DESIGNING DURABILITY
EMERGING OPPORTUNITIES

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"Use it up . . . Wear It Out . . . Make It Do . . . or Do Without"
WWII public slogan from the US Office of Price Administration

Design for Durability is an ecodesign strategy that holds tremendous, largely untapped potential to support environmental quality, for fundamental physical reasons. It can help overcome the insidious problem of planned obsolescence. Businesses, product designers, design engineers, and many private and public participants can take advantage of the growing opportunities to develop more durable product systems, thereby reducing ecological damage and supporting environment sustainability.

PLANNED OBSOLESCENCE: A PERPETUAL VICE

Since the advent of mass production, businesses have used design to not only stimulate the demand for new products but to make products that breakdown long before it is necessary. This is known as planned obsolescence, which should not be confused with technological obsolescence or psychological obsolescence. Technological obsolescence occurs when new technology renders a product with older technology to be inferior, such as when cell phone cameras displaced the use of many photographic-film cameras. Psychological obsolescence occurs when an old product becomes unfashionable, such as occurs now weekly in the apparel industry, which now churns out 52 "micro-seasons" per year. Technological obsolescence is usually unavoidable due disruptions from new technologies. Planned and psychological obsolescence, however, are entirely avoidable, and should be seen for what they are: unethically wasteful practices.

Planned obsolescence can increase the demand for new product purchases which, in turn, can bolster profits. Karl Marx presciently described the need for obsolescence "The production of . . . surplus value based on the increase and development of the productive forces requires the production of new consumption" (Marx 1861). Business managers in the early 20th century extolled the virtues of consumer engineering, which meant "any plan that increases the consumption of goods" (Shelden & Arens 1932, Boradkar 2010). Don Norman relayed a story of when Henry Ford asked his engineers to analyze all the parts of scrapped Ford cars to determine which parts failed (Norman 2013). Ford's goal was not to redesign the weak parts to be stronger, but to design the strong parts to be weaker and hence save money. Likewise, in 1939, internal documents at General Electric document how they manufactured lightbulbs to burn out 33% earlier than was necessary, noting that “no publicity or other announcement will be made of this change” (Packard 1960).

Figure 1. The Apple iPod was designed so that only an electronic specialist could replace a broken battery. This led users to throw away many, possibly the majority, of these circuit laden devices before it was necessary. Like all systems that were designed for obsolescence, this product may have boosted sales, but it unnecessarily created pollution and wasted an immense amount of resources.

The second world war nationalized US industries, saw massive public investment into new technologies like synthetic rubber, and channeled scarce material and energy resources into the war effort. With the federal government in charge, the motivation for planned obsolescence temporarily stopped (Rogers 2005). Frugal use of products was promoted by the Federal Price Board (see slogan at beginning of this article) as a patriotic way to stop inflation.

When post-war industry returned to private management, the consumption pendulum swung back with unprecedented force. Annual automobile design changes became standard, new disposable plastic products and packaging were created and heavily promoted, while marketing experts advised that “We need things to be consumed, burned up, worn out, replaced and discarded at an ever-increasing pace’ (Lebow 1955). The material excesses of consumer culture and the unmitigated pollution of land, water and air in the US lead to the creation of the environmental movement in the 1960s. A series of major environmental laws were passed with broad bi-partisan support, leading to the creation of the US EPA in the 1970s.

STRATEGIC EVOLUTION

In response to the alarming evidence of stratospheric ozone layer depletion, global habitat destruction and climate change in 1980's and 1990's, businesses and governments increasingly adopted 'design for environment' policies that applied to manufactured products (Papanek 1995, Fiskel 2012). New business models and strategies to reduce damage to the natural environment from human-made systems were also investigated. Each stage of the product life cycle was explored to identify opportunities to reduce ecological burdens. Comprehensive arrays of ecodesign strategies that follow the stages of the product system life cycle were proposed to businesses and design teams (Brezet & Van Hemel 1997, White, St. Pierre & Belletire 2013).

Figure 2. Tools produced with robust components and steel enclosures, such as this Husqvarna 3600 Viking sewing machine, circa 1972, exemplify products with a long service life. Photograph: Petri Krohn

Businesses and design teams have increasingly recognized Design for Durability as potent ecodesign strategy. A product system that delivers the maximum amount of service that is physically possible over its life consumes fewer resources and produces less pollution per unit of service than a similar product system with a shorter life. The expanding practice of leasing products instead of owning them, also known as product service systems, reduces the number of products that must be purchased while incentivizing the business owner to use the most durable products (Behrendt, et. al. 2003).

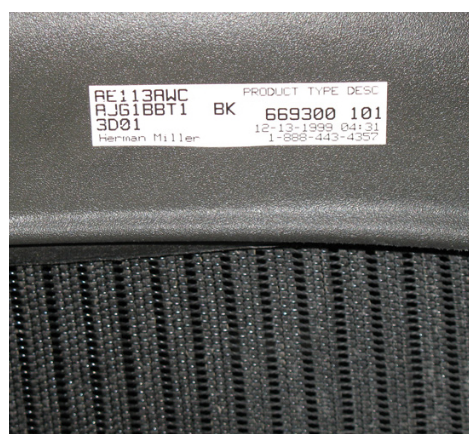
Concurrently, concerns about the disposability of goods in the global marketplace prompted ‘Eternally Yours,' a discourse over the need for greater product longevity (Van Hinte 1997). A reciprocal characteristic of a product delivering more service is having a longer product lifespan. Conny Bakker observed, “A longer product lifespan is a cornerstone of the circular economy, because it slows the speed of the materials and goods flowing through society, thus reducing waste” (2015).

The concept of the ‘circular economy’ was adopted around 2010 to describe economic models and strategies that support commercial vitality while minimizing consumption of physical resources. “A circular economy is one that is restorative by design, and which aims to keep products, components and materials at their highest utility and value, at all times” (Webster 2015). It requires that society treats materials and product systems with greater attention than the prevailing market driven system which is addicted to the global production of material waste.

BUSINESS OPPORTUNITIES

Planned obsolescence is a common and deplorable strategy employed by many product system manufacturers. It is not, however, the only way to operate a profitable manufacturing business. Other business approaches deliver durable product systems and robust revenues.

One often overlooked approach is the humble **product warranty**. Warranties have served an essential role in ensuring the quality of traded goods since the time of the Babylonians (Loomba 2008). Warranties for parts and service provide substantial benefits to the manufacturer that can outweigh their financial costs. The benefits include long-term customer relationships with strong customer loyalty, an assured supply of materials of known quality for material recycling, and increased brand value.



Figures 3. and 4. Smith Optics warrants your sunglasses, goggles and helmets for their lifetimes, while Herman Miller offers a standard twelve-year warranty on parts and service for of their all office chairs sold in North America, documented by the ‘birthmark’ label such as the one on this Aeron Chair.

Another business strategy for bolstering durable products is not to sell the physical product, but to **sell the service of the product**. As described earlier, product service systems rent or lease products. Leased automobiles and rented formal clothing are a few of the most familiar product services. The range of markets adopting this strategy expanded dramatically over the past decade (Webster 2015) to include carpeting, sound and vision systems, kitchen appliances, toys, and medical equipment, to name a few. As with extended warranties, the primary benefits include an economic incentive for a physical design with the longest possible lifetime, definitive control over the material quality in the stock, access to components that may be re-used in new or refurbished products, and ongoing customer interactions that build brand loyalty.

Figure 5. Bike-share systems require the design the hub and its interface, as well as the reciprocating bicycle hardware, such as in this Bay Area Transportation system`. *(NOTE to editor: please crop any image as needed).*

PRODUCT DESIGNERS' OPPORTUNITIES

Design teams often do not develop system longevity because the project brief does not ask for it. Design briefs rarely give durability a high priority, if they mention it at all. In many projects, a member of a design team (product designer, marketer, or engineer) can suggest **adding durability as one of the goals in the design brief.** Before a team member suggests extending the product lifetime, she or he would be prudent to research the technical and economic costs and benefits of the directions under consideration. Informal one-on-one discussions with other team members can clarify preliminary conflicts. Supporting the suggestion with credible information will increase the probability of a positive reception. Where possible, designers can also maneuver, where possible, to **participate earlier in the creation of the design brief**, thereby leveraging greater influence.

Engineers are trained to understand how a product can mechanically or electrically fail. Naturally, product designers transfer the responsibility for many technical aspects of durability to the product engineers. But **product designers can give fresh creative input** in the process. By working with the engineers to understand the technical and economic reasons that favor a design direction, designers can propose tougher materials or visualize new configurations that offer better aesthetics, greater usability, as well as longer system life.

Because product designers take primary responsibility for the aesthetic qualities of the product, designers may strive to **create a timeless aesthetic appeal**. The appeal would ideally make users desire to keep the product for a long period (Van Hinte 1997). Realizing this opportunity, however, can be an elusive process. Designers today cannot readily assess the opinions of people in the future because we implicitly base such projections on current aesthetic standards.

Figures 6. and 7. Time will tell if an eternal aesthetic appeal can be realized through minimal gestural forms, such as this lamp, by Bonderup and Thorup, 1968, or the Alfi High Back Chair, a “simple, comfortable, and strong design that will last generations”, by Jasper Morrison, polypropylene and wood fiber composite with ash wood legs, 2015.

ENGINEERS’ OPPORTUNITIES

Engineers can learn how to **apply the most effective methods to measure and minimize product system failures.** The bulk of research on engineering design failures has focused on building materials (Ashby, 2005) and large constructions such as bridges (Petroski 2006). But the rules of mechanical failure from forces and vibrations also apply on smaller scales with finer layers of complexity. Ever advancing parametric CAD software can identify stress-points where parts of a system will break. Such powerful programs increasingly compute part geometries with minimal material use and maximum strength. Analogous electronic software model the functionality of integrated circuitry with microprocessors and components that transmit electrical signals, predicting interferences, hot spots and probable failure modes.

Engineers and designers need **access to documentation of existing product failures.** Well-run manufacturing operations collect this information on all the products that they manufacture and sell. These documents often reveal the most critical insights for increasing the durability of each product. Such information is habitually kept secret from competitor manufacturers and the company's customers, so a company often only shares it among select employees. If the company does not have such a library, the design team can ask about the best way to organize it.

BROADER OPPORTUNITIES

Product (industrial) design and engineering **educators can include clear design for durability guidelines in appropriate courses**. Such guidelines can describe viable business models, how manufacturers evaluate and document product failures (covering the mechanical or electronic analysis methods via problem exercises), and best collaborative communication practices for design teams to promote durable product systems.

Software developers can advance software to simultaneously **analyze systems with a muiltitude of sub-sassemblies and parts for mechanical and electrical failure.** They can also develop software that **accurately simulates potential corrosion and its effects on the mechanical and electrical integrity** of products that must swithstand decades of fluctuating exterior temperature, humidity, and ultraviolet-light exposure.

Marketers may avoid publicizing product lifetime claims because the legal advisors such claims may expose the enterprise to lawsuits. Legal advisors can research liability law to **strategize how best to navigate existing laws and can advise on how the laws may need to be modified.** They can also map potential legal pathways to realize those modifications.

Independent laboratories, such as Consumer Reports, can establish credible **protocols for reporting of probable product lifetimes in years or hours of use in many product categories**. Further, they can **begin reporting measured product lifetimes based on the measured field data** from older product models.
Independent eco-labeling organizations, such as those that certify Environmental Product Declarations (EPDs) can develop **voluntary lifetime reporting standards** for participating product categories. This program may begin with environmentally receptive market sectors, such as contract office furniture, that already embrace many aspects of durable product systems.

Not-for-profit organizations, collaborating with the participating industries, legislators, the US Environmental Protection Agency, and possibly with the independent laboratories and eco-labeling organizations, can coordinate the **development of mandatory product lifetime reporting standards**

for major product categories. Regulators could phase-in this long-term program after initial pilots establish standards that appropriately match the needs of respective industries and product categories.

DURABILITY IS ESSENTIAL

Design for Durability holds a strong capacity to improve the environmental performance of human-made systems. Promoting durable product systems is a constructive and hopeful act that can help us protect biodiversity while increasing our capacity to meet the real needs of the vast human population. Regardless of culture, nationality, or specialized discipline, people around the world recognize the crucial value of tools and product systems that last. The universally understood value of durable products means that this is a concrete, fathomable goal for product manufacturers and design teams. The age-old problem of planned obsolescence and its flagrant waste of products and materials will not be resolved easily. But this should not deter us from exploring the opportunities.

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