipment Leasing Association, *Survey of Industry Activity 1999*, p. 11.

In 1998, articles in *Computer Reseller News* estimated that 30 to 35 percent of computer equipment transactions involved leasing.⁹¹ This number is on the rise. In its *Survey of Industry Activity 1999*, the Equipment Leasing Association (ELA) recorded a 159 percent increase in the number of computer leasing transactions from 1997 to 1998. Within this total, leasing of PCs grew by 149 percent, while leasing of mainframes, peripherals, and software grew by 161 percent, 46 percent, and 465 percent, respectively.⁹²

Overview of the Industry

An estimated 2000 companies, including banks, independent leasing companies, and equipment manufacturers, provide leases to American businesses. According to the Equipment Leasing Association, leasing companies tend to specialize in certain equipment or industries, as well as in

In 1998, computer leases accounted for almost 19 percent of all leased assets, with personal computer networks outpacing mainframes (6.0 percent and 5.1 percent, respectively). Computer leasing was second only to transportation equipment leasing (38.2 percent), as shown in Table 3.4.⁹⁰

transactions of a specific dollar value. An on-line search of the ELA's member database retrieved 306 companies out of its 700-plus members specializing in computer leasing.⁹³ These sources offer leasing programs to small- and medium-sized businesses, large corporations, government agencies, and educational institutions. Some companies offer leases to individual consumers as well.

Despite the growing trend in leasing, this option is not widely used by distributors such as computer resellers and dealers that buy from manufacturers and sell to end users; in 1998, its penetration rate among resellers was estimated at only 5 to 15 percent.⁹⁴ However, the Gartner Group (a Stamford, CT, market research firm) estimates that, by 2002, about 50 percent of all computers distributed through resellers will be leased.⁹⁵

One trend evident in the computer leasing landscape is the recent entry of captive leasing companies, or subsidiaries of equipment manufacturers that lease their parent company's products. In 1997 alone, Dell, Compaq, and Silicon Graphics introduced captive leasing programs, while Gateway did so in the first half of 1998. Internalizing the lease function is essentially a sales and marketing tool that creates an ongoing customer relationship and a mechanism to promote brand loyalty. When the customer is ready to upgrade or replace old technology, the manufacturer as lessor is right there, ready to lease the next generation of product. From the customer's perspective, captive leasing can simplify the leasing process with "one-stop" shopping. At Dell and Gateway, for example, financing is integrated with the equipment order process.

Greater involvement with leasing also provides manufacturers with greater control over the resale market for computer equipment. This is critical to manufacturers because secondary market prices and equipment availability can impact new product sales and pricing. Control over the used equipment market was a major factor in the decision by Silicon Graphics Inc. (SGI) to develop a captive leasing program when it discovered that a competitor's financing arm was leasing 30 percent of its equipment. Not only could the competitor "dump" SGI equipment on the secondary market, depressing the price and sale of new equipment, but it also had direct access to Silicon Graphics customers.⁹⁶

Captive leasing companies that provide the capital for purchases are often behind manufacturers' finance programs. Leasing arrangements differ, but generally the manufacturer's financial services department completes the lease agreement with the customer. Behind the scenes, the captive leasing subsidiary purchases the equipment from the manufacturer and the equipment title is transferred to the leasing company. This transaction is not obvious to the customer, who makes lease payments to the manufacturer's affiliated financial services company and returns the equipment to the manufacturer at the end of the lease. Even though the equipment is owned by the leasing company, the manufacturer may assist with remarketing it, since this is its core competency. Under this arrangement, the leasing subsidiary receives the income from remarketing the returned equipment and the manufacturer also benefits because the secondary market value of the equipment is preserved, thereby helping maintain the price of new equipment. In addition, the manufacturer can continue its relationships with its customers and may also be able to retrieve spare parts. In other variations, Dell Computer formed a joint venture (Dell Financial Services) with Newcourt Commercial Credit, while Gateway contracts with several leasing companies, including the Leasing Group, Inc., to provide leasing and other financing options to business customers.⁹⁷

Computer Lease Options

When businesses need computer equipment, they have three basic choices for financing the acquisition. They can pay cash, borrow money, or lease. A lease is a contract in which the owner of property (lessor) grants to a customer (lessee) the right to use the property for a specified period of time in exchange for an agreed upon periodic payment. Leasing is a method of acquiring assets that conserves a company's cash and preserves its credit lines. Leasing also allows computer equipment users the opportunity to bundle hardware purchases with the financing of software and services into one monthly payment. In the computer industry, typical lease terms range from 12 to 48 months. It is generally the lessee's responsibility to maintain and service the equipment while under the lease (unless a service contract is procured).

Table 2.1 in Part II (page 17) shows the two basic kinds of leases: operating leases and capital leases. An **operating lease**, or true lease, requires that the lessor retain ownership of the equipment at lease end, that the lease term not exceed 75 percent of the estimated life span of the equipment, that the lease contract specify that the equipment will retain substantial residual value at the end of the lease term, and that the lease not contain a bargain payment option. A **capital lease**, on the other hand, acts more like a financing tool by transferring equipment ownership to the lessee at the end of the lease term; thus, equipment is not automatically returned to the lessor at lease end. The major computer manufacturers offer both operating leases (generally called fair market value, or FMV, leases) and capital leases. Capital leases may differ in the structure of the final payment: often manufacturers offer both a 10 percent buyout option, with a final payment of 10 percent of the initial cost, and a \$1 buyout option, with a final payment of only \$1. The size of the monthly lease payments will vary with the option chosen.

Initially, the capital lease with the \$1 final payment seemed to be the most popular, offering customers the benefits of spreading payments out over time and owning the computer equipment at lease end. However, with rapidly advancing technology, the trend now is toward operating leases, with the lessee returning the equipment to the lessor at lease end. For example, at Dell and Silicon Graphics, approximately 85 percent of leases are operating (FMV) leases.⁹⁸

According to the Equipment Leasing Association, about 77 percent of high-technology equipment (not necessarily information technology equipment) on lease is either upgraded or replaced within 24 months, while an estimated 95 percent is upgraded or replaced within 36 months.⁹⁹ At Dell, for example, 20 percent of leases are for two years and 80 percent are for three years; laptop computers make up the majority of two-year leases.¹⁰⁰

The purchase price customers pay at lease end, if they want to keep the equipment, is determined by the lease option chosen. With an operating lease, a customer must pay the fair market value of the equipment at lease end. With capital leases, the customer pays either 10 percent of the original purchase price or \$1, depending on the option chosen. For any lease option, the customer can return equipment to the lessor at lease end, generally paying only for packaging, shipping, and data destruction, unless the lease specifies an additional fee for service.

Technology Refresh Options

As technology rapidly advances, computer users are looking for assurances that they will not be stuck with older equipment that does not meet their performance needs. While leases themselves offer some protection against obsolescence by matching lease term to turnover expectations, many lease agreements today also offer “tech refresh” options. With refresh options, a customer can swap old equipment for new prior to lease termination. For the leasing company or computer vendor, it provides a vehicle for going back to the customer prior to lease end, getting a jump on competitors before the lease goes out for rebid. The lessor can lock the customer into the next technology cycle and maintain control over the account.

Dell Financial Services, for example, offers a fee-based “technology rotation option” with its leases. This program allows customers to rotate all or part of the leased equipment after a predetermined period. The customer pays the difference between the old lease rate and the costlier monthly rate it would have paid on a shorter lease. Toshiba (another manufacturer, not profiled in this report) uses a similar fee structure. For example, if a customer has a three-year lease and turns the equipment in after two years, the fee is the difference in accumulated payments between the two- and three-year leases.¹⁰¹

As part of its Your:)Ware for Business program, Gateway offers a slightly different option, its “technology refresh business lease.” Customers can enter into an agreement with a fixed payment schedule for the lease term that allows them to replace technology every two years. Equipment is refreshed with the latest available model in the product class under lease, as determined by Gateway.¹⁰²

Gateway’s Your:)Ware program for individuals addresses technology obsolescence for individual consumers. At the end of a three- or four-year term, the Gateway customer owns the computer equipment, but at any time between 24 and 48 months the customer may trade in the system for a new one, receiving a trade-in allowance toward the purchase of the new PC based on the value specified in the *Orion Blue Book*, a standard guide for used computer prices.¹⁰³ According to the publisher of the *Orion Blue Book*, the fair market value of a two-year-old computer is about 15 to 20 percent of its original price.¹⁰⁴ Gateway credits much of the increase in units shipped (61 percent) and revenues (38 percent) for its consumer business in the first quarter of 1999, compared to 1998, to its Your:)Ware program.¹⁰⁵ However, the Gateway Your:)Ware program for individuals is essentially a personal loan, not a lease. INFORM found no successful computer leasing plans for individual consumers.

Why Lease?

For businesses and government, leasing can be an attractive vehicle for financing information technology by allowing them to bundle acquisitions of hardware, software, services, and maintenance into one monthly payment. Through leasing, customers can preserve cash, match payments to cash flow cycles, simplify tax preparation (for example, by avoiding the need to prepare depreciation schedules for capital assets), and streamline purchases by avoiding approvals associated with capital appropriations.

Keeping pace with technology is the primary reason that end users lease computer equipment, according to a study by the ICR Survey Research Group (Media, PA).¹⁰⁶ Similarly, in a survey of its customers (see Table 3.5), Dell Financial Services found that their primary reasons for choosing leasing are technology transition and refresh options (68 percent). A majority of customers also believe that leasing is more cost effective than purchasing equipment (54 percent). Ease of acquisition (68 percent) and ease of disposal (42 percent) also enter into the decision.¹⁰⁷

Table 3.5 Why Dell Customers Choose Leasing

Reason for Leasing	% of Customers Responding*
Technology transition (i.e., total cost of ownership, technology refresh)	68%
Ease of acquisition	68%
More cost-effective than purchasing	54%
Ease of disposal	42%
Off-balance-sheet financing	20%

* Percentages do not add up to 100% because of multiple responses.

Source: Denise Demers, Dell Financial Services, presentation at Electronic Product Recovery and Recycling Conference, Washington DC, March 23, 1999.

Technology Transition. About every two years, the PC industry witnesses a significant change in technology, such as the introduction of faster processors or new operating systems, that bumps information technology performance up a notch. In the industry, this is referred to as an “upgrade cycle,” in which the “new and improved” technology becomes the minimum standard for new equipment on the market and users seeking higher performance upgrade their systems. Major upgrade cycles were seen, for example, in 1995 with the introduction of Windows 95 and in 1997 with corporate upgrades to Pentiums with Windows NT.

Leasing allows companies to manage technology obsolescence and more easily upgrade than if they own equipment outright. A company can match the lease term to the equipment’s estimated useful life for its performance needs, and then return the equipment to the lessor in exchange for the latest technology. (Here, “useful” life refers to the adequacy of a PC system in meeting the performance needs of a specific user. A computer considered “obsolete” by one user may be adequate for a user with less demanding performance needs.) The lessee can also upgrade its systems through technology refresh options offered by some vendors.

Cost Effectiveness. The total cost of owning a PC is more than its purchase price. Installation, technical support, repair, asset management, and removal costs must be factored into the total ownership cost. As stated by the Texas Department of Information Resources, “Cost savings from a true lease will not be apparent when simply comparing the price of the lease to the price of the equipment. The savings and efficiencies come from improvements in the IT [information technology] life cycle management process, and are dependent upon the situation at the individual agency or university.”¹⁰⁸ Depending on how long a customer keeps a unit, the equipment may also need software or performance upgrades, or may be swapped among employees.

Disposal of outdated equipment can also be costly. As outlined in Table 3.6, International Data Corporation (a leading provider of market research data for the information technology industry) estimated the costs of managing outdated equipment at a low of \$118.90 to sell the equipment to brokers to a high of almost \$400 to “cascade” the PC to another worker within the organization.¹⁰⁹ For businesses and organizations with many PCs, these costs add up.

Hence, the cost savings associated with leasing can be substantial, particularly for larger organizations. Dataquest (a major market research organization) estimates that an organization with more than 1000 PCs can reduce the cost of acquiring equipment by up to 12 percent and can reduce the three-year cost of ownership by 15 percent using leasing.

Table 3.6 Cost of Managing Outdated PCs

Disposition Option	Cost per PC
Sell to broker	\$118.90
Throw away	\$216.75
Sell to employee	\$272.49
Donate to charity	\$343.90
Re-deploy or cascade within organization	\$397.30

Source: Dell Computer, www.dell.com/us/en/biz/services/asset_005.htm, citing International Data Corporation, “Measuring and Lowering Total Cost of Ownership,” June 1998.

Equipment at Lease End

What happens to computer equipment at lease end? The answer to this question is central to evaluating whether leasing can achieve the goals of extended producer responsibility policies.

A 1997 survey conducted by the Computer Leasing & Remarketing Association (now called the Information Technology Resellers Association) found that 65 percent of leased computer equipment (all types) coming to the end of term was either re-leased (40 percent) or purchased (25 percent) by the original lessee. The remaining 35 percent was returned to the lessor, of which 20 percent was subsequently remarketed to a wholesaler and 15 percent was leased or sold to a different end user.¹¹⁰ The Equipment Leasing Association found a slightly higher rate of purchase and renewal (about 80 percent) for end-of-lease computer equipment (all types), and also showed that end users were less likely to purchase at the end of lease for seven-year leases than for three- and five-year leases, as shown in Table 3.7.¹¹¹ No comparable industrywide statistics were found specifically for personal computers. However, IBM reports that the rate of product return at lease end is greater for personal computers than for its other technology products, with approximately 80 percent of personal computers returned at the end of lease.¹¹²

Table 3.7 End-of-Lease Transactions for Computers (All Types)

	3-year leases	5-year leases	7-year leases
Purchased Equipment	59%	61%	39%
Renewed Lease	23%	19%	40%
Returned Equipment	18%	20%	21%
TOTAL	100%	100%	100%

Source: Equipment Leasing Association, *Survey of Industry Activity 1999*, p. 53.

Table 3.8 How Interviewed Companies Handle Off-Lease Equipment

Company	Off-Lease Disposition
Manufacturer-Affiliated Leasing	
Compaq Financial Services (CFS)	<p>Predominantly utilizes three remarketing channels with an emphasis on retail resale, which brings the most value to the company:</p> <ul style="list-style-type: none"> • Reselling refurbished equipment to new end users through CFS pre-owned equipment program • Selling parts to internal maintenance departments for use as spare parts (e.g., hard drives, memory, network cards) • Selling "as is" to wholesale secondary market <p>Minimum materials recycling of off-lease equipment because of equipment age. Equipment remarketing and recycling by in-house operations.</p>
Dell Financial Services	<p>Remarkets most off-lease equipment through several sales channels:</p> <ul style="list-style-type: none"> • Wholesale secondary market (i.e., brokers) • Retail market on the Internet • Other retail markets such as secondhand computer sellers • Employee purchase plan at customer site
Gateway	<p>Not applicable until second quarter of 2000, when first equipment comes back through Your:)Ware program (information not available at press time).</p>
IBM Global Financing	<p>Remarkets majority of off-lease units based on asset value, including:</p> <ul style="list-style-type: none"> • Refurbishing and resale • "As is" resale • Recovery of service parts during demanufacturing for resale • Scrapping/recycling materials
Silicon Graphics Inc.	<p>Sells to brokers and direct to end users; also auctions off equipment.</p>
Independent Leasing Companies	
Computer Sales International	<p>Sells through company-owned retail outlet (approximately 85 percent of equipment) and wholesale brokers. For retail sales, systems undergo cleaning, diagnostic testing, and simple to mid-level repairs.</p>
GE Capital	<p>Sells to broker for resale in secondary markets. Equipment passes directly from customer to broker. GE pays broker a fee to inventory and test equipment to ensure its return in good operating condition. GE receives a percentage of proceeds from sale of systems.</p>
Leasing Group, Inc.	<p>Auctions off equipment to companies that remarket/resell used equipment.</p>
Stamford Computer Group	<p>Resells personal computers:</p> <ul style="list-style-type: none"> • To wholesale brokers (80%) • Direct to end users through Internet and classified advertisements (20%). In-house operation to clean and test equipment. 30 day warranty provided. Upgrades (e.g., adding features such as CD ROMs, modems, and sound cards) upon customer request
Recycling Company	
Resource Concepts Inc.	<p>Utilizes several channels for off-lease equipment, including:</p> <ul style="list-style-type: none"> • Selling "as is" to wholesale dealers • Refurbishing and reselling with software upgrades (only in retail store and through sales staff) • Using some systems for parts to rebuild others

Desktop computer equipment coming off lease today is generally two to three years old, with a trend toward two years, according to several companies interviewed for this report. This mirrors the average lease term, which the companies see shifting from three to two years. Since such off-lease equipment is relatively recent technology, the majority of equipment is remarketed, according to all the companies interviewed.

Table 3.8 summarizes the current practices of the leasing companies interviewed for this report. (See Appendix A for definitions of end-of-use management terms.) Depending on the age and condition of equipment, leasing companies may remarket it via retail channels or sell it to wholesale brokers. The major manufacturer-based programs, as well as some independents, apply the following remarketing hierarchy, aimed at recovering maximum value from off-lease equipment:

- Refurbish and resell direct to end users.
- Resell “as is” to secondary market brokers.
- Utilize for spare parts in service departments.
- Donate to charitable organizations.
- Recycle for material value.

Independent leasing companies, however, generally focus on selling returned equipment to secondary market brokers, although some may resell the computers in the best condition to end users.

Direct resale or re-lease of used computer systems to end users appears to be on the rise, particularly as major computer manufacturers move into financing. This remarketing channel provides the greatest value to manufacturers, including higher revenues, control of secondary market prices, and alternative product offerings to customers. Compaq, Dell, and IBM offer off-lease equipment direct to customers through their affiliated financial services organization. IBM Global Financing and Compaq Financial Services have in-house operations that refurbish computer systems for retail sale. All of Compaq’s pre-owned systems are refurbished to company specifications to qualify for maintenance and extended warranty programs (beyond the standard 30-day warranty on used systems).

IBM Global Financing actively markets refurbished equipment to large corporate customers, to the education and small business markets, and to resellers. The secondary user benefits from receiving technology at a lower price. On its web site, Compaq targets sales of pre-owned equipment to small and medium-size businesses, which tend to be more concerned about information technology costs. Other customers may want pre-owned equipment to expand existing systems to accommodate additional users, while maintaining a standard system configuration.

One remarketing trend among major manufacturers, as well as several independent leasing companies, is the resale of off-lease equipment through retail stores and on-line warehouses. IBM’s web site, for example, offers IBM’s Refurbished PC Warehouse. The Global Financing Group advertises this site as a repository for equipment coming off corporate leases. Interested parties can receive regular faxed updates of available equipment.¹¹³ Similarly, Dell operates DellAuction.com, which allows

customers to bid on off-lease equipment. Dell Auction also includes Your Marketplace, a service that directly links buyers and sellers of customer-owned equipment. Dell customers can post equipment for resale (from one unit up) for a small fee and 2 to 4 percent of the sales transaction; buyers pay no fees to Dell.¹¹⁴

As shown in Table 3.8, off-lease equipment is managed in a variety of ways: by the company itself or by company-owned facilities, by a third party under contract to the leasing company or manufacturer, or by sale directly to a broker for remarketing and disposal. At GE Capital, for example, equipment typically passes directly from the customer's site to brokers without GE taking physical possession of the off-lease equipment.

Resource Concepts Inc. (RCI), a Dallas-based electronics recycler, manages off-lease equipment for Dell Financial Services and other leasing companies, although it does not engage in leasing itself. RCI offers "soup-to-nuts" asset disposition services, including deinstallation and reverse logistics, asset tracking and reporting, proprietary data destruction, equipment remarketing, and materials recycling. Off-lease equipment destined for retail remarketing channels undergoes a standard refurbishment process – basically data destruction, testing, cleaning, and reloading of software – prior to resale, as detailed in the box below. Remarketing revenues are returned to the leasing company, minus a fee for service. If equipment is not remarketable, RCI disassembles it and recycles it into materials fractions, such as metals and plastics, charging the leasing company for these recycling services, with fees ranging from \$6.50 for a central processing unit (CPU) to \$18 for a monitor.¹¹⁵

Refurbishment Process at Resource Concepts Inc.

Off-lease equipment destined for retail remarketing channels undergoes the following multistep asset management and refurbishment process:

1. Receive equipment and record serial numbers.
2. Determine the system configuration (e.g., type of microprocessor and speed, size of hard drive) and perform diagnostic tests to assess system condition.
3. Erase data using triple-flux process.
4. Reload software on remarketable units.
5. "Burn in" units (i.e., plug them in and turn them on to make sure they are operating within established parameters).
6. Clean equipment, removing stickers and dust.
7. Remarket with three-year warranty for desktop systems or one-year warranty for notebooks.
8. Provide detailed asset disposition report to customer and certificate of data destruction.

Today, the cutoff for remarketing desktop units is a Pentium 166 processor or faster. Older technologies (e.g., 386, 486, and low-end Pentium microprocessors) are recycled as scrap to recover base materials (metals, plastic). While older equipment may still be functional and "reusable," it often

is not considered “resellable” for several reasons: the availability of Pentiums on the resale market, which makes older technologies less attractive; the inability of older machines to easily accommodate today’s software; and the cost of refurbishing and upgrading equipment, which can exceed market prices for new equipment.

System upgrades do not appear to be the preferred route at lease end, according to the experts interviewed, although no quantitative data was available. The Leasing Group, Inc., finds that customers prefer shorter lease terms to technology upgrade options.¹¹⁶ Upgrade programs are not always beneficial for the customer. Customers pay higher fees for upgrade programs, since they increase the level of uncertainty for the leasing company.

3. Beyond Leasing: Manufacturer Equipment Recovery Initiatives

Leasing is not the only way that manufacturers recover used equipment. Most major computer manufacturers in the United States recover products from customers through trade-ins with the purchase of new equipment or deinstallation of existing equipment. The recovered equipment may be their own or that of other manufacturers. As a service to customers, Dell, IBM, and Compaq also offer fee-based product recycling services. Product returns through leasing arrangements will be Gateway’s first foray into product remarketing and recycling.

IBM’s North American customers can utilize IBM’s Product-End-of-Life-Management Services to return equipment for recycling. Customers can call or fax an equipment list to IBM, which will arrange for disposition at IBM recycling centers. Depending on the value of the used equipment, customers pay a disposition fee or receive cash back. IBM also offers product take-back programs for customers (mostly commercial) in several countries in Europe and in Japan. Most of these programs charge the customer a disposition fee. However, IBM offers take-back services in the Netherlands without charge.

Worldwide, IBM processed approximately 130 million pounds of end-of-life equipment in 1998, with US facilities handling about half the volume. Recovery programs captured end-of-lease equipment, manufacturing surplus, engineering scrap, replaced internal equipment, and equipment from customer return programs. IBM estimates that while 80 percent of its leased personal computers are returned, less than 5 percent of all its products on the market (PCs to mainframes, leased and sold) enter the company’s recovery channels.¹¹⁷

For its major North America demanufacturing operations, IBM estimates the following breakdown for disposition of end-of-life equipment:

- 40 percent resold or reused
- 56 percent recycled for material value
- 4 percent landfilled or incinerated.

All machines that are not resold are first dismantled and checked for parts with resale potential.¹¹⁸

Dell initiated its Asset Recovery Service (ARS) in 1993 in response to customers seeking assistance with the secure disposition of used equipment that they owned outright. For a fee, Dell Financial Services will manage all or part of the computer disposition process for a customer, starting at the desktop or dock. The customer receives an auditable paper trail, including a detailed inventory of equipment, asset tags, certificate of data destruction, and guaranteed EPA-compliant disposal, if applicable. This service is available only to customers disposing of at least 20 individual units (such as CPU, monitor, laptop, or printer) or ten complete systems at a time.

Dell offers two disposition options as part of ARS, depending on the remarketing potential of the equipment. Its value recovery service is targeted at customers getting rid of functional equipment that still has economic value in the secondary PC market. The customer receives the revenue, minus a fee to Dell Financial Services for managing the disposition process. Dell's PC Recycling Services, a fee-based system, is available to customers with older systems, regardless of manufacturer or condition. Customers are typically charged \$20 per unit, and packaging and shipping costs are the customer's responsibility. The units returned under this program are usually disassembled and scrapped to recover the component metals. Some components may be sold as used parts, or entire units sold to wholesale markets.¹¹⁹

Compaq Financial Services offers trade-in programs for selected equipment. The principal goal of these programs is to sell new products while displacing those of the company's competitors. A fee-based PC recycling service is also available to customers through Compaq's recycling organization.

4. Environmental Product Design

In the early to mid-1990s, leading computer manufacturers began to consider environmental issues in the design of products, largely the result of emerging extended producer responsibility legislation and eco-label requirements in Europe. With the prospect of having to take back and recycle old equipment, computer manufacturers such as IBM looked toward product design changes as a way to lower the cost of recycling products at the end of life. The quest to market "green" products under eco-label programs such as Germany's Blue Angel provided companies with a rationale to pursue design changes such as those reflected in Dell's largest-volume PC product, the OptiPlex model (described in Appendix B).¹²⁰ In addition to guaranteed product recovery, the Blue Angel program, for example, requires products to meet specific design criteria intended to facilitate recycling and prolong product lifetime.

As a result of these legislative and market pressures, design for environment (DfE) among computer manufacturers, both in the US and in Europe, has focused on several key areas, with the major efforts directed toward designing for recycling rather than for reuse:

- Designing products to facilitate disassembly (e.g., minimizing the number of parts, replacing screws with snap-together parts)
- Selecting materials to optimize product recyclability (e.g., eliminating painted finishes on plastic parts, reducing the variety of plastics, coding plastic parts for easy identification).

To a lesser extent, their efforts include designing products to increase opportunities for reuse and upgrades (e.g., modular designs, using common part designs).

In theory, leasing – and the increased probability of product recovery associated with it – should provide an additional impetus for computer manufacturers to design products that enhance end-of-life value and opportunities for reuse. However, the manufacturers interviewed for this study consider leasing to be primarily a financing and marketing mechanism that kicks in after product manufacture. When products come off lease, the lessor then tries to recover maximum value based on prevailing market rates. Value recovery is generally an end-of-lease, after-the-fact concern, not an overt product strategy tied in with the potential for remanufacturing.

Additionally, the manufacturers studied do not differentiate between leased and nonleased equipment in product design. It is not practical or economical to maintain separate production lines, so any design changes they make that increase the durability and life span of leased equipment will increase the durability and potential life span of nonleased equipment as well.

The limited influence of leasing on product design may be rooted in the industry's organizational structure, in which leasing entities are largely independent from manufacturers. Even for captive leasing programs, the manufacturer's leasing arm is often detached from the manufacturing arm and focuses on remarketing equipment returned at lease end, or selling parts to internal maintenance departments for use as spare parts, rather than returning the equipment to the manufacturing arm. In these cases, the manufacturing arm has little incentive to increase the end-of-life value of its products since it does not receive the products back at end of life. In addition, designing in greater value may increase the initial purchase price, which could make the product less attractive for initial purchase.

However, for IBM, which operates its own recycling facilities, leasing appears to have had an indirect impact on product design. While leased products are not designed any differently than nonleased products, direct involvement in the recycling of products (leased and nonleased) led IBM to develop its Environmentally Conscious Product (ECP) program as a way to facilitate product recycling and lower processing costs at its recycling facilities. When a company gets its products back, whether from leasing, trade-ins, or paid take-back, it has an incentive to focus on maximizing asset recovery at end of life. IBM has linked this to product design.

By the beginning of the 1990s, IBM realized that it would be legally required to take back equipment at end of life or would find it competitively advantageous to do so. The company also recognized the importance of product design in facilitating computer recycling and lowering end-of-life costs. Thus, when IBM initiated the ECP program in 1991, its goals were improving product recyclability, upgradability, and use of recycled materials. Characteristics such as recyclability and upgradability are included in the design of all equipment as much as technology and other product requirements allow.

The ECP requirements are incorporated into IBM's integrated product development process and the basics on design for environment are contained in various IBM corporate design standards and guidelines. However, the real drivers for change are the measurement tools and metrics designed to track company progress toward ECP goals by, for example, providing ratings for new product

design (see Table 3.9), recycled content, and landfill avoidance. Additionally, IBM annually brings product designers and procurement personnel together with end-of-life managers (recyclers) at a Product Stewardship Workshop held at IBM's Endicott Asset Recovery Center.

Table 3.9 IBM's Design for Environment Rating for a Hypothetical Product

Environmentally Conscious Product (ECP) Attribute	Maximum Score	Product Score
Upgradability, expandability, commonality	10	9
Assembly and disassembly	10	9
Electromagnetic emissions	5	5
Batteries	5	4
Acoustics	5	5
Power management	10	10
Fewer materials	5	5
Coding of plastics (> 25g)	5	5
Use of recycled materials	10	9
Recyclability and reutilization	10	10
Finishing of parts	5	4
Electromagnetic shielding	5	5
Supplier ECP compliance	5	4
Labels/markings of plastic parts	5	5
Use of regulated materials	5	5
Total Score	100	94

Source: Dewey Pitts, IBM Engineering Center for Environmentally Conscious Products, presentation at Northeast Recycling Council, Albany, New York, June 17, 1999.

After more than five years of targeted efforts, IBM states that its DfE initiatives are paying off. Products designed using ECP program guidance are now coming back to IBM recovery centers. Studies performed by IBM on end-of-life equipment of various ages demonstrated overall improvement in ECP-designed products for seven of the fifteen targeted attributes, specifically:

- Ease of disassembly.
- Battery information and location.
- Reduced number of materials (plastics and metals).
- Coding of plastic parts.
- Finishes on plastic parts.
- Labels/markings on plastic parts.
- Electromagnetic shielding impact on recyclability.¹²¹

5. The Role of Leasing

While countries around the world institute extended producer responsibility mandates for product end of life, the traditional leasing model may be able to achieve some similar objectives – such as extended responsibility, resource conservation, and recycling – without legislation. In terms of achieving resource conservation and recycling goals, leasing appears to be advantageous compared to outright purchases of computer equipment. Leasing can result in more rapid return of equipment to product recovery channels, avoiding prolonged equipment storage and increasing resale and reuse opportunities. When products are returned to the manufacturer, leasing can also enhance manufacturer access to its own equipment for use in spare parts and remanufacturing programs.

The effectiveness of leasing in encouraging companies to close materials loops is tied to who owns the equipment at end of life and whether a system is in place to ensure that it ultimately flows into a recovery channel for reuse, remanufacturing, or recycling. Under an operating lease, which is currently the most popular leasing option, the leasing company owns the equipment at lease end. The leasing companies interviewed for this study had extensive experience with and access to remarketing channels; the majority of off-lease PC equipment they handle is remarketed. Equipment that is no longer remarketable enters the recycling stream, where it is demanufactured for spare parts or recycled for material value. Recycling older equipment is driven by both economics and the potential liabilities associated with improper disposal of equipment.

There are several caveats to the environmental benefits of leasing. First, not all leased computer equipment comes back to the lessor. As discussed earlier, one study showed that lessees either purchase or extend the lease on about 65 percent of computer equipment of all types at lease end, although IBM reports an 80 percent return rate for personal computers under lease agreements. When equipment is purchased at lease end, ownership is transferred to the user along with the end-of-life responsibility, and in this respect is no different than an initial outright purchase. However, when combined with equipment trade-in, outright purchases, either initially or at lease end, may achieve similar results to leasing, since in both cases the end user can return the old PC to the manufacturer or designated agent.

Second, by design, leasing makes it easier for end users to push aside older technology to make way for the latest technology. With or without leasing, some end users will always want or need the newest technology to meet their performance requirements. However, if leasing makes it easier to rapidly deploy off-lease equipment to an end user with lower system performance needs, it could actually extend the total service life of the equipment.

Third, the benefits of leasing in terms of materials recovery may not extend to the end of the product's life. If returned equipment is subsequently sold through remarketing channels, it exits the recovery loop built into the leasing process, unless the new customer chooses to access the vendor's fee-based product recovery service. In contrast, re-leasing equipment through the end of its service life, even to a new owner, is more likely to result in its ultimate return to the manufacturer, thereby achieving extended producer responsibility objectives.

Finally, although computer manufacturers are aggressively moving into the financing arena and taking greater interest in managing off-lease equipment, this is not necessarily translating into the closing of materials loops through remanufacturing. Recovery of off-lease equipment combined with other asset management and recycling program offerings is resulting in a greater focus on product end-of-life management, value recovery, and product design to facilitate recycling, but interviews with industry representatives suggest that the industry is not headed in the direction of coupling equipment recovery with remanufacturing. There may be several reasons for this, including changing technology, the relative cost of refurbishing versus purchasing new parts, and inadequate returned equipment volume to fill the supply pipeline. This could change, however, with greater standardization of designs and increasing recovery volumes.

Appendix A: Selected End-of-Life Management Definitions

Demanufacturing	The process or sequence of operations by which an unusable, obsolete, or end-of-life product is disassembled and segregated into reusable or recyclable components and/or materials.
Recycling	The processing or reprocessing of any discarded material or item into a usable material for direct dissemination into commerce as a raw material, an intermediate product, or a finished good.
Reuse	The reuse of a material, component, piece part, and/or subassembly by employing it as an ingredient in an industrial process to make a product, or in a particular function or application as an effective substitute for a commercial product.
Refurbishing	Upgrading, rebuilding, repairing, reconfiguring, and/or improving the performance of equipment to extend its usable life in lieu of disposal, recycling, or recovery.
Remanufacturing	The process of disassembling a product, replacing obsolete, nonfunctional, or nonusable parts, and reassembling the product to meet the original specifications.

Source: D. T. Allen, UCLA, and Joseph Fiksel, Decision Focus, Inc., "Terminology Used in Design for the Environment," cited in Electronics Industry Alliance, "Position Paper on the Management of Used Electronic Products," March 1997.

Appendix B: Selected Case Studies

Much of the information in these case studies was included in the main text of Part III. The case studies are presented here so that interested readers can find all the information about the individual companies profiled in one place.

Compaq Financial Services¹²²

Compaq Computer Corporation is the largest supplier of computer systems in the world, with revenues exceeding \$38 billion in 1999.¹²³ Compaq designs, manufactures, and markets desktop and portable computers, workstations, servers, storage systems, monitors, and printers to the business, home, government, and education sectors, reaching customers in more than 200 countries.¹²⁴

In 1997, Compaq Computer Corporation established Compaq Financial Services (CFS), a wholly owned subsidiary, to provide financing solutions to its customers.

Management of Off-Lease Equipment

Compaq Financial Services predominantly utilizes three remarketing channels for off-lease equipment:

- Reselling refurbished equipment to new end users through the CFS pre-owned equipment program
- Selling parts to internal maintenance and service departments for use as spare parts (e.g., hard drives, memory, network cards)
- Selling “as is” to the wholesale secondary market.

Retail sales are the preferred remarketing route as they bring the most value to the company. A minimum amount of off-lease equipment is recycled, since the equipment is generally only one to four years old.

Compaq Financial Services has an in-house operation that refurbishes and tests computer systems to standard specifications. This qualifies equipment for maintenance and extended warranty programs (beyond the standard 30-day warranty on used systems).

Compaq Financial Services targets sales of pre-owned equipment to small and medium-size businesses, which tend to be more concerned about information technology costs than larger businesses. Some other customers want pre-owned equipment to expand existing systems to accommodate additional users, while maintaining a standard system configuration.

Other Product Recovery Services

In support of Compaq Computer, CFS offers trade-in programs for selected equipment. The principal goal of these trade-in programs is to sell new products while displacing those of competitors. Hence, Compaq will also take back other manufacturers' products.

Compaq also offers a fee-based recycling service, to any organization wishing to dispose of obsolete equipment of any brand, through its Computer Asset Recovery Services (CARS) group. The goal of CARS is to recover the maximum value from equipment. Depending on the technology, the condition of the products, and the available markets, CARS may:

- Sell equipment in the secondary marketplace.
- Recover parts (e.g., EPROMs, DRAMs) for resale in the secondary marketplace.
- Recycle material fractions.

Less than 0.5 percent of products recovered by CARS end up in landfills.¹²⁵

Dell Computer Corporation¹²⁶

Dell Computer Corporation is the number one direct seller of PCs in the United States, with annual sales reaching more than \$25 billion in 1999.¹²⁷ Dell pioneered the “build-to-order” and direct-sales model for PCs. These lower-cost manufacturing and sales strategies have contributed to Dell’s success and have altered the industry. Dell’s product offerings include several desktop and notebook models, workstations, servers, and storage products. Nearly 60 percent of Dell’s sales are to large corporations, government agencies, and educational institutions.¹²⁸

Leasing Programs

Dell Financial Services (DFS) is an independent entity formed in 1997 as a joint venture between Dell Computer and Newcourt Credit Group Inc. Its goal is to help grow Dell’s market share by providing Dell customers with a “total solution,” or “one-stop shopping.” Through DFS, customers have access to financing, asset management services, and PC recovery and recycling options. In 1999, DFS originated \$1.8 billion in financing for customers, up from \$895 million in 1998.¹²⁹

For business, government, and educational institutions, Dell offers three lease options: an operating lease (called a fair market value lease) and capital leases with two different payment structures and final payment options (10 percent of the original cost, or \$1). A fee-based “technology rotation” option is available on any of the above leases. The fee is a percentage of the original purchase price of the equipment.¹³⁰

The operating lease is the most popular, accounting for 86 percent of DFS leases. Three-year lease terms account for 80 percent of the leases; two-year leases account for 20 percent of leases, and are mostly laptops.¹³¹

Managing Off-Lease Equipment

The typical age of equipment coming off lease is three years old. Most off-lease equipment is remarketed through several sales channels, including:

- Wholesale secondary market (i.e., brokers).
- Retail market on the Internet.
- Traditional retail markets, such as secondhand computer sellers.
- Employee purchase plans at customer sites.

With almost 50 percent of Dell’s revenues generated from the Internet by the end of 1999,¹³² it is not surprising that the company has turned to its web site to sell off-lease equipment to customers. At DellAuction.com, customers can bid on previously leased computers owned by Dell Financial Services. Prior to resale, computer systems are inspected for cosmetic damage, tested to ensure workable condition, and then sold “as is.” Since many of the computer systems are less than two years old, Dell’s original three-year warranty may still apply and can be transferred to the new owner.¹³³ In addition to the sale of off-lease equipment, Dell’s online factory outlet offers factory-refurbished

products. These are products that were returned to Dell under its 30-day total satisfaction guarantee. Returned products are rebuilt to original factory specifications and then tested to meet the original specifications. The refurbished products come with the same three-year limited warranty and technical support offered on new Dell products.¹³⁴

Product Recovery and Recycling

Dell initiated its Asset Recovery Service (ARS, now managed by DFS) in 1993 in response to customers seeking assistance with the secure disposition of used equipment that they owned outright. For a fee, DFS will manage all or part of the computer disposition process for a customer, starting at the desktop or dock. DFS removes equipment from the customer's site, takes an inventory of assets (e.g., make and model, system configuration, serial numbers), assesses the remarketing potential, destroys data, and sends the equipment to remarketing channels or recycling vendors. The customer receives an auditable paper trail, including a detailed inventory of equipment, asset tags, certificate of data destruction, and guaranteed EPA-compliant disposal, if applicable.

Dell offers two disposition options, depending on the remarketing potential of the technology. Its value recovery service is targeted at customers getting rid of functional equipment of any brand that still has economic value in the secondary PC market, which at a minimum is a Pentium 166 or better today. (While older technologies, such as 486s, may have a market, the cost of receiving, sorting, cleaning, and reformatting the hard drive is greater than what the market is willing to pay.) The service is available to customers disposing of a minimum of 40 individual units (such as CPUs, monitors, laptops, or printers), or ten complete systems at a time.¹³⁵ A competitive bid process establishes the price for used equipment. The customer receives this revenue, minus a fee to DFS for managing the disposition process.

DFS's PC Recycling Services, a fee-based system, is available to customers with older systems, regardless of manufacturer or condition. Customers are typically charged \$20 per unit, and packaging and shipping costs are the customer's responsibility. Returned units are processed by one of several companies under contract to DFS. This program is designed for nonfunctional equipment with no value in the secondary market. In today's market, this typically applies to early 486, 386, and older technologies. To participate in this recycling program, customers must have a minimum of 200 units or 5000 pounds of equipment at a time.¹³⁶ Given the age of the computer systems, the units are usually disassembled and scrapped to recover the component metals. Some components may be sold as used parts, or entire units sold to wholesale markets.¹³⁷

Product Design

In 1996, Dell initiated a "cradle-to-cradle" design philosophy for the OptiPlex product line, its largest-volume PC product. The OptiPlex now features a modular design for easy upgradability, disassembly, reuse, and recycling and a fully recyclable chassis. Many OptiPlex models have received the German Blue Angel eco-label, and the OptiPlex Gn/Gn+ has received the more rigorous Swedish TCO '95 certification.¹³⁸

Gateway¹³⁹

Gateway is among the top five sellers of personal computers in the United States. In 1999, it shipped more than 4.68 million computer systems worldwide, with net sales of more than \$8.6 billion.¹⁴⁰ Gateway sells approximately 50 percent of its PCs to households, and 50 percent to the business and education markets. Selling direct to customers – by telephone, the Internet, and Gateway Country stores – is a hallmark of the company’s business model.

Financing Programs

In 1998, Gateway introduced its PC financing program for individual consumers, Your:)Ware, complete with a technology upgrade option. The popularity of Your:)Ware is credited with boosting Gateway’s earnings.¹⁴¹ Your:)Ware for consumers is not a leasing program. It is a consumer finance program that allows customers to trade in their system for a new one any time between 24 and 48 months from the date of purchase. The customer receives a trade-in allowance toward the purchase of a new Gateway PC. The trade-in value is based on the *Orion Blue Book*, a standard guide for used computer prices. To qualify for trade-in, the system must be complete and in good operating condition. Customers are responsible for the cost of shipping the product back to Gateway.¹⁴²

To obtain the Your:)Ware option, customers must buy a Gateway PC and choose one of the following options:

- Finance the purchase through Gateway.
- Purchase a software package along with the computer hardware.
- Purchase a support package upgrade, such as internet access, through Gateway.¹⁴³

The cost of the Your:)Ware program is included in the overall price of the computer and not billed separately.

After launching the consumer program, Gateway introduced similar programs geared toward its small- and medium-size business and education markets. As part of its Your:)Ware for Business program, Gateway offers a “technology refresh business lease” that allows its customers to replace technology every two years while maintaining a fixed payment schedule. Equipment is refreshed with the latest available model in the product class under lease, as determined by Gateway.¹⁴⁴

Gateway also offers customers other financing options, including an operating (fair market value) lease for business and credit card purchases for individual consumers. A network of finance companies, in partnerships with Gateway, provide the capital to finance PC purchases.¹⁴⁵

Managing Product Returns

Trade-ins under the Your:)Ware program did not begin until mid-2000, or 24 months after the inception of the program; at the time of INFORM’s interviews, Gateway representatives would not disclose any details of their plans and did not return follow-up calls as this report went to press. Computer disposition will be a new opportunity and challenge for Gateway, since the company did not accept trade-ins with the purchase of new equipment until the inception of the Your:)Ware program.

International Business Machines (IBM)¹⁴⁶

IBM, a high-tech giant, offers more than 40,000 information technology products, including computer systems, software, networking systems, storage devices, and microelectronics. In 1999, IBM's revenues exceeded \$85 billion, with hardware sales accounting for about 42 percent of revenues. Nearly 60 percent of IBM's sales were from services, software, and electronic components.¹⁴⁷

Leasing and Financing Programs

IBM Global Financing provides leasing and financing for hardware, software, and services from IBM, as well as other vendors. In 1998, IBM Global Financing leased products and services totaling \$7 billion in the United States alone. IBM has witnessed a growth in leasing among all sectors – commercial customers, educational institutions, and government agencies – in recent years. To provide small businesses, one of IBM's fastest growing customer segments, with easy access to financing, IBM developed its web-delivered SuccessLease. (SuccessLease is offered and administered by Fidelity Leasing Inc., an approved provider of business financing for IBM Global Financing. All terms are provided by Fidelity Leasing Inc. SuccessLease is an IBM trademark.)

The types of products leased range from personal computers, printers, and storage devices to mid-range servers and mainframes. Personal computers represent a large percentage of total leasing activity, although IBM did not provide a precise figure. Currently, the average lease is three to five years, but this is decreasing as the pace of technology change accelerates. The lease term varies by product category; for example, the typical PC notebook lease duration is 24 months, while an average printer lease is 60 months.

Various technology upgrades or exchanges are available during the course of the lease. Customers use upgrades to add capacity and functionality during the lease. Desktop customers commonly replace older PCs with newer PCs and extend their leases.

IBM Global Financing offers customers several options at end of lease, including keeping the equipment on a month-to-month basis, extending the lease, and purchasing or returning the equipment. The majority of leased products are returned at end of lease and remarketed. The customer pays to ship the equipment back to IBM, and IBM absorbs all refurbishment costs and receives the remarketing revenue.

Managing Off-Lease Equipment

IBM recovers more than 5000 off-lease computers – from mainframes to PCs – each week. Approximately 80 percent of IBM's leased personal computers come back to the company at lease end. IBM's Global Asset Recovery Services manages the end-of-lease return process, as well as other surplus and returned equipment, with the goal of maximizing returns by remarketing assets. IBM has been in the refurbished used equipment remarketing business for many years and has invested in processing systems, logistics, and distributor development.

Equipment entering the resale channel is typically three to five years old, depending on type. As part of the process of receipt and asset verification, IBM determines the asset value of returning equipment and decides whether it will be:

- Refurbished and resold.
- Resold “as is.”
- Demanufactured with recovery of service parts for resale.
- Scrapped/recycled for materials.

A majority of the off-lease units are resold.

IBM Global Financing then actively markets refurbished equipment to large corporate customers, the education and small business markets, and resellers. Secondary users benefit from receiving technology at a lower price. Off-lease equipment is also reutilized internally by IBM to support existing maintenance contracts, benefiting customers through the timely availability of spare parts at a fraction of the cost of new parts. In addition, IBM operates its on-line Refurbished PC Warehouse, comprising mostly off-lease inventory. The warehouse also resells remanufactured systems from the IBM Personal Systems Group.

Other Product Recovery and Recycling Initiatives

IBM processed approximately 130 million pounds of end-of-life and other equipment in 1998. This includes end-of-lease equipment, manufacturing surplus, engineering scrap, replaced internal equipment, and equipment from customer return programs. The company estimates that less than 5 percent of its own equipment of all types on the market enters IBM recovery channels.

North American customers can utilize IBM’s Product-End-of-Life-Management Services to return equipment for recycling. Customers can call or fax an equipment list to IBM, which will arrange for disposition at IBM recycling centers. Depending on the value of the used equipment, customers pay a disposal fee or receive cash back. IBM also offers product take-back programs for customers (mostly commercial customers) in several major countries in Europe and in Japan. Most of these programs charge the customer a disposal fee, but IBM offers take-back services in the Netherlands without a charge.

To process equipment, IBM operates a worldwide network of materials recovery centers. More than 50 percent of the equipment recovered is processed at six recovery centers in the United States. The largest facility, in Endicott, New York, processed 35.1 percent of equipment recovered by IBM worldwide in 1998.¹⁴⁸ For its major North America demanufacturing operations, IBM estimates the following breakdown:

- 40 percent resold/reused
- 56 percent recycled for material value
- 4 percent landfilled or incinerated.

Equipment that is not resold is first dismantled and checked for parts with resale potential.

Product Design Initiatives

By the beginning of the 1990s, IBM realized that it would either be legally required to take back equipment at end of life or would find it competitively advantageous to do so. The company also realized the importance of product design in facilitating computer recycling and lowering end-of-life costs. Thus, in 1991, IBM initiated its Environmentally Conscious Product (ECP) program to improve product recyclability, upgradability, and use of recycled materials. Characteristics such as recyclability and upgradability are included in product designs for all equipment as much as technology and other product requirements allow.

The ECP requirements are incorporated into IBM's integrated product development process and the basics on design for environment (DfE) are contained in various IBM corporate design standards and guidelines. However, the real drivers for change are the measurement tools and metrics designed to track company progress toward ECP goals by, for example, providing ratings for new product design (see Table B.1), recycled content, and landfill avoidance. Additionally, IBM annually brings product designers and procurement personnel together with end-of-life managers (recyclers) at a Product Stewardship Workshop held at IBM's Endicott Asset Recovery Center.

Table B.1 IBM's Design for Environment Rating for a Hypothetical Product

Environmentally Conscious Product (ECP) Attribute	Maximum Score	Product Score
Upgradability, expandability, commonality	10	9
Assembly and disassembly	10	9
Electromagnetic emissions	5	5
Batteries	5	4
Acoustics	5	5
Power management	10	10
Fewer materials	5	5
Coding of plastics (> 25g)	5	5
Use of recycled materials	10	9
Recyclability and reutilization	10	10
Finishing of parts	5	4
Electromagnetic shielding	5	5
Supplier ECP compliance	5	4
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Use of regulated materials	5	5
Total Score	100	94

Source: Dewey Pitts, IBM Engineering Center for Environmentally Conscious Products, presentation at Northeast Recycling Council, Albany, New York, June 17, 1999.

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- Coding of plastic parts.
- Finishes on plastic parts.
- Labels/markings on plastic parts.
- Electromagnetic shielding impact on recyclability.¹⁴⁹

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