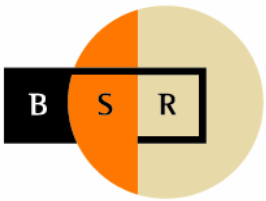

Business for Social Responsibility

Aligned for Sustainable Design

An A-B-C-D Approach to Making Better Products

May 2008

About This Report

Companies succeed in sustainable product design, at least in the short term, by developing a more integrated design process. Rather than just focusing on acquiring new skill sets, they create new cross-functional interactions in their organizations that enable them to design and commercialize breakthrough products. Using in-depth case studies, this report offers examples of the introspective process that organizations have gone through to develop the capacity to design products more sustainably. These real-world examples illustrate how an Assess-Bridge-Create-Diffuse framework builds sustainability intelligence and life-cycle awareness into the product design process.

The report was written by Chad White with Emma Stewart, Ph.D., of BSR's Environmental R&D team, and Ted Howes with Bob Adams of IDEO. The report was reviewed by Jeremy Faludi of Worldchanging and Alastair Iles, Ph.D., Assistant Professor of Environmental Science, Policy and Management at UC Berkeley. Interviewees included Ken Alston (MBDC), Bryant Bainbridge and Erin Dobson (Nike Inc.), Chris Hacker (Johnson & Johnson), Bill Morrissey and Sumi Cate (Clorox), Paul Murray and Gabriel Wing (Herman Miller Inc.), Monica Oberkofler (Gap Inc.), and David Rinard (Steelcase Inc.). Please direct comments or questions to BSR's Environmental R&D team at environment@bsr.org.

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Since 1992, Business for Social Responsibility (BSR) has been providing socially responsible business solutions to many of the world's leading corporations. Headquartered in San Francisco and with offices in Beijing, Guangzhou, Hong Kong, New York and Paris, BSR is a nonprofit business association that serves its 250 member companies and other Global 1000 enterprises. Through advisory services, seminars and research, BSR works with corporations and concerned stakeholders of all types to create a more just and sustainable global economy. As a non-profit organization, BSR is uniquely positioned to promote cross-sector collaboration in ways that contribute to the advancement of corporate social responsibility and business success. For more information, visit www.bsr.org.

About IDEO

IDEO is an innovation and design firm that uses a human-centered, design-based approach to help organizations generate new offerings and build new capabilities. Well known for many standard-setting innovations, including the first mouse (for Apple Computer) and the world's first notebook computer (for GRiD Computer), IDEO is a forerunner in the development of products, services and experiences that bring design strategy to life. IDEO has been independently ranked by global business leaders as one of the world's most innovative companies and continues to gain recognition for its work with the CDC, Acumen Fund, Bank of America, Eli Lilly, Shimano and Eclipse Aviation—to name a few. For more information, visit www.ideo.com.

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1. Executive Summary

A wide collection of sustainability frameworks and tools are providing important insights for thinking about the outcomes or analytical processes of designing sustainably. Yet they still largely overlook the adaptations needed for business organizations to put them into practice.

Sustainability frameworks need to acknowledge the adaptations required to bring sustainable design into practice in business organizations.

These adaptation challenges are becoming more acute, particularly around:

- The extension of business product relationships into additional life-cycle phases, such as upstream sourcing and downstream recovery
- The wider range of factors to consider in product design and management, such as eco-toxicity, recyclability or renewability, many of which lie outside the expertise of traditional designers and product managers

Addressing these challenges by integrating new tools into traditional design practice is a good start, but companies developing leading sustainable design practices are recognizing that success in sustainable design involves going steps beyond that. As they begin to pursue sustainable design, they recognize that many functions shape design options and choices. Focusing narrowly on an "upstream" design phase overlooks the ways that many functions shape the sustainability of the final product and that blind spots between different parts of the organization undermine and impede sustainability opportunities.

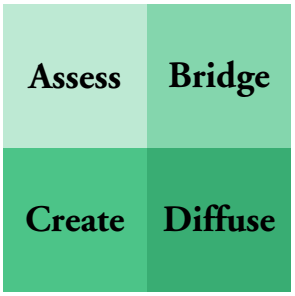
Product sustainability expands design from a narrow, upstream activity to a broad process with complex considerations and a wider set of participants. It is reframing what design is and who does it.

This report outlines the "sustainable design intelligence" needed for an organization to design better products and create lasting business and customer value. Case studies from apparel, furniture and cleaning product companies highlight how and why organizational development takes place to share product innovation ideas, establish a durable business case and coordinate around designs across life-cycle phases of production.

Companies create lasting value through sustainable design by managing across the functions and life-cycle phases that shape the sustainability of the final product.

The A-B-C-D framework in this report breaks sustainability intelligence down into four behaviors, which make design an area of dynamic organizational learning and interest:

- **Assessing** material impacts of projects and design capacity in an organization
- **Bridging** functions and people to make valuable, tractable product redesigns
- **Creating** generative internal and external learning projects
- **Diffusing** lessons and accountability mechanisms that build literacy and affect better decision making around the organization



This framework equips companies to address various questions, such as:

- What communication capacities do we need to support sustainability analyses?
- How can designers work with sustainability experts to improve products?
- How can corporate responsibility managers effectively engage the design process to advance the sustainability of products?

Questions like these highlight the importance in sustainable design of breaking down barriers and creating cross-functional innovations. In design practice sustainability requires a merging of logics and tools to enable people to recognize and integrate sustainability factors into product specifications. In the broader design function it requires expanding coordination channels, creating feedback communication among groups to develop opportunities and establishing accountability for design sustainability.

"Integrative product design" helps companies develop sustainable design intelligence and spur innovation.

For this reason, leading companies are transitioning away from a "pipeline" model of product development, in which groups throw and receive designs "over a wall" without understanding the upstream and downstream implications. The alternative, more "integrative product design" process featured in this report draws together disconnected groups and helps them strategize development of the competencies needed to improve products. It empowers eyes and ears around the organization to identify and manage sustainability issues emerging on the horizon.

Sustainable design is a challenge and opportunity to build smarter, nimbler, more sustainable innovation capabilities.

Taking these steps is helping companies not only to design more sustainable products today, but also helping them recognize how sustainability can be fluid, contextual and evolutionary. Following (and repeating) the A-B-C-D process of assessing, bridging, creating and diffusing helps companies accumulate the knowledge and (re)design aptitude they need to stay ahead of sustainability concerns and to make product changes as the world around them changes. It positions them to transform sustainability into an area of continuous improvement and to build smarter, nimbler and more sustainable innovation capabilities.

II. The Shifting Business Environment for Design

Compared to manufacturing-related environmental management, government policy and markets have done little to spur companies to develop and organize themselves around *product* sustainability. Similarly, customers have historically lacked the will and the tools to make sustainability a robust part of their product purchasing choices.

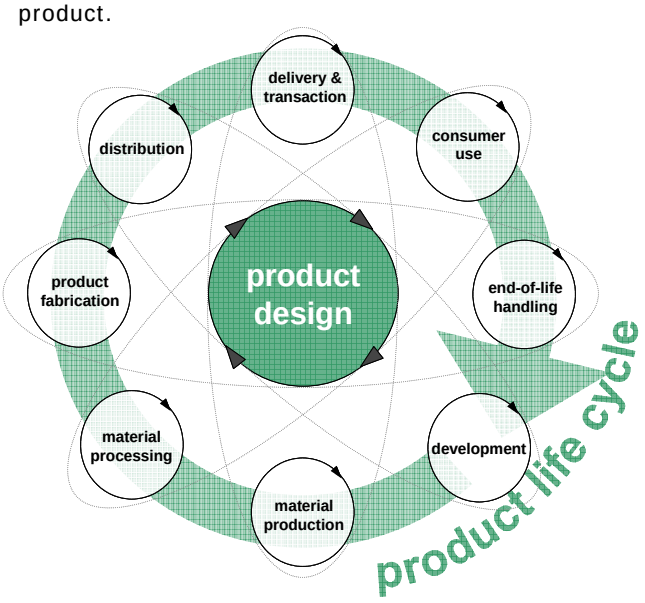
As a result, many companies still rely on a traditional design mode that lacks adequate communication infrastructure to help the company learn to design more sustainably. In this mode responsibilities for product sustainability are unclear because different functional units that shape the final design of a product have not yet developed the capacity to assess how their choices have social and environmental dimensions. In addition, these functions tend to receive and pass work through the design process or "funnel" with little knowledge or even awareness of any sustainability initiatives that others are undertaking. In short, when parts of companies lack sustainability awareness, coordination bridges and measurement tools, they miss leading innovation opportunities and critical business issues emerging on the horizon.

Today the business and regulatory climate is changing. New stakeholder and investor demands are extending business responsibility beyond the operational "fenceline" to products and the value chains that produce them. The diverse set of risks and opportunities that now confront companies make consideration of environmental and social impacts in design more than a nice thing to do. Increasingly, it is becoming a matter of remaining relevant and viable in domestic and global economies. Trends suggest that being inattentive to product sustainability is starting to cause business disruptions, loss of market share and sully brands. A slew of product recalls and global debates about

Box 1. Product Life Cycles and Sustainable Design

A product life-cycle view is one that considers the sustainability of a product across all stages of production and consumption — from its origins to its end as a desirable service. The stage commonly treated as a point of origin is product *development*, where initial marketing and product planning take place. The start of physical activity is the *material production* phase, in which resources for making products are harvested. The next stage, when needed, is *material processing*, which converts resources into feedstocks. The *product fabrication* phase then turns these input materials into finished goods. From there products enter *distribution* networks that support *customer transactions,* after which the *consumer use* phase begins. Products stay with the user until a consumer deems its service no longer useful and moves to get rid of it. At this point, *end-of-life* disposition determines whether a product is reused, recycled or dissipated. In a continuous, cradle-to-cradle cycle, end-of-life processes feed into another cycle of development.

As depicted, life-cycle planning links all of these phases into the design function of the organization. The result is a need to think about sustainability for each stage of activity and across the life cycle(s) of a product.



product toxicity have begun to accelerate this trend by spurring calls for new regulatory frameworks that look across a product's life cycle. At the same time, those at the vanguard of sustainable product design are seeing customer loyalty and product margins increase concomitantly with enhanced innovation capacity and employee satisfaction.

A. Drivers for More Sustainable Design

A variety of regulatory and non-regulatory drivers are beginning to form a new governance paradigm around product sustainability. To address product social and environmental life-cycle impacts, these drivers are generating attention toward the product design function in companies as a focus of sustainability-based reforms.

1. **More regulation.** The European Union has demonstrated that governments can and will tackle sustainability issues through product regulation. Directives passed in 2003 have extended producer responsibility to end-of-life management for Waste Electrical and Electronic Equipment (WEEE) and required the Restriction on Hazardous Substances (RoHS) in products for six chemicals so far. The Registration, Evaluation, Authorisation and Restriction of Chemicals (REACH) directive in Europe that came into effect in July 2007 is a chemical screening regulation that has the potential to extend restrictions to additional substances and product types.[1]

   While these directives have global effect just by governing access to sizeable European markets, it is worth noting that other states have followed suit. For example, China has its own RoHS directive, and efforts underway in California to address data, safety and technology gaps in chemical regulations have the potential to ripple through supply chains.[2] This emerging set of regulations requires new capacities to communicate about sustainable materials internally and in supply chains.

2. **Global product recalls.**[3] A little over six years ago Dutch officials gave Sony an unpleasant holiday surprise by blocking import of PlayStation modules due to cables with excessively high cadmium levels. Numerous times in the last year, similar events have occurred. The rising tide of recalls in the United States included flagship toy brands like Barbie and rising stars like Thomas the Tank Engine. The unappetizing string of events in the food industry included melamine found in pet food and the largest-ever meat recall when beef from ailing cattle entered the food stream.[4] Product composition audits are on the rise, particularly as integrated product regulations go into effect (see number 1), and are increasing the cost of ignorance about upstream material choices.

3. **Innovations by competitors and in supply chains.** For companies trying to differentiate their products as green(er), a widening set of eco-labels and green marketing approaches offer opportunities to build connections to customers. But even for those not positioned to follow the marketing mega-trend, there are the sustainability initiatives of retail juggernauts like Wal-Mart and Marks & Spencer, which are reshaping products in their supply chains. The combined effects of greener customer interest and supply chain eco-discipline are making product sustainability no longer a market niche, but rather a matter of market access.

4. **Demand for product transparency.** Missing an eco-label may not be a company's biggest problem. Consumers remain skeptical of green marketing but are willing to shun products based on negative information about their production methods, sustainability ethics and product claims.[5] A growing number of organizations are developing online resources and researching handheld device applications to help consumers learn what is lurking beneath the surface of some of their favorite brands. For example, the Environmental Working Group's Skin Deep database offers consumers the opportunity to query details about the contents of personal care and cosmetics products (www.cosmeticsdatabase.com). Another consortium is producing an Electronic Product Environmental Assessment Tool (EPEAT) to help users procure greener electronics (www.epeat.net), and ventures like The New American Dream or National Geographic's The Green Guide (www.thegreenguide.com) are rallying around the idea of helping consumers search for products based on sustainability evaluations.

5. **Product boycotts and media campaigns.** If past success is any indication, then expect activist NGOs to continue targeting companies at various points in the supply chain to green products and production. Product boycotts organized by pro-forest sustainability networks have succeeded in shifting the practices of lumber companies, timber retailers and office supply manufacturers. Anti-sweatshop campaigns have stimulated unprecedented transparency in global apparel supply chains. And dogged campaigns against e-waste are driving electronics companies to make life-cycle impacts part of their product design processes.[6]

B. Opportunities for Sustainable (Re)Design

Beyond managing risk or pressures from external parties, sustainable design offers a variety of opportunities to prosper. Companies can gain access to markets, increase market share, reduce or avoid compliance costs, and more easily attract investor capital. There are also positive ripple effects related to product performance, cleaner production, customer satisfaction and brand loyalty, employee morale, and community relations. These opportunities provide the business case for sustainable product design — the way to strengthen a company's position and produce benefits for the bottom line.

1. **Better product performance through improved resource efficiency.** Learning how to do more with less has the potential to spill over into better product performance and greater customer value. Consider the case of semiconductors and electronics. Designs that improve energy efficiency decrease direct energy use. They also decrease the thermal cycling that degrades microchips over time, reduce the active ventilation demands in downstream electronic products like computers, and lessen the energy needed for space conditioning where the equipment is used. The cascade multiplies improvements in product value.[7]

2. **Strengthened market position.** Consumer appetite for sustainability shows signs of increasing. Sustainability is now more readily associated with higher product quality, products less likely to cause consumer harm, and products that consumers can feel better about using.[8] These associations make sustainable design a way to align with emerging consumer interests and to **improve customer satisfaction and retention**, provided that sustainability improvements are credible and clearly communicated.[9]

Sustainable design may also protect corporate value and reputation by **reducing risk of operating crises** (e.g., recalls, consumer campaigns, supply chain resilience, labor concerns). The combination has potential to broaden market access as well as to strengthen your brand and existing customer relationships.

3. **Improved compliance and preparedness.** It has become a matter of course that companies will strive to comply with environmental laws, but the legal landscape continues to change. An active program in sustainable design not only helps a company meet the obligations of current environmental laws; it may also avoid the need to operate emission controls or to pay for hazardous waste treatment, as well as create resources that help the company stay aware of and prepare for future legal requirements.[10]

4. **Greater acumen and agility.** In addition to streamlining regulatory review and costs, a sustainable design program may improve communication flows and enable a company to plan and manage complexity more effectively. For example, product leasing or product take-back as part of a sales contract can alert a company to a customer's interest in another purchase. These strategies may increase operating efficiency, reduce business costs and improve technological agility.

5. **Serendipitous innovation.** Many companies that undertake sustainability audits of their product lines identify opportunities for innovation. Some of these innovations emerge because investigations discover unnecessary complexity that adds costs, such as an unnecessarily diverse variety of materials going into products. Others come from dialogues with suppliers, customers and stakeholders that identify better-performing, cost-improving options and overlooked customer needs.

6. **Improved morale and productivity.** Closely related to innovation potential, sustainability initiatives may bolster employees' satisfaction at work and encourage them to communicate insights and suggestions for improvement. Employee-driven design can be highly effective because their intimate knowledge of processes and products is a source of detailed, practical insights.

The overall point is that product sustainability is emerging as a significant new area for corporate management. However, the set of attributes that make a product sustainable are still unclear because accountability structures that reward a firm or hold it responsible for product sustainability are still forming. In today's climate it is hard to say where opportunity exists or how soon pressure about the sustainability of products will turn into a business crisis. The likelihood is that, sooner or later, inattention to social or environmental impacts will drive a product boycott, block the sale of a product into advantageous supply chains or markets, or make it hard to attract talent and capital. In this sense, managing product sustainability extends beyond strategic positioning to prudent management across a corporate brand.

C. The Challenge: Evolution of Design Intelligence

Product sustainability is more than producing different kinds of products. It is about a different way of thinking about and making products. But how does a company incorporate sustainability concerns into its design function, as illustrated in Figure 1?

Figure 1. The Shift to Sustainable Design

This question is important, given the nature of sustainability as an unfolding theoretical ideal. Despite impressive advances, no company can claim yet to offer a truly sustainable product. What leading companies are achieving now is an ability to continue evolving their design capabilities so that, as the world around them changes, their abilities to develop more sustainable products can improve along with it.

Consequently, it's important to emphasize that **designing sustainably is an ongoing learning process** that makes flexibility and adaptability crucial to success. There are already a wide variety of frameworks available to help companies think about what product sustainability should look like (Appendix A). An important challenge is developing the organizational capacity to absorb these evolving insights and to integrate them into a company's design function.

There are many launching points for sustainable design. The case studies in this report demonstrate that companies designing more sustainable products get started in different ways and take different development paths. Some companies have thoroughly redesigned flagship products, launched new product lines, or invested in tackling individual issues applicable to all their products. Some have leaped forward through commitments made at the top of their organizations. Others have progressed gradually in the background as practitioners concurrently built sustainable design capacity and business cases. The clear point is that, shaped by different product circumstances and design functions, companies take different approaches to developing sustainable design intelligence. All of these approaches can work effectively to improve sustainability and strengthen products.

A sustainable design journey has many launching points.

Sustainable Pilot Project Examples

- **Single Product Redesign**: Nike creates the Considered Boot. Herman Miller designs its Mirra Chair to implement a cradle-to-cradle approach.
- **New Product Line Launch**: Clorox launches its Green Works line of natural cleaning products.
- **Advancing an Aspect of All Products**: SC Johnson develops a chemical screening Greenlist to shift choices toward more sustainable materials.

The framework in this report is generalized from the experiences of several companies. Built from an organizational development perspective, this ABCD framework describes the process of building sustainable design capacity into four components — Assessing, Bridging, Creating and Diffusing — and provides examples to help companies envision it. This framework explains that "sustainable design intelligence" consists of abilities to:

- **Assess** material impacts of projects and the design capacity in the organization

- **Bridge** the right functions and people to make valuable, tractable change
- **Create** internal and external learning projects
- **Diffuse** lessons and accountability mechanisms that affect better decision making around the organization

Leading firms are developing these abilities to deliver real sustainability results, create credible consumer value and improve business acumen.

Of course, tackling all these challenges simultaneously can make it hard to pick a place to begin — that is, to identify a particular issue to tackle or a particular kind of product to (re)design as a starting point. Acknowledging this challenge, Paul Murray shared pragmatic insight based on experiences at Herman Miller: there is no single promising place to start this process. The important thing is simply to pick a tractable spot and begin taking meaningful steps forward.

David Rinard, Director of Global Environmental Performance at Steelcase, offers a similar sentiment. As he explains, there are challenges no matter where an organization starts. At the top it is the challenge of justifying resources. At the bottom there is a need for literacy and insight about how to turn ideas into practice. In the end, innovators just have to start somewhere.

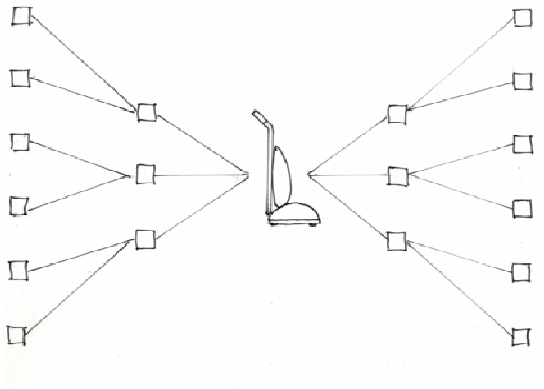
The ABCD model is designed to help companies do this.

"The challenge of sustainability is broad enough that there is no one right place to start. The important part is just to start somewhere. So, just pick a location and dig in."

- Paul Murray, EHS Director and product sustainability innovator at Herman Miller Inc.

III. Innovation in Design Practice

Design is increasingly being viewed as a critical enabling component for sustainability because **the design function is a concentration point for decisions about a large set of human and material resource flows**. Design specifications can have significant economic, environmental and social ripple effects. For example, design specifications for an American running shoe can impact communities and ecosystems in Southeast Asia. Formulations for personal care products and pharmaceuticals can impact the biochemistry in downstream watersheds.



Additionally, **design can have a large impact on the materialization or dematerialization of products**. Design choices about material weight and packaging have direct impacts on transport costs and fuel use. Choices about energy efficiency directly impact energy consumption in a product's use phase. And choices about durability, disassembly or re-usability affect the technological challenges and economics of product recovery.

These points are well established as arguments for sustainable design.[11] What has been less discussed is how to marry a sustainability perspective with the practice of design and innovation. The challenge is that design practice is values-agnostic by intent. The same methods that can be used to design positive sustainability programs, such as an effective healthcare program for HIV prevention, or to design in ways that contribute to sustainability problems, such as enhancing the appeal of inefficient transportation like SUVs. Good design is generally judged based on its ability to meet a need. The challenge is developing frameworks that allow people to design with the needs of sustainability in mind. Addressing this challenge requires more than adding new tools to a designer's toolkit. It requires bringing sustainability into the ethos of design.

Following are ways in which sustainability can be integrated into practice in a way that meshes systematically with the way that designers design.

1. **Marry "Human Factors" and "Systems Thinking" in Design Analysis.** Leading firms like IDEO have built design and innovation practice rooted in an understanding of the latent needs and desires of people. Dubbed the "human factors" aspect of design, a key objective of designers is to systematically and empathetically integrate human behavioral needs in design. For this reason, design is carried out by multidisciplinary project teams — with engineers, industrial designers, anthropologists and business experts all participating in "design." A multi-disciplinary approach based on human behavior and needs assessment provides a key opportunity for linkage to sustainability concerns.

   Here is how. Sustainability thinking often takes a systems approach to problems to account for and chronicle the complex intertwining of resource, social and economic ecosystems. However, this approach often fails to provide a clear map for changing that system.

   For example, replacing one resource-intensive or polluting material with another is not enough to create real change. Creating a shirt from organic cotton and sustainably harvested

bamboo does not automatically produce positive behavioral change if consumers do not understand and/or buy the product. Likewise, eliminating toxics and reducing water consumption in electronics manufacturing are necessary and laudable efforts, but they are likely to be missed opportunities if they are not considered in the context of how they can be made meaningful or desirable to users.

Consequently, a powerful component of sustainable design thinking is the human-factor approach, which extends traditional sustainable design thinking (e.g., life-cycle analyses and resource assessments). It links sustainability thinking with important questions about how elegant, positive technical solutions can be linked with human interests.

Linking human-factor and systems-thinking approaches is the new facet of design that sustainability is bringing to light. The combination expands the number of factors to evaluate and incorporate into a product design but also increases the opportunity for synergy and breakthrough innovation. The challenge is determining when and how to consider the viewpoints of internal and external stakeholders in a many layered ecosystem.

CASE STUDY: Pangea Organics

One of IDEO's early projects was for Pangea Organics, then a 4-year-old bodycare product company — small in size and with limited distribution. Pangea was in need of an identity and brand language that would increase demand while embracing the sustainability and organic living philosophies upon which the company was founded. After a deep dive into understanding the company's and its customers' core values, IDEO defined Pangea's brand principles. These were translated into a full identity guideline and brand story, which were then used in sustainable packaging design for 35 products — including a compostable bar soap box inspired by egg cartons and made from 100% post-consumer content. Pangea Organics' renewed retail presence quickly resulted in a tripling of its product distribution and numerous design awards.

Source: IDEO (2007)

The important point is that it reinforces what has been the longstanding definition of effective design practice: finding inspiration in a complex space, establishing reasonable constraints to guide choices, and crafting solutions that resonate with users. What the marriage of approaches underscores is the importance of multi-disciplinary teams and cross-functional organizations. These are elements of an integrative design process (an approach discussed in detail in Section IV).

2. **Select Tools to Match the Task.** Design and sustainability are broad domains and a wide set of techniques have been developed to guide work in them (Appendix A). A challenge in sustainable design is choosing the technique that fits the task at hand, given the need to balance rigor with cost-effectiveness. Consequently, designers may need to scale tools to fit their budget constraints. Consider this set of options:

   a. *Option One: Full life-cycle assessment (LCA)*. A comprehensive LCA combined with stakeholder feedback can offer valuable insights for design and increase the credibility of a sustainability claim. It is a resource-intensive undertaking, but a very useful technique for marrying systems-thinking with human-centered sustainable design.

   b. *Option Two: Simplified LCA*. While the insights from a full LCA may always be desirable, its magnitude can run aground on time- and resource-intensity. A simplified

LCA is an alternative worth considering. It enables a designer to see and understand some impacts of design choices at a more modest cost.

c. *Option Three: Basic Material Assessment*. At the low end of the cost scale is a simple material assessment, such as an activity-based costing of material alternatives. While less comprehensive than an LCA, it can help designers coarsely understand and assess impacts of their design choices. It is a minimum standard of review that any sustainable design should establish.

The selection of the most appropriate tool may depend upon where a company is in the design process. For instance, when redesigning a desk chair to be more environmentally sound, questions at the early stages regarding dematerialization and lightness may serve as inspiration for a new aesthetic approach that can refresh a well-known brand. But as the chair's design becomes increasingly resolved, designers also must ask questions as specific as "what finish shall be specified for this screw?" Answer to the early questions may be resolved using a basic material assessment, while the later question requires a detailed analysis like a full LCA.

3. **Allow Unintuitive Approaches.** It is important to keep in mind that traditional designers generally dislike following checklists or manuals. Their forte is to envision, prototype and iterate on projects. Accordingly, establishing conditions that facilitate creativity is an important step to inspiring design innovations and could lead to a product breakthrough. One way to feed designers' curiosity is to raise awareness about sustainability with inspiring speakers, books or experiences. The process may be unintuitive in some areas of practice, but it is a common approach in design for introducing new considerations and inspiring alternative ideas.

4. **Anticipate Unintended Consequences.** Consideration of the system and its users is a critical expansion of the design process because it helps deal with one of the major pitfalls of designing for sustainability: the law of unintended consequences. Just because a product is bio-based, for example, does not mean it is superior to a synthetic product in terms of environmental performance, since it may be more toxic or resource intensive to produce. While some outcomes are unpredictable or unknowable until after the fact, the broad reach of sustainability encourages us to "know what we do not know." That is, it reinforces the importance of a multidisciplinary approach as a way to forestall myopia and groupthink, and it encourages secondary investigations to revisit and revise assumptions.

5. **Focus on Staying Dynamic.** Design. Sustainability. Both are words of continually evolving meaning and understanding. As global pressures around natural resources, energy and stakeholder concerns increasingly alter the business landscape of product-based companies, more and more companies will make lofty requests of their designers. The landscape will differ for every company and the answers will rarely be static over time. Increasingly, design may be an effective approach not only for creating products, but for solving dynamic problems with unconventional means.

IV. Re-envisioning the Design Function

"Design for Sustainability" frameworks and tools provide important insights for thinking about the outcomes or analytical processes of designing sustainably. What they rarely discuss are the adaptations associated with bringing sustainable design into practice in business organizations. This oversight is notable given that product sustainability:

Organizational adaptations are needed to bring sustainable design into practice in business organizations.

- Extends traditional product relationships into new life-cycle phases, such as upstream sourcing and downstream recovery
- Requires a wider range of factors to be considered in product design and management, such as eco-toxicity, recyclability or renewability, many of which lie outside the expertise of traditional designers and product managers

An often overlooked detail is the impact of these changes on the nature and organization of the design function. Sustainable design informed by a life-cycle perspective can reveal that:

- A wide range of organizational functions and teams are shaping the design and, thus, sustainability performance of a product
- Creating the intelligence to design sustainably requires stronger capacity to communicate and coordinate about sustainability within and between many functional units and occupational groups, both within the organization and in its supply chain

Sustainable design requires more than an addition of new tools in an early life-cycle phase of production (i.e., the upstream "design" phase). Rather, **sustainable design is comprised of tasks distributed around the company and, as a result, is a broad organizational function**.

To see how this is so, consider the range of activities that might be needed to improve product sustainability. Relevant tasks might include (to name a few):

- Social and environmental responsibility analysis
- Applied research and development
- Brand and product strategy
- Aesthetic and product service conceptualization
- Product line management and merchandising
- Production planning, procurement and supply chain management
- Marketing
- Reverse logistics and recycling

People performing these tasks may be industrial designers, engineering designers, fashion designers, technology developers, architects, technical writers, brand managers, manufacturing staff, merchandisers, planners and consultants who hold titles like designer, engineer, biologist, anthropologist, writer, chemist, marketer, manager, etc. Their design interactions may take place during research and development, materials production, material processing or product fabrication.

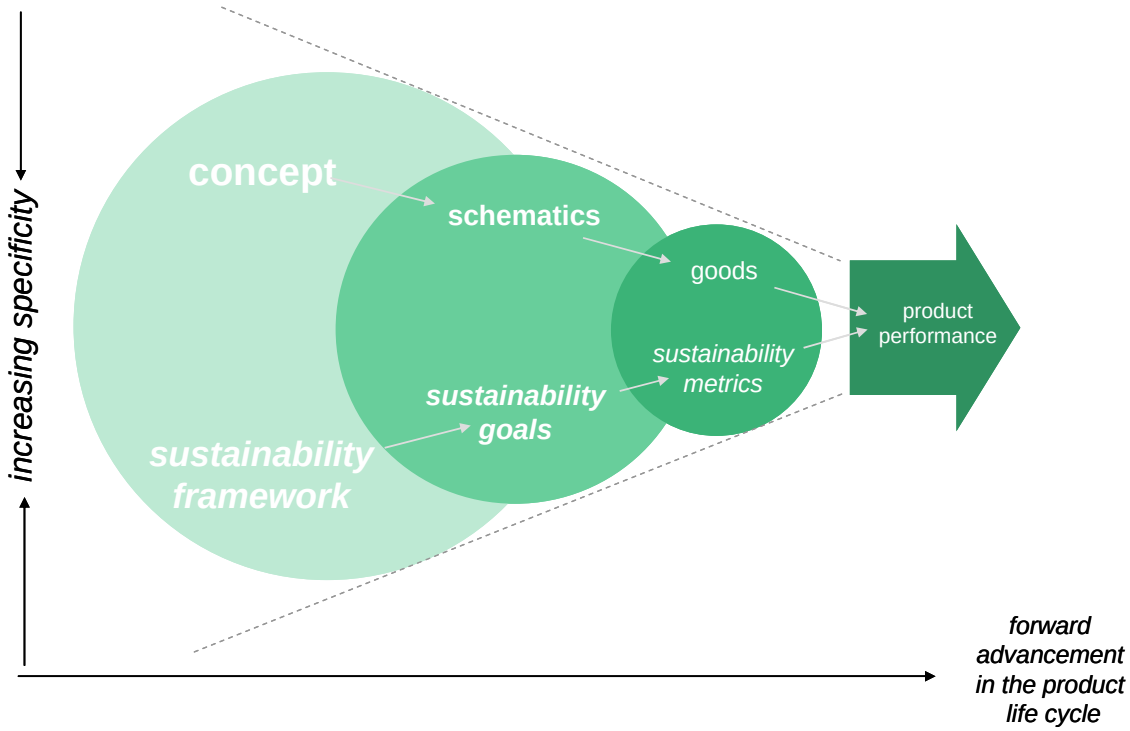
When packaging is taken into account, design may also include distribution and marketing around customer transactions. The important thing to note is that, traditionally, these groups have not all been treated as parts of the design process.

It is important to treat the many groups shaping the final product as part of the design process.

As model of the design process, the "design funnel" illustrates how a diverse set of sustainability activities reshapes the design process (Figure 2). The funnel is a linear representation of design as a process of increasingly specifying product characteristics. The process begins with concepts, where design is a blank slate. As strategies narrow, concepts are refined into schematics to inform prototyping and, eventually, manufacture of goods. These "forward life-cycle" stages of production culminate in the packaging of a product for the marketplace and its being put into use.

The circles in Figure 2 represent the range of choices at each stage of production and that the people involved — whether they wear the hats of designers or are manufacturing engineers, merchandisers, marketers, etc. — have the capacity to impact the design and, thus, the performance of the final product.

Figure 2. Sustainability and the Design Funnel



The usefulness of the design funnel is its ability to represent design as an ongoing aspect of production. Decisions made by a range of experts and functions are involved in making a final product, and this ongoing effort makes it difficult to think of design as something undertaken only by "designers" in an early life-cycle phase. For example, interaction among designers, production staff and marketing staff can be an important step in aligning greener options, such as more natural or biodegradable products, with customer value and making the business case for a sustainable product advance. Likewise, collaboration among technology researchers, product line planners and

procurement staff can be important for connecting upstream with the supply base to learn about and source alternative materials to make a product more natural or biodegradable.

The point is that **sustainable design may require coordination among conventionally unconnected parts of the organization**. It requires that:

- Companies think about how people in different parts of the organization need to coordinate with one another
- A company is able, as an organization, to coordinate about product sustainability across phases of the life cycle

The design funnel also helps illustrate how different assessment techniques may be needed to enhance decision making at different parts of the process. In the initial phases of design, a broad sustainability **framework** may be the right tool for steering the direction of product development. As concepts resolve and product designs progress down the design funnel, frameworks may need to evolve into more detailed **goals** to integrate sustainability into decision making about the function, form and composition of the product. At various points in the process, but particularly as later-stage production choices are made, individuals and groups may need **metrics** that help evaluate the sustainability performance of a design and choose alternatives.

A. The Design Pipeline: A Challenge for Sustainability Learning

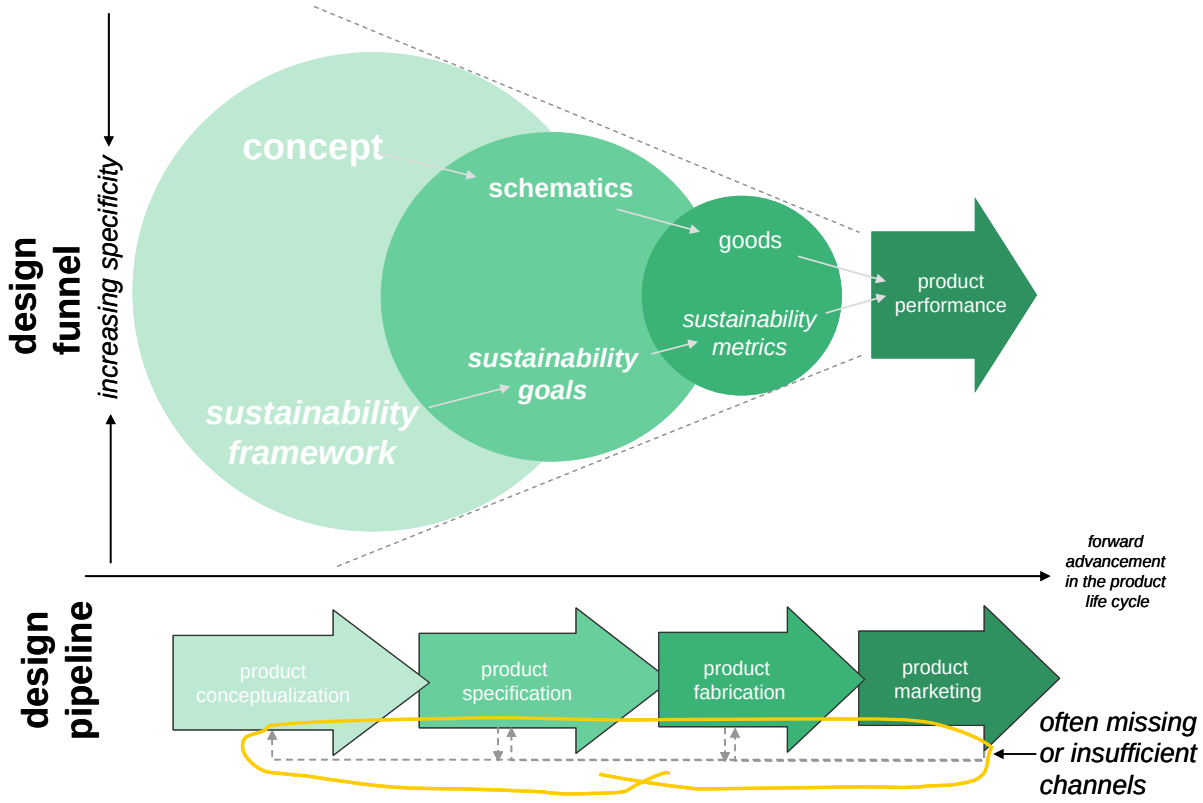
Given the need for coordination, a stumbling block for sustainable design can be the efficiency of a company's design funnel. A "design pipeline" is a particularly efficient way to organize in the design funnel, but it can impede a company's ability to design sustainably. Why?

To increase efficiency, many companies have organized groups in a kind of design funnel that functionally specializes and sequences activities. What makes a funnel into a pipeline is the separation of activities into stages and distribution of responsibilities among them (see Figure 3 on next page).

A design pipeline facilitates sustainable design only if an organization already has ample knowledge about and clarity around what sustainability is and who should design with it in mind. That means that people already know who is responsible for sustainability and how to achieve success. Given the rapid evolution of sustainability in theory and practice, it is unlikely that most companies have this foresight. Without it, a design pipeline is going to cause problems.

As a result, **companies developing sustainable design programs need communication bandwidth and cross-linkages across their design funnels that enable them, as organizations, to learn how to design sustainably**. This cross-linked approach is an "integrative" style of product design (which is described on page 19) and it is valuable for developing a company's sustainability intelligence.

Figure 3. The Design Funnel and the Communication-Limited Pipeline



Like any design funnel, the purpose of the pipeline is to whittle down choices and to move products from early-stage strategies to finished, marketable wares. The problem is that the limited feedback in a design pipeline impedes learning *across* stages because products are handed off from one group to another. This distinction is particularly problematic when specialists are separated enough that they throw specifications "over the wall" from one stage to the next and, consequently, are not knowledgeable about the processes and the choices that the next group makes. Without ample feedforward and feedback communication, the design funnel lacks the learning infrastructure needed to identify sustainability-related design risks and opportunities.

Some companies, such as global apparel retailer Gap Inc., are recognizing the challenges that a design pipeline can pose during the transition to sustainability. Consider how the company's design funnel works. Gap's design process begins at a broad level with corporate managers, who develop a brand strategy. Then each season fashion designers conceptualize and create designs that they present to internal merchandisers or "buyers." These buyers review the design collections and shape the product lines that will ultimately be sold in the company's retail stores. Once the merchandising team has settled on the collection, it hands off product specifications to production teams, who then work with Gap's sourcing offices around the world to identify third-party contract factories that have the

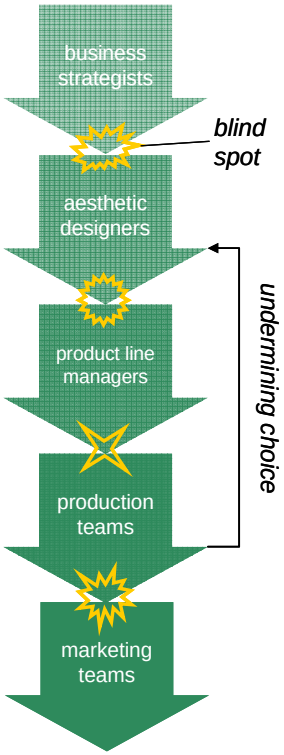
right capabilities to make the products. At times, merchandising and production may need to review and adapt various product details in order to meet budget targets, schedules and performance requirements. At the same time, marketing teams are working to create the overall marketing message(s) for each season, which includes both product packaging and in-store messaging. At each stage in this process, product specifications may be adapted or tweaked, changing material contents, quantities and qualities. These changes can include the addition or subtraction of non-toxic dyes, organic fabrics, reduced packaging concepts, greener labels or more durable materials.

For a company like Gap Inc., a pipeline organization can produce challenges to implementing sustainability initiatives. Without appropriate tools and communication channels, sustainability-advancing choices made at one stage can be modified in another to align them with each team's goals, occupational knowledge and the principles they use to strategize and make decisions. The result can be blindness to and unintentional undermining of sustainability opportunities.

In evaluating a design funnel, there are two important obstacles to consider in order to design sustainably across the product life cycle:

- **Pipeline Blindness:** Where does limited purview in the design funnel leave participants blind to the sustainability impacts of their products? Without integrative mechanisms that help designers understand the goals, methodologies or change capacities of their counterparts in other functions and stages of the process, they miss opportunities to change components, modify content or creatively solve a need.

- **Undermining Sustainability Advances:** In the design funnel, do participants unknowingly block or undo each other's sustainability initiatives? Without ways to measure and communicate product sustainability throughout the design process, upstream and downstream groups may be undermining sustainable designs. For example, upstream efforts to improve recyclability can be overturned if cost management during production substitutes cheaper fasteners or materials without conferring about the changes. Similarly, downstream efforts to improve eco-efficiency can be constrained if upstream designers perpetuate resource-intensive product specifications.



While much of the sustainable design literature focuses on enabling knowledge and techniques, the coordination challenges that companies face from pipeline design suggests that redeveloping communication infrastructure is an important part of building sustainability intelligence. When there is little infrastructure linking stages (i.e., communication channels, technology and objectives), it can be very hard for people to identify and cooperate with the sustainability programs of each other. This limitation also means that innovators may miss viable opportunities because they sit in a difficult spot to communicate about them. For example, product designers lack the vantage to spot key issues that corporate social responsibility (CSR) managers often have. Likewise, CSR practitioners who understand emerging issues often sit in a challenging position to engage in product design.

An important part of the journey toward sustainable design is organizational learning about these obstacles and actions taken to overcome them. To develop sustainability intelligence, successful companies have created new mechanisms that bridge participants in design. These steps have been an important part of the corporate learning processes and key contributors to success.

B. Integrative Product Design: An Alternative Approach

To design better products, decision makers need to be able to identify options that are more sustainable and to leverage organizational resources to pursue them. Doing so is difficult in a pipeline because no functional group is adept enough to identify sustainability options and launch innovations that systematically survive the design funnel. The reason is that pipeline organization is based on a clear delineation and distribution of responsibilities. For sustainable design, at the onset it is unclear what responsibilities should look like, who should have them, and how people should communicate or work together to make product sustainability happen.

Because sustainability is still unfolding as a product concept, successful firms are developing more integrative product design approaches that facilitate ongoing learning about sustainable design, as well as product innovations. Integrative design recognizes that **sustainability is not just about modifying products, but about modifying the way that products are made**. It acknowledges that it is difficult to establish sustainable design responsibilities upfront and distribute them efficiently among people traditionally involved in design. Because of these challenges, integrative design creates new channels of communication and coordination that enable learning across groups. It offers a transition path that helps designers learn to identify sustainability options and to launch innovations that traverse the design funnel.

For Example…

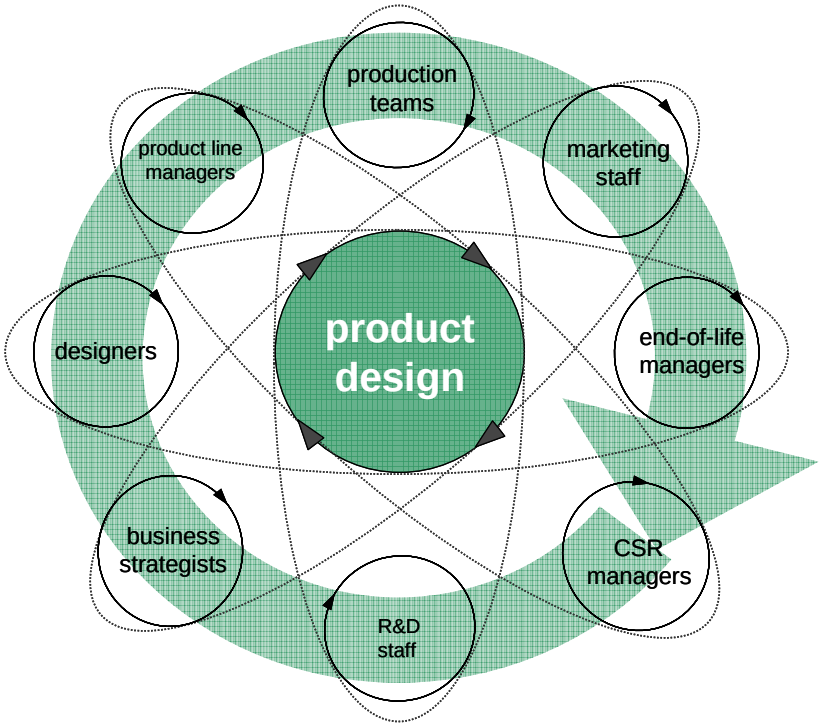
Imagine that a company sets a goal of 20-percent recycled-material content in its products. As an organization it must be able to:

- Identify appropriate materials to use
- Develop and assure designs that can accommodate them
- Procure the selected materials
- Market them based on this recycled content attribute (if desired)

Because no one functional group has been in charge of or literate about all of these activities, the ability to execute toward a goal like 20-percent recycled content requires new means of internal and external coordination.

One of the keys to integrated design is recognizing the wide variety of organizational actors whose decisions impact the sustainability of a final product. Integrative design draws them together into a learning-oriented dialogue about product sustainability across the product life cycle (see Figure 4 on next page). This organization puts tools in people's hands that enable them to consider and communicate about sustainability concepts and options across functions that can shape the design of the final product.

Figure 4. Integrative Product Design as an Inclusive Life-Cycle Process



As depicted at left, integrative product design connects participants around the life cycle and in ongoing learning loops throughout the design process.

It represents a reflective design process that encourages ongoing learning and innovation.

Participants in this process need to build their literacy about sustainability, as well as to increase their awareness of the entire design process. To depict this need, the circle around each group mimics the learning cycle in the overall diagram.

Companies moving toward product sustainability are using integrative design to help them get there. In the case of Gap Inc., the company recognized the organizational challenges inherent in sustainable design and introduced cross-functional learning mechanisms to enhance its design function. Following a series of discussions with a sustainability team, the head of design in one brand called a meeting of functional heads to talk about product sustainability. This meeting led to monthly meetings among representatives from design, merchandising, production, marketing, planning, finance, store operations and social responsibility to discuss the opportunities that sustainability could present to the brand. As the team began to work through conceptual and practical issues, it developed cross-functional subteams. These subteams have explored ways to use more sustainable materials in garments, to improve product packaging and store operations, and to communicate the sustainability attributes of the brand's product and business operations to its customers. What is notable about this cross-functional collaboration is that the brand first stepped back to assess its capacity and took steps to bridge functions, create a pilot project, and diffuse and share lessons across the different teams.

C. The A-B-C-D Framework: A Guide for Developing Sustainable Design Intelligence

Despite differences in their products and starting points, successful companies are building a similar sustainability intelligence into their design process. This intelligence consists of abilities to assess, bridge, create and diffuse sustainable design competencies.

Assess	The ability to analyze the social and environmental impacts of products and production and to evaluate organizational capacity to address them.
Bridge	The ability to connect ready parties and to bring the right functions and the right people together to redesign products.
Create	The ability to generate projects that enable exploration and learning about product sustainability and about changes needed to the design process.
Diffuse	The ability to deploy tools that build literacy, put information in the hands of the right people in the right place and time, and create accountability for product outcomes.

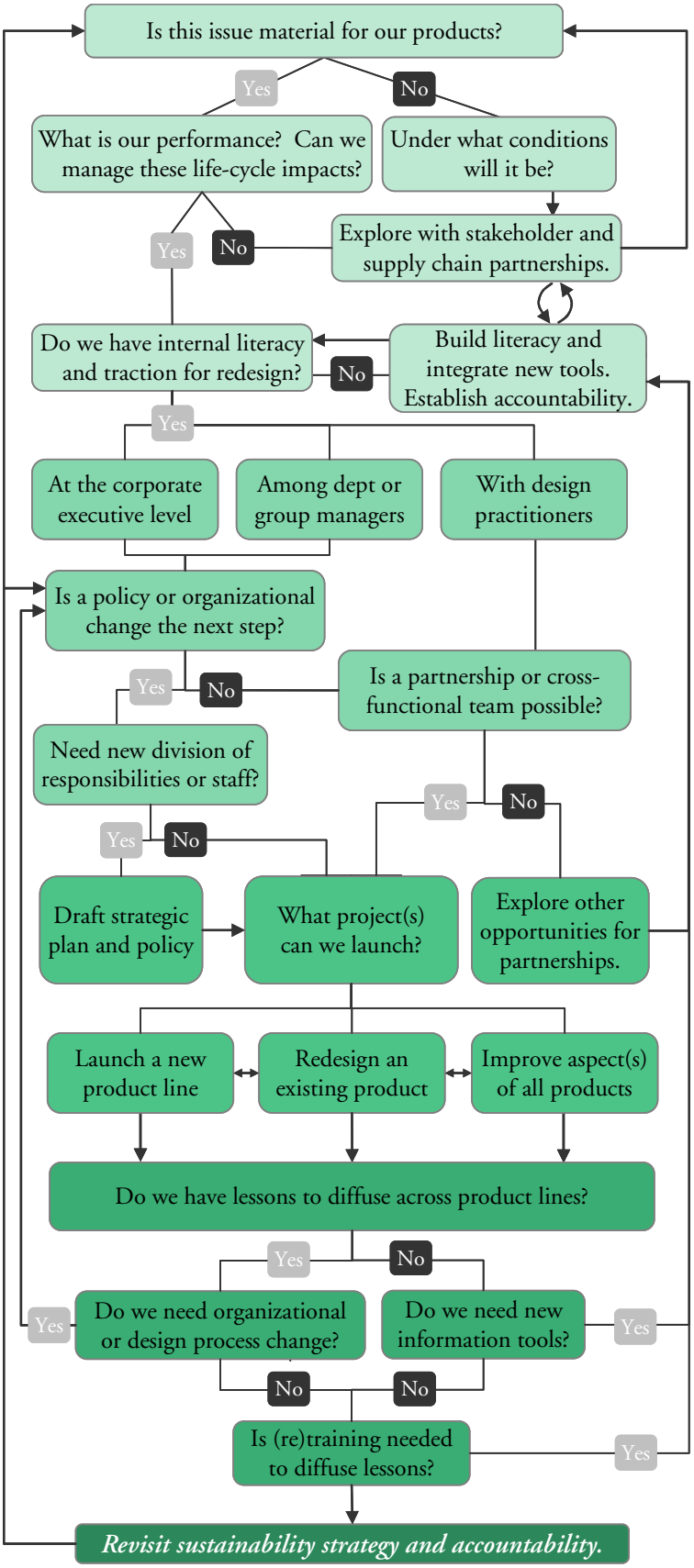
This new organizational intelligence is needed because sustainability introduces a range of factors into organizations that lie outside the expertise of people traditionally called designers. As a result, **sustainable design is not just about making better products, but about developing the capacity of the organization to make better products**. It means increasing the sustainability intelligence of an organization and making sustainability a systematic part of the design process. It is about re-envisioning design, not just following a marketing mega-trend, since approaching sustainability in a one-off manner runs the risk of missing opportunities and of sustainability-related consumer boycotts.

Leading organizations developing their sustainable design intelligence are doing so by building communication infrastructure that enables sustainability learning and coordination throughout the design funnel. **This integrative design model is a way for companies to explore relationships between sustainability and functions throughout their design funnels**. There are a few reasons for companies to adopt an integrative approach:

- Sustainability is still evolving as a concept and companies need to be in a position to assess how issues are becoming material to their operations
- Companies recognize sustainability issues with different parts of their organizations and need robust communication channels to bring these insights into the design process
- At the onset of a new sustainability issue, it is often unclear what design responsibilities should look like, who should have them, and how people should communicate or work together to make product sustainability happen

The A-B-C-D model helps companies recognize different challenges, as well as think about sustainable design as a process of organizational development (see Figure 5 on next page). It represents a process of discovery that cuts across company experiences and applies throughout the journey toward sustainability.

Figure 5. The A-B-C-D Model as a Flow Chart



ASSESS

- What aspects of sustainability are material for our products?
- What is our current level of performance in these areas?
- Who is literate in sustainability and willing to re-envision design?

BRIDGE

- Where is corporate policy change needed to bridge functions?
- Where will cross-functional teaming overcome strategic blind spots?
- Should we make new staff assignments or hire new specialists?

CREATE

- Will a pilot project explore a new product or revise a current one?
- Should we develop a new line or a new protocol for all products?
- Where will internal/external partnerships identify and fix gaps?

DIFFUSE

- What kinds of information are needed to advance sustainable design?
- What kinds of tools are capable of delivering this information?
- How should we build and transfer these tools in our organization?

Assess

Assessment is the ability to analyze the social and environmental impacts of products and production, as well as to evaluate organizational capacity to address them. It recognizes that individuals and organizations benefit from figuring out where they are and it helps them to chart a course.

Sustainability frameworks tend to discuss only assessment of product performance to understand impacts and prioritize actions to mitigate them. However, t**o enable sustainability learning, companies also need to assess their sustainability competency and preparedness to move forward as an organization**. For some issues and product aspects, organizational capacity may be patchy. It may be easier or more difficult to launch pilot projects because of the literacy, interest and resources available.

To be helpful, an effective assessment should help to identify:

- Sustainability issues material to a company's products and how its products perform on them
- Where these issues occur in the product life cycle
- Where there is organizational capacity (i.e., the knowledge, skills and interest) to act meaningfully and valuably to address them

The assessment should not only evaluate the performance of a product at each life-cycle phase; it should also help a company understand *how* its organization affects design in each phase of the life cycle and *where* it has capacity to (re)design for sustainability.

These insights are important for identifying capacity development needs, areas for internal alignment and product innovation opportunities. For example, it is important to understand how upstream strategic planners are shaping product sustainability and how downstream manufacturing managers are altering a product's resource footprint when they make choices to meet schedule or cost requirements.

In all, a good assessment helps a company become more self-aware about activities across the life cycle that shape the sustainability performance of a product. It helps an organization locate key decision events, even if they lie outside the normal purview (e.g., in another department or a supplier company). It provides a strong learning orientation that helps a company stay on top of issues before they hit the news.

Bridge

While assessment explores issue materiality and organizational capacity, **bridging builds connections among ready parties and brings functions together to explore and redesign products**. It develops communication channels that overcome blind spots and prevent sustainability choices made in one part of the design funnel from undermining initiatives in another.

There are three aspects of bridging to keep in mind:

- There are multiple kinds of bridges to build in an organization
- Different kinds of bridges may be appropriate at different times
- Bridges may be useful externally as well as internally

The bridging point for sustainable design may be at the pinnacle, middle or base of the hierarchy, or at all three. These levels represent different approaches to organizational change. From the top a policy or organizational change may shift resource flows, redistrict work domains or widely legitimize new product performance criteria and design goals. In the middle, managers may identify blind spots and explore how different functions might work better together — an important insight for establishing value and working through strategic opportunities and implementation challenges. At the bottom, practitioners may explore ways to incorporate alternative information and choices to make different products. Each of these processes may involve reshuffling responsibilities or creating new, cross-functional lines of communication. Particularly in the middle and at the base of the organization, informal partnerships may be important routes for exploring integration, identifying alignment opportunities and building sustainable practice.

CASE STUDY: DEC

When Digital Equipment Corporation (DEC) began its design for environment program in the mid-1990s, environmental analysts interfaced most easily with the production engineering phase of the product design process. However, waiting until that stage of the process missed significant opportunities to impact materials assessment, energy management and ergonomics cost effectively during conceptualization. As a result, DEC developed new routes of collaboration to bring sustainability considerations into its product strategy and concept phase.

Source: Rooney, Frank P, 1998. "Designing EHS Principles Into Digital Equipment Corporation Products," Corporate Environmental Strategy *5 (4): 18-25.*

Bridging may be opportunistic, since active support for (re)design projects may lie in corners of the organization. The life-cycle view of a product means that many aspects of an organization may be affecting product performance. Each is a route into sustainable design. Staff with innovative ideas and motivation to pursue them may be scattered among the workforce or in different pockets around the company. (In particular, individuals in the newer generation may be committed to sustainability and willing to carve out time beyond their direct responsibilities to get involved.) Learning who has the capacity and interest to get started is a good way to decide whether to begin a project with a given manufacturing group, marketing group, product development group, etc., and whether to start at the top, middle or base of the organization.[12]

External and internal partnerships reinforce each other. External partnerships play a key role in the sustainable design learning of companies. Many find that the supply base is an important source of information about the materials they use, as well as more sustainable alternatives. Thought and practice leaders, such as McDonough Braungart Design Chemistry (MBDC), have provided catalyzing frameworks and insights for organizations to leverage in their journeys. Partnerships with contradictory as well as cooperative external stakeholders are important sources of learning. Research is revealing that organizations that engage diverse partners are more likely to be sustainability leaders.[13]

Building cross-functional teams or learning-based coordination fora into an organization and its projects may be an important step for sustainable design. For example, in the building sector leading designers have recognized the problem that the pipeline creates. To compensate, they have expanded their charrette (early design review) process to include a larger range of stakeholders and specialists who can affect the sustainability of the final product. The charrette helps them articulate goals and share ideas at the start of a project.

Create

Creating is a third facet of sustainability intelligence. **Creating is the ability to launch generative pilot projects**. That is, a successful project will provide insights to advance sustainable design and create inspiration for another.

Much like the proverb that "every journey begins with a single step," sustainable design programs begin with pilot projects. Figure 5 calls attention to three kinds of pilot projects:

- Projects that explore changes in strategy or policy
- Projects that (re)design all or part of a product
- Projects that explore partnering relationships or organizational designs

Pilot projects vary in intensity as well. For example, some pilot projects are modest, such as an exploration of improvement on a single sustainability factor for a single product. Others are more aggressive, such as a complete product redesign with the goal of developing a sustainable design protocol for all new products. The same variation might exist for a strategy or policy change or for a partnership.

What a pilot project entails depends on the capacity and interest within a company. Its nature also depends on the bridges that enable it. It may be a quiet project undertaken behind the scenes, or it may be a very actively supported, highly publicized venture.

Regardless of its product objective or intensity, the goal of a pilot project should be to stimulate learning. This learning should extend beyond lessons about the product and include discovery of blind spots and communication gaps in the design process.

Diffuse

The final aspect of sustainability intelligence is diffusion. **Diffusion means developing tools and techniques that advance literacy and create accountability mechanisms that put sustainable design into practice**. It is a matter of building awareness about sustainability and enabling the right information to be on hand at the right place and time. It means creating a review process to communicate about and hold people accountable for the sustainability outcomes of the products. This may mean improving information flow and deploying new decision tools in functions throughout the design funnel, not just the early conceptualization and specification activities dubbed "design." It means creating a series of communication and evaluation tools, such as design indices, that can track the performance of a product down the design funnel.

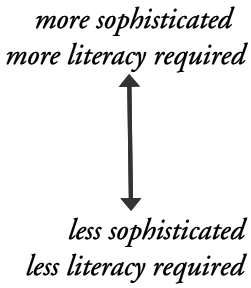
Diffusion can take different forms. It can involve putting tools like a sustainability calculator on a company Intranet. As discussed in the case studies in Section V, it might involve establishing new design rules, such as the cradle-to-cradle protocol that Herman Miller developed. It might involve creating a centralized agent to oversee and interface throughout the design funnel, such as Nike's Considered Design Team, which engages participants across stages in the design process.

At the same time, companies need to improve their sustainability literacy and integrate tools that can help decision makers and hold them accountable for prudent, value-adding choices. **Sustainability decision tools differ in sophistication and required literacy**. It important to package information

into the right-sized bundles so that people in different circumstances and different levels of understanding will be able to access and use it readily.

Using chemical screening as an example, the trade-off is between building literacy across the organization (to expand the number of people who can evaluate chemical hazards) versus deploying simplified tools that are more broadly accessible but less empowering for designers.

- *Chemical screening tools (e.g., SAR-based analyses*)*
- *Databases of ranked chemicals*
- *Lists of restricted substances*
- *Catalog of approved goods*



For example, a more sophisticated chemical screening tool can assess substances based on a large number of hazard characteristics. Some tools may offer ways to aggregate scores on a variety of endpoints (from toxicity to flammability) and give an overall hazard ranking between LOW and HIGH. These tools are useful for performing a risk-based chemical substitution analysis. On the other end, less sophisticated tools include catalogs of approved products, which just restrict users' choices to products that have already gone through a sustainability screening, but do not require users to understand dimensions of sustainability. In between there are a range of other options.

An important point is that, **persistence greatly improves the diffusion of sustainable design tools and techniques**. Sustainability and corporate social responsibility professionals face resistance in new areas of communication. It is common for practitioners to push back when asked for new information or when encouraged to integrate new metrics into their decision processes. There are a variety of reasons — perceived opportunity costs, transaction costs and the feeling that "it's too hard to change" — that are likely to make it more difficult to build sustainability intelligence.

Despite these barriers, what many leaders find is that people are not outright opposed to sustainability, nor are the direct costs of information requests prohibitive. Rather, information requests often require initial learning to make them understandable and to fit them into work routines. A parallel thing can be said about metrics. Without assuring literacy among those who are encouraged to use them, sustainability metrics are likely to be limitedly integrated into design processes or ignored altogether. The end result is that sustainable design may require patient conversations to find ways to reduce the perceived costs and inertia that make them hard to undertake at first blush. As part of an assessment, a company

"For many people associated with developing products, environmental considerations are far removed from the mainstream features that [they deem] critical. … It is very easy to mistakenly assume they will know, understand and remember [such considerations], especially when the environment is one's area of responsibility."

- Frank Rooney,
DEC Manager of Product Stewardship

* *SAR refers to structure-activity relationships, a study of chemical behavior based on the chemical structure.*

should identify the parts of its organization that are ready to explore opportunities, create pilot projects with them and build out from there.

"Starting the Process with One Candle"

When DEC launched a product stewardship program in the 1990s, it made a pragmatic choice when staffing its team. It designated a member of its Environmental, Health and Safety (EHS) staff to be a "product integration manager" (PIM) for a first pilot project. The PIM was a formal member of the product development team, whose role was to act as a champion for its sustainability principles (e.g., to reduce hazardous materials, to design for recyclability and to reduce packaging waste). Given the breadth of these principles, the purpose of the PIM was to look for sustainability integration with existing design, manufacturing and service requirements.

A successful first pilot project led to creation of PIMs in product development for additional business units and the development and diffusion of successful sustainability-based innovation. As typical of early-phase sustainable design efforts, the pilot project revealed key learning experiences for developing competency to make substantive changes. Although there was some significant outcome progress, such as reduction in VOC emissions from a switch from solvent-based to powder surface coatings, the early project successes involved procedural advances like standardizing fasteners or marking all plastics with material identifiers to facilitate disassembly and recycling.

An interesting detail for managers leading organizational development is that, as projects grew, PIMs shared lessons with each other and began to build an expert knowledge source within the company. This development of the environmental function enabled the product sustainability team to reach out beyond the design phase to integrate principles and metrics into the production and marketing of products.

Source: Rooney, Frank P, 1998. "Designing EHS Principles into Digital Equipment Corporation Products," Corporate Environmental Strategy *5 (4): 18-25.*

V. Applying the ABCDs: Examples from Apparel, Furniture and Cleaning Products

Designing for sustainability via an integrative design funnel involves a variety of strategic and operational transitions. The case studies in this section describe how companies have gone through these transitions and progressed in their journeys toward designing more sustainably.

There are three things worth noting about the experiences of these companies:

- They have chosen to advance, but not wholly reinvent, their existing design processes; consequently, they have looked for ways to adapt relevant functions and their inter-relationships to integrate sustainability intelligence into design.
- The primary challenge they faced has been determining how to develop and diffuse sustainable design competencies into relevant functions.
- They have created new organizational forms and learning bridges in the short run to enable relevant organizational participants to communicate and coordinate about what sustainability is and how it is material to their products.

In the examples below, the *Assess-Bridge-Create-Diffuse* framework highlights aspects of the organizational evolution that have made progress possible. The lessons extracted are meant to help companies advance their sustainable design capabilities.

A. How Sustainability Became Considered at Nike Inc.

In 2005 Nike launched a new line of footwear deliberately designed and marketed with sustainability in mind. Compared to its conventional footwear, the first model in the Considered line, the *Considered Boot*, wasted 61 percent less material during manufacturing, required 35 percent less energy to make, used 89 percent less solvents (from reduced adhesive usage), and was designed for readier recycling in Nike's Reuse-A-Shoe program. Nike expanded Considered into its All Conditions line in 2007 with shoe updates that use less material and toxic adhesives. In January 2008 Nike released the XX3 model of the Air Jordan, a version of its flagship basketball shoe that boldly integrated sustainable design features and doubly marked the shoe's 23rd anniversary and the jersey number of its famed namesake. A month later, Nike released the Trash Talk, a basketball shoe comprised entirely of factory scrap material.

Sustainability Features of the Considered Boot

- Uses materials found primarily within 200 miles of the Nike factory
- 80-percent less toxic solvent usage for adhesion due to an inter-locking sole and a welt stitch
- Contains hemp and more sustainably produced leather to shift toward more renewable materials that still breathe well
- Contains recycled polyethylene teraphthalate in the laces and recycled rubber from factory waste in the outsole
- Reduces the number of production steps to improve factory energy efficiency
- Optimizes material layout to reduce waste in the cutting process
- Designed for recycling, notably in Nike's Reuse-a-Shoe recovery program

What started at Nike as a line of shoes has turned into a design ethos that the company is applying across its brand. By 2011 Nike plans to have all its footwear meeting the base level of its Considered

Design Index. The company plans to follow by introducing the metric in 2010 for all its apparel and by phasing it into its range of equipment offerings beginning in 2011.

How did Nike make its advances? What changes did it make to develop the sustainability intelligence needed to design more sustainable yet salable products? **In contrast to its marketing tagline, Nike did not "just do it."** Its product design successes needed organizational intelligence that the company developed over more than a decade.

The origins of Nike's sustainable design efforts trace to the early 1990s and the creation of a small department called the Nike Environmental Action Team (NEAT). The initial efforts of NEAT focused on recycling and education and helped develop Nike's Reuse-A-Shoe program, a recovery initiative launched in 1993 to turn spent footwear into sport surfaces. As the NEAT team continued its work through the 1990s, frameworks aligning sustainability and business inspired them to expand the scope of Nike's sustainability vision. By the end of the decade NEAT had worked with Nike management to write the first corporate environmental policy and a set of broad sustainability goals.[14]

Empowered by sustainability-oriented corporate policy and goals, NEAT members doggedly encouraged product design initiatives and a number of important innovations emerged. However, two problems prevented these efforts from stimulating a significant evolution in sustainable product design. One was the approach to change, which was based on creating an informal, internal network of sustainability advocates to act as change agents. Despite the ability to support small projects, this network lacked sufficient organizational resources to diffuse lessons in a way that catalyzed systemic improvements in products or the design process. The other problem was the limited integration the group achieved with functions important in shaping the design funnel. The network that NEAT created contained many participants from the operations side, but not the customer-facing side of the business. As a result, NEAT's innovations lacked critical elements as a business case.

Assess

Recognizing the need to re-evaluate, **Nike stepped back and made two changes: it carried out a life-cycle assessment of product impacts and their activities, and it developed new monitoring tools to guide its efforts**. An evaluation conducted with The Natural Step in 2003 revealed that Nike was not focusing on the most significant impacts in its product life cycle, which lie in the supply base upstream of the company's operations and in downstream use and disposal of its products. In response to this review, Nike reprioritized and made creating innovative, sustainable products its unifying environmental goal.

To guide the company toward this goal, Nike staff developed and rolled out a sustainability index (now called the Considered Design Index) to all design teams and factory partners around the globe. The Index assesses the footprint of a shoe using three major metrics — a volatile organic compound (VOC) index, a waste index and a material sustainability index — which reflect Nike's ongoing

"Understanding Nike's global footprint and prioritizing areas where we have the greatest environmental and social impact is essential for building a robust business case for corporate responsibility and prioritizing our efforts."

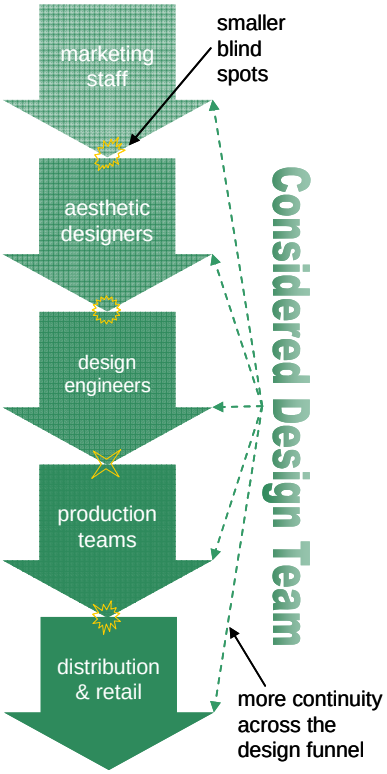
As part of its ongoing assessment efforts, in 2006 Nike carried out a company-wide assessment for its packaging footprint. To its surprise, Nike found that retail packaging contributed almost 75 percent of all waste related to its products.

Source: Nike FY05-06 Corporate Responsibility Report

goals to reduce product toxicity to zero, to eliminate waste in production and to close material loops. (Where applicable, it includes a fourth "innovation" metric, which was developed to encourage and reward new ideas from product teams.) Notably, the overall Considered Design Index is now being integrated into accountability systems to be evaluated alongside cost and performance in the design process.

Bridge

Following the success of the Considered Boot, in 2005 **Nike created a sustainable design team to serve as a conduit for <u>product</u> sustainability ideas, goals and lessons**. Nike had already formed a Sustainable Development group in the Corporate Responsibility department to expand on sustainability programs that NEAT had started. Going a step further, the company pooled core talent to form the Considered Design Team. This small group of chemists, biologists, material specialists, designers and product developers works directly with the design functions in Nike's footwear, apparel and equipment product lines. With reporting lines up through Corporate Responsibility and the product lines it serves, this team operates with three purposes:



- To develop metrics and tools that can make sustainability tractable across the design funnel
- To extend sustainable innovation capacity in product teams
- To increase the creation and use of less toxic, renewable and recycled materials

As a knowledge source, an advocate and a communication channel, the Considered Design Team creates sustainability bridges across the design funnel. Internally, its engagements correct for gaps in information, understanding and coordination. Externally, the team interfaces with stakeholders as part of Nike's "open-source" approach to corporate responsibility.

Create

Over the years, **Nike has grown its sustainability intelligence from a variety of forward-looking initiatives**. As its corporate sustainability reports recount, projects with a sustainability dimension can be traced back 10 years.[15] For example, the Reuse-A-Shoe program has helped Nike not only reduce production scrap and divert worn-out shoes from disposal; it has also laid a foundation for Nike's recycling of waste material into a next generation of shoes like the XX3 or Trash Talk. Its proactive phase-out of the greenhouse gas sulfur hexafluoride (SF_6) from bladders in air soles and its voluntary switch to water-based solvents for adhesives manufacturing operations has similarly advanced its sustainability learning capacity around materials chemistry.

Experiences from companies like Nike reveal that **creating pilot projects is an important part of the sustainable design evolution**. Despite past innovations, Nike did not have ready channels to integrate sustainability principles and lessons into its design process. To learn *how* to design more sustainable products, it started with a pilot project. Pulling together proven talent from different functions, Nike created and challenged a sustainable design team to develop a salable, more sustainable product. In addition to producing the Considered Boot, this pilot project provided important insights about its process as well. Through ongoing explorations, what began as a single product evolved first into a line of shoes and now into a design ethos for all product lines.

Diffuse

In addition to supporting pilot projects, the Considered Design Team also serves as a mechanism for diffusion of lessons across Nike. The team works across functions and product lines to build literacy and to establish goals and metrics for sustainable design. The members act both as advocates and educators, giving people tools that allow them to evaluate and report performance on the Considered Design Index.

One of the innovative tools the Considered Design Team has built to support the use of its Index is a calculator that computes a Considered bill of materials score, a solvent use score and a waste score. Another is a database of relative scores for various materials that designers can browse to select and compare materials. In addition to making the tools readily available on the company Intranet, the team continues to improve its sophistication. For example, it updates predictive values for product waste scores based on regular measurements of the actual waste data from the factory.

Suggestions for Future Achievement

- Expand the Index to include factory-level energy, water and climate impacts
- Expand materials assessment to a wider range of ecological and health effects
- Incorporate impacts from land-use and global production, given growing factory base and business travel
- Expand the amount of materials recycled from one shoe generation to another
- Improve consumer information about the product performance
- Explain and disclose "environmentally preferred materials" in detail

The efforts to update its Considered Design Index are one indicator of the ongoing nature of Nike's journey. There are many areas left for achievement, which encourage ongoing evolution in its corporate reporting functions, environmental management systems and supply chain engagement, as well as its strategic and cultural emphasis on product design as a core competency.

B. The Way a Stand Has Changed a Seat at Herman Miller Inc.[16]

Herman Miller, a leading global producer of office furniture, has a remarkable vision for the future. By 2020 the company strives to have a **zero ecological footprint from its products**. It recognizes that sourcing alternative materials and closing manufacturing loops will be hard to obtain amidst current gaps in technology, supply chains and markets. What gives the company confidence and helps maintain its commitment to this ambitious goal is its past progress in sustainable design.

Herman Miller's Perfect Vision 2020

- Zero ecological footprint:
  - Zero landfill waste
  - Zero hazardous waste
  - Zero air and water emissions
  - 100% renewable energy
- All products cradle-to-cradle designed
- All buildings rated at least LEED Silver

Component View of the Mirra Chair

Noteworthy Features of the Mirra Chair

- Contains no polyvinyl chloride (PVC)
- 96% recyclable
- Takes 15 minutes to disassemble with simple tools

Take its Mirra Chair as an example. Launched in 2003, it was co-developed with a design protocol rooted in recyclability, renewability and reduced toxicity. The result: well-selling task seating that is 96-percent recyclable, contains no PVC and can be disassembled in 15 minutes using simple tools. Building on this as a learning experience, Herman Miller has now used its new protocol to (re)design 27 percent of its product line.

Mainstream integration of the sustainable design protocol is a noteworthy accomplishment. Looking back at Herman Miller's journey, **how did sustainability get a regular seat at the design table?**

It has through the work of dedicated change agents, who have built the leading sustainable design practice now producing positive ripples in the company's supply chains and markets. Aided by a supportive company culture,[*] a band of committed practitioners have assiduously explored and developed new coordination mechanisms and learning experiments to enable sustainable design transitions. This foundational work is an insightful — and little highlighted — aspect of Herman Miller's evolution.

The journey to sustainable design has roots 20 years ago, when the environmental department launched a pollution prevention project to reduce formaldehyde emissions from wood finishing products. This initial inter-departmental collaboration led to the formation in 1989 of a cross-functional Environmental Quality Advisory Team (EQAT), a standing internal working group that draws together middle managers and experts from around the company. Started as a forum for tactical coordination and performance evaluation for environmental projects, over time it has grown into a primary corporate forum for setting environmental strategy and now matrixes 400 people (in a company of around 6,000) into environmental innovation and strategic planning. Interestingly, EQAT was designed *not* to include top executives — a choice made to enable directors and managers to explore opportunities more candidly.

Sustainable Design Questions That Herman Miller Asks:

- Are materials homogenous enough to enable recycling?
- Can common tools be used to disassemble the product?
- Does it take more than 30 seconds to unfasten any part?
- Is the material likely to be recycled, burned or landfilled?

[*] *Company founder D.J. DuPree (whose father-in-law and early business partner was named Herman Miller) imbued environmental sensitivity into company culture such that resource conservation has modestly figured into its design and operations for half a century. In keeping with these progressive ethics, today the company has executives who are supportive of, if not enthusiastic about, sustainability.*

Assess

Building on this collaborative model, in the early 1990s Herman Miller launched an offshoot Design for Environment (DfE) team to take the lead in product redesign. Pooling talent from development, purchasing, manufacturing and environmental functions, the DfE team pursued a corporate goal to send zero waste to landfill. Led by an engineering manager from the manufacturing department, in the mid-1990s the team undertook a gutsy project to design the breakthrough Aeron Chair using Earth Friendly Design Guidelines, the first version of its DfE protocol that emphasized recycled content.

A successful outcome from this project generated momentum for another layer of assessment. By the late 1990s Herman Miller developed interest in a more systematic, cradle-to-cradle approach to product design, and it dedicated staff in the environmental department to build the DfE capability. Examining the "materials chemistry" of its products, Herman Miller cataloged every material in every product — a substantial investment in sustainability learning that has subsequently facilitated supply chain re-optimizations and significant cost savings.

Bridge

Teaming up with McDonough Braungart Design Chemistry (MBDC) to dive more deeply into an examination of its materials, Herman Miller also started building bridges. **An interdisciplinary discovery team undertook a one-year project exploring how a cradle-to-cradle approach would influence and require involvement from different functional operations**. Formed with senior representatives across the company (i.e., from product development, engineering, materials research, purchasing, finance, marketing and environmental affairs), the team considered a variety of challenges: how to implement sustainability assessments for products and materials, how to work with suppliers to procure more sustainable materials, how to hire and retrain staff with sustainability expertise, how to reshape the design culture to include sustainability, and how to inspire attention to sustainability throughout the company.

The investment in internal alignment and chemical audits around materials chemistry was an important step before setting out to engage suppliers and re-channel procurement around more sustainable materials. To study the sustainability of materials and manufacturing needed to make a chair, Herman Miller asked its suppliers for additional information. Addressing concerns that arose around intellectual property, it developed new procedures to manage suppliers' material information. It also partnered with other companies, sometimes from outside its sector, to build common communication frameworks to improve the flow of environmental information. Not all suppliers were ready to be partners and **Herman Miller committed only to companies who could support its sustainability needs**.

Key Facilitators of Sustainable Design Success

- A company founder and culture generally supportive of sustainability
- Formation of a cross-functional advisory team to explore and coordinate changes in design practice
- Establishment of zero landfill waste goals and then zero ecological footprint goals
- Launching a design for environment team and projects in materials chemistry
- Adequate resources for pilot projects and development of learning and literacy tools

Create

Through this process Herman Miller has launched a series of pilot projects. The first wave in the mid-1990s concentrated on product durability and reduced impact, and on improving the recyclability and recycled content of its products. A second wave beginning around 2000 focused on ecological footprint reduction and stimulated a deeper examination of the supply chain and product design roots of its material impacts.

These projects helped Herman Miller develop its "cradle-to-cradle design protocol," a set of design guidelines developed to apply across its products. The protocol guides consideration of sustainability through:

- Materials chemistry analysis
- Product ease-of-disassembly review
- Materials recycling evaluation to improve recycled content in its products as well as to enable material recycling from them

Building Momentum at Herman Miller

Other projects helped sustainable design gain momentum. For example, by 1993 EQAT worked sustainability considerations into the company's new combined administrative and manufacturing center dubbed the "GreenHouse." The design invested considerably in daylighting, fresh air ventilation and landscape integration to improve stormwater management and maintain ambient wildlife habitat. In addition to strengthening the company's reputation as a good neighbor, the design has had measured increases in employee productivity and job satisfaction.

Herman Miller has integrated the cradle-to-cradle protocol into its new product commissioning process — a move that assures all products get screened for sustainability.

Diffuse

Working through its implementation issues and strategizing environmental goals around it has helped Herman Miller identify gaps in occupational literacy and needs for knowledge-sharing tools to replicate sustainable design success across products.

For example, to help design engineers evaluate material options for products, Herman Miller developed a step-by-step assessment and selection process. The approach guides a user through evaluation of materials along a variety of characteristics (human health and eco-toxicological effects, recycle-ability, recycled content and/or use of renewable resources, and product design for disassembly). To improve its usability, the DfE team developed a color-coded assessment scheme to make it easier to integrate into new design projects. The scheme has four levels: little or no hazard (green), low to moderate hazard (yellow), high hazard (red), and inadequate information (orange).[*] With the goal of phasing out reds and oranges, staff uses a simple spreadsheet to evaluate products three times — in the early, middle and final launch phases of the design process.

Ongoing Efforts at Herman Miller

- Developing PVC alternatives
- Getting formaldehyde out of particle board
- Exploring alternative chemistry for textiles and dyes
- Finding fiberglass replacements
- Finding safer metal finishes
- Sourcing bio-based materials
- Reducing packaging

[*] *The CleanGredients program of GreenBlue (www.greenblue.org), the Green Screen of Clean Production Action (www.cleanproduction.org), and the Greenlist of SC Johnson use comparable four-point, color-coded schemes.*

Herman Miller is now working externally to build bridges and diffuse its sustainable design lessons. Having decided to treat sustainability as a common good, not a matter of market competition, it is exploring ways to share its protocol with other companies. Leaders in the sustainable design program are giving presentations at industry conferences and working to build sustainable design standards through trade associations.

The progress made at Herman Miller has taken patience and persistence. Its success has been achieved because it has taken the time to establish its assessment capacity, to build appropriate communication channels, to evolve common language and performance metrics, and to develop support tools that allowed people to see sustainability in their operating functions and everyday work.

CASE STUDY: Steelcase

Steelcase offers an interesting contrast in route of progress. Just up the road from Herman Miller, it is the largest office furniture producer in the country. It also has a founder with progressive environmental ethics and executives who are supportive of, if not enthusiastic about, sustainability. Its Think Chair (designed in collaboration with MBDC) contains similarly noteworthy advances: 99-percent recyclable by weight, contains 44-percent recycled materials, and can be disassembled in five minutes using ordinary tools.

Yet at Steelcase the patient, persistent work of committed change agents has taken place more behind the scenes. Unlike Herman Miller, where a formal cross-functional teaming preceded or coincided with pilot projects, at Steelcase considerable explorations took place early on informally through "soft authorizations" where slack was available. The difference reveals how sustainable design may depend more on informal, bottom-up processes in some companies.

C. Reflecting on Green Works in The Clorox Company

In late 2007 Clorox announced an addition to its product portfolio: a set of cleaners marketed for their sustainability attributes. Made from sources like coconuts, corn and lemon oil, the GreenWorks line of household cleaners boasts an ingredient list that is 99-percent plant-derived. (The fragrance and preservative are the 1 percent not derived from plants.) The design of this product line also includes strides to make the cleaners more biodegradable, non-allergenic and non-toxic, as well as to avoid testing on animals and packaging that is non-recyclable. In all, a bold advance for a company virtually synonymous with bleach and with no previous noteworthy achievements in sustainable product design.

How has Clorox cleaned up?

Clorox is an interesting case because the company is early in its sustainability journey. It is, as the company's eco-director quips, "at the front end of the pack following the sustainable design leaders." The GreenWorks line was its first significant pilot project and took three years to complete. Having developed it from the perspective of business growth into a new consumer market, the challenge Clorox now faces is extracting lessons and building design intelligence that can be applied across its established brands. Here is a look back at Clorox's journey and at the road forward.

Assess

The GreenWorks story began over three years ago, when goals to increase the top-line growth of the company identified "natural" cleaning products as an emerging market mega-trend. This business assessment raised questions for which Clorox had no ready answers. What would it mean to be a "natural" product? How could the company increase the "natural" attributes of its products through design? Despite a steady record of regulatory compliance, Clorox had made no habit of sustainability accounting or reporting. Developing sustainability intelligence had been largely off the company's radar.

The GreenWorks experience has motivated Clorox to reconsider its position. For example, Clorox developed its first formal environmental strategy in 2007, two years *after* GreenWorks was underway. In 2006, management authorized a small group of internal leaders to conduct a 90-day sustainability audit of the company. The goal of this audit was to evaluate the company's sustainability capacity and to benchmark it against its competitors.

A review of business units and functions across the company revealed that sustainability initiatives were already taking place. But most initiatives were local and uncoordinated — a product of the compliance mindset and decentralized organization that Clorox had emphasized for its environmental function. The audit team concluded that, although Clorox had ample technical expertise to make near-term sustainability advances, it lacked a strategic coordinating function to synergize and build on them. What it needed was the capacity to collect sustainability insights and diffuse them across the company.

Bridge

This need is different from what the GreenWorks model could support. To develop that new product line, Clorox pulled together a team of proven staff and gave them the mandate and resources to build a line of natural cleaners. The team had relied heavily on its supply base and on trade associations for knowledge about natural materials and market sources for them. Leveraging good relationships with key

suppliers and working closely with the procurement staff, the GreenWorks team collected more information about materials and their origins than ever before. This information was needed not only for analysis during product development, but also to communicate credibly with downstream customers, retailers and environmental advocates willing to endorse the product.

Key Lessons from GreenWorks

- Choose language that sparks interest in change. The sustainability "mega-trend" worked at Clorox.
- Spend time developing metrics that can steadily guide the process. (At Clorox the definition of "natural" cleaner was an important reference point and guide.)
- Staff new projects with people resilient in the face of adversity.
- Compose a team that is passionate, but not overzealous, about the project. If their approach is pragmatic, their passion will be infectious.

Coming out of the experience, Clorox needed a new way to collect and build on the lessons and external bridges from this project. Heeding findings from the sustainability audit, management chose to create a small corporate "Eco Office." Less than a year old, its purpose is to lead and coordinate sustainability initiatives with an eye toward business growth. As part of this effort, the Eco Office is considering setting up a cross-functional advisory council to explore where sustainability makes sense and can be effectively integrated across its 10 business units and roughly 40 brands.

Create

Looking back over the experience, Clorox created several new things in the process of launching GreenWorks. One was a credible and durable definition of a "natural" cleaner — something it accomplished by leveraging the talents of its public affairs function and drawing on insights from sustainability thought leaders and NGOs. This definition has proved to be an important rallying point and source of continuity through the twists and turns of the GreenWorks development process.

The GreenWorks project also motivated Clorox to add more technical expertise in toxicology and environmental impact analysis. In addition to creating a corporate environmental strategy and centralized Eco Office, beefing up these skills in the shared product development function has expanded its in-house capacity to analyze and communicate sustainability opportunities.

Diffuse

It took approximately one year to convince senior Strategy executives to give designers the freedom to explore the GreenWorks concept. Initially, Clorox looked at GreenWorks as a product for a niche market. Its recognition that it was able to develop cleaners on par with conventional competitors at only a modest price increase has changed that perspective. Within the company there is now a growing belief that sustainability could be a more mainstream attribute of Clorox's product offerings.

At a company like Clorox, garnering this support is important for moving forward in product development. With employees eager to get involved with sustainability initiatives, what the company needs now is an improved ability to understand and see strategic opportunities in sustainability. Clorox has taken a positive step by creating the Eco Office with the mission to promote literacy and serve as an information repository. Its journey forward, and whether it can green more of its works, will depend on the company's ability to continue building its sustainable design intelligence.

Suggestions for Future Achievement

- Improve consumer information about product performance and define "natural materials" in detail
- Embrace green chemistry and carbon neutrality across Clorox's product lines
- Make the whole product container recyclable, not just the bottle

VI. Conclusions

Sustainability is an opportunity for design practice and for the organization of the design function in the modern company. Realizing this opportunity involves integrating new information in product analyses and developing communication infrastructure to identify, collect and transmit it. It also involves remaining reflective and engaged in dialogue with stakeholders to understand the evolving meaning of sustainability. This combination of introspection and integration — in particular appropriate accountability systems — is enabling leading firms to create value through sustainable design.

A. Sustainable Design Is an Innovation in Practice

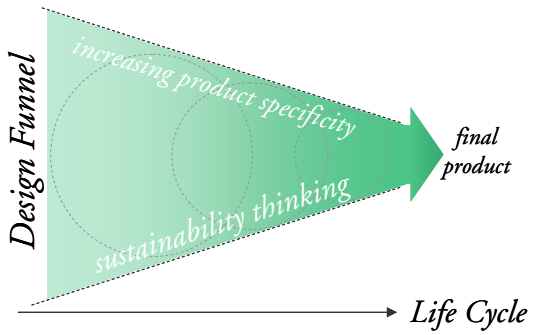
Because design decisions can impact products across their life cycles, the design process is increasingly viewed as a critical component of enabling sustainability, and the implication for design practice is expanded design thinking. It means:

- Marrying "human factors" and "systems thinking" in design analysis
- Selecting appropriate tools for a task's sustainability challenges
- Anticipating unintended consequences better
- Allowing non-intuitive approaches, since old logics may not suffice
- Focusing on staying dynamic as the systems and issues evolve

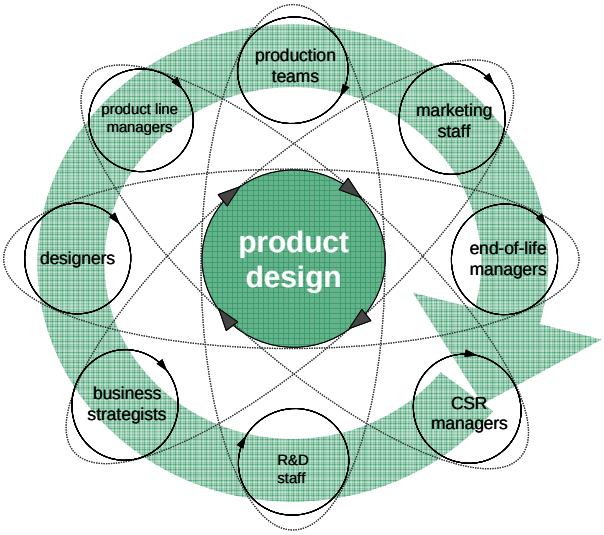
The key point to keep in mind is that, as a design challenge, sustainability requires building the capacity to recognize a sustainability issue. Design teams who can do so will be able to identify strategic opportunities and to reduce the risk of a sustainability crisis.

B. Sustainable Design Is a Kind of Organizational Intelligence

Sustainable design is more than an innovation in design practice or analysis during an upstream focal point in product development. It is a recognition that many groups around the company can shape the final design of a product, but may not yet know it. Thus, designing for sustainability means organizing so that people can recognize how their choices are shaping product sustainability and can identify resources to improve them. It means that, in addition to thinking across the life cycle, organizations encourage thinking about design sustainability in each part of their design funnels.



This report highlights ways that companies are building this sustainability intelligence through an integrative design process. Integrating involves expanding coordination channels and creating feedback communication among groups who might otherwise be separated into a pipeline design sequence. By bridging functions and knowledge centers, integrative design facilitates new awareness about how groups interact with product sustainability, as well as overcomes purview problems, such as blind spots in the design funnel that disrupt initiatives and innovation. As a result, taking these steps helps companies not only design more sustainable products today, but also helps them build smarter, more nimble design processes capable of sustainable innovation.



In addition to building communication infrastructure that improves design coordination along the design funnel, leading companies are also developing support tools that help people make more sustainable choices and build accountability around product outcomes. Tools like sustainability calculators and chemical databases help people ask and answer questions like:

- How sustainable is this material? How toxic, renewable, reusable, recyclable, biodegradable and ethical is the product as a result of its use?
- Where in our organization do we have information and/or need to have information to guide decision making about this material? Who has access to it and how efficiently can they access it?
- How much of this material are we using in our product or in the processes that make it? What are the implications for our employees? What are the implications for the way that we envision customers using it?

Even if raising the same sustainability questions, companies have different transition experiences because their products and underlying design processes vary. However, the communication infrastructure they develop has similar elements of success. It helps them assess the sustainability of their products *and* their capacity as organizations to (re)design them. It bridges functions and people internally and externally and creates learning engagements that lead to tractable, meaningful and profitable sustainable product (re)designs. And it diffuses tools so that information is accessible in the right place and time.

The A-B-C-D model highlights these four behaviors as components of "sustainable design intelligence," a dynamic learning model to help companies build more sustainable products.

- **Assessing**: The ability to analyze the social and environmental impacts of products and production and to evaluate organizational capacity to address them.
- **Bridging**: The ability to connect ready parties and to bring the right functions and the right people together to redesign products.

- **Creating**: The ability to generate projects that enable exploration and learning about product sustainability and about changes needed to the design process.
- **Diffusing**: The ability to deploy tools that build literacy, integrate learned design principles and build accountability across the design funnel.

C. Sustainable Design Is Organizational Learning

This report introduces sustainable design as a **learning orientation**. The reason is straightforward. Sustainability is fluid, contextual and evolving in its meaning. Consequently, a sustainable product is a moving target. The companies featured are making advances in their product designs, but this report also focuses on their development of a design function that can continue to learn about sustainability issues and make product changes as the world around them changes.

In this sense, leading companies recognize that they are making *more* sustainable products, not yet altogether sustainable ones. They are approaching sustainable design as an area of continuous improvement and repeating the process of assessing, bridging, creating and diffusing. They are accumulating knowledge and information that expands the scope of their sustainable (re)design capabilities. As part of this process they are working closely with thought leaders, stakeholders and design experts to understand the changing nature of "sustainability" and emerging design possibilities. They are paying attention to sustainable design options as the world around them changes.

A learning orientation is important because there are few clear-cut choices. There are no simple lists of input materials or products that are "good" and few resources that clearly spell out materials or procurement options as "bad." Much of sustainable design is about developing a capacity to navigate the muddy waters in between. It is about learning to think across the product life cycle, up and down the supply chain, and across the boundaries of an organization to make sustainability visible, tractable and profitable. As the diagram to the right illustrates, it builds from initial projects toward integration of sustainable intelligence throughout the organization.

As an area of organizational learning, sustainable design may start small with pilot projects involving only some parts of the organization. As sustainability intelligence grows, the design process should grow and include more functions.

The diagram above represents this change as growth from pale to dark green and from small involvements to robust and routine connections across functions.

To conclude, this report explores sustainable design by discussing products; however, sustainable design also creates opportunities for break-through innovations that can

transform a product offering. For example, a radical redesign can dematerialize a product, such as miniaturization or creation of all-in-one electronic devices. It can substitute technologies, such as videoconferencing instead of airline travel. And it can transform ownership patterns and draw closer together phases of the life cycle, such as shifts to leasing models have done for production and recycling of electronic equipment and floor covering. These innovations are available to companies through the synergy of opportunity and design capacity. The challenge is building the practice and organization to make them achievable.

Appendix: Concepts and Tools for Sustainable Design

This appendix reviews some of the significant concepts and design tools that have been shaping the development of sustainable design. As an umbrella over terms like eco-design, innovation and socially conscious design, sustainable design is meant to encourage the development of products that are environmentally, socially and economically sustainable. The list here focuses primarily on environmental factors and principles of sustainability.[17]

Closed-loop or Closed-cycle Design

A closed-loop or closed-cycle system recovers materials and returns them from one product life cycle to another. The idea is a metaphor for biogeochemical cycling in natural ecosystems and is a founding idea behind industrial ecology.[18] Closed-loop or closed-cycle design helps companies develop products that reduce waste and improve their recyclability. The cradle-to-cradle concept popularized by William McDonough and Michael Braungart is based on the idea of closed-cycle design.[19]

Design for X (DfX)

Design for X is an umbrella term for design approaches that attempt to improve an aspect of a product. The "X" is the substitutable aspect. Although DfX applies to activities that do not necessarily have a clear link to sustainability (e.g., Design to Cost, Design for Assembly, Design for Quality), in sustainable design it serves as a catch-all for sustainability-enhancing design activities.

Design for Environment (DfE) is the best known of these approaches. It refers to design activities or analyses undertaken to reduce the environmental impacts of a product, generally across the product's life cycle. DfE strives to conserve energy and resources, reduce health and ecological disturbances, and eliminate product and production waste.

Design for Disassembly (DfD) describes analyses and design efforts undertaken to make a product more easily, readily and economically recyclable. It includes actions like standardizing fasteners, making fasteners more easily removed and not fusing materials so that they cannot be practicably separated.

Design for Recycling (DfR) describes analyses and design efforts undertaken to make a product more recyclable. DfR includes activities like designing out materials that are not readily recyclable, marking components to communicate their material contents, and building systems that facilitate disposal alternatives for decommissioned or spent products.

Design for Biodegradability (DfB) is a still-emerging alternative to the older DfE approaches. Instead of activities undertaken to improve the longevity or recyclability of a product, design for biodegradability is a planned product obsolescence around degradation into substances that become ready nutrients in ecosystems.

Eco-compass

Eco-compass is a term that Dow Europe applied to its multi-criteria evaluation of environmental components in product design.[20] The process graphs six characteristics (service extension, recoverability, resource conservation, energy intensity, material intensity, and health and environmental impacts) onto a hexagonal plot. The process is useful for comparing products and has no absolute baseline.

Ecological Footprint

Ecological footprint is an analysis and visualization tool developed to relate the idea of human resource usage to productive surface area of earth – in essence, human activity to planetary carrying capacity.[21] Ecological footprint equates a population's or company's resource usage habits to an equivalent amount of surface area (i.e., of land or water) needed to support it (see www.footprintnetwork.org).

Extended Producer Responsibility (EPR)

Extended producer responsibility is a framework that assigns producers of products greater physical and/or financial responsibility for their material impacts, most notably at product end-of-life.[22] As part of a more integrated product policy, EPR is intended to stimulate producers to consider and design out life-cycle impacts of their products.

Factor X/Factor 10/Factor 4

The "Factor X" (originally "Factor 4") is a concept developed as a normative guideline for improving product quality and service delivery while reducing material and energy intensity.[23] Its emphasis on "resource productivity" is intended to spur intense innovation to decrease material flows through the economy. An extension of this idea is the "Factor 10" concept, which suggests that long-term development needs to focus on a ten-fold decrease in material flows. These ideas have their basis in industrial metabolism and material flow analysis, concepts emerging from industrial ecology.[24]

Fair Trade

Fair trade is a social movement attempting to reconcile economic disparities that arise in production chains among sellers and producers. The movement emphasizes equitable pay, as well as robust social and environmental standards, for laborers working in resource, extraction and handicraft industries, generally in the developing world. The Fair Trade label has become a certified standard for more equitable wealth-sharing practices in supply chains. The nonprofit, multi-stakeholder FLO International is the leading organization governing fair trade certification globally.

Life-cycle Analysis (LCA)

Life-cycle analysis (sometimes called life-cycle assessment) is a framework for examining the range of sustainability impacts that occur from the time a product is born into existence (i.e., its cradle or womb) until it reaches its death (i.e., its grave or tomb). Life cycles are typically broken into phases, such as raw material extraction, material processing, manufacturing, distribution, sale, use and end-of-life. (Note: LCAs rarely consider cross-cutting functions like design, accounting or marketing as life-cycle stages.)

A cradle-to-grave analysis is intended to account for a full range of resource demands and environmental burdens associated with a product. As a result, LCA can be a very data-

intensive process, and interpretation of data often requires judgment calls about the relative importance of different kinds of impacts. Multiple types of LCA have been developed over time to simplify the process or to extend its insights.

Simplified LCA or Eco-indicator LCA is a simpler version of the more comprehensive LCA. A simplified LCA reduces the number of indicators and phases considered to those initially identified as significant.[25] There are numerous versions, such as the Environmentally Responsible Product Assessment matrix.

Basic Materials Assessment or Environmental Effect Analysis (EEA) is a method designed for early phases of product development and can be done qualitatively. Developed in the 1990s, it is intended to guide quick identification of significant potential environmental effects and to clarify product goals and objectives early in the design process.[26]

Economic Input-Output LCA (EIO-LCA) is an approach that incorporates data from commodity input-output databases with the resource requirements and environmental impacts traditionally included in an LCA. The purpose is to relate material purchases (prices) to their environmental impacts and is particularly useful when complex resource inputs (such as materials data based on prices) are involved.

Material Input Per Service Unit (MIPS) is a form of LCA that focuses only on material inputs. The purpose of MIPS is to draw attention to the material intensity of products and to serve as a "robust initial measure for estimating the ecological stress potential of goods and services from cradle to grave."[27] A close conceptual companion to MIPS is the "ecological rucksack," which refers to the embodied materials and energy that a product carries with it. Another related idea is Flaeche Input Per Unit Service (FIPS), which takes the MIPS concept and extends it to a unit of Earth surface area.

Life-cycle Design

Life-cycle design is the explicit application of life-cycle analysis and planning in product design.[28] It encourages consideration of environmental impacts and trade-offs early in the product life cycle. Some organizations, such as The Natural Step, have developed tools to enhance life-cycle considerations throughout the design process. For example, its Sustainability Product Analysis Matrix (SPA Matrix) uses a hierarchical set of questions to identify and find alternatives to non-sustainable materials in products.[29]

Life-cycle Management (LCM)

Life-cycle management is a product management approach that accounts for the life-cycle impacts of products and processes. It integrates activity-based and full-cost evaluation into conventional management tools, like accounting and budgeting, to include environmental considerations more readily in decision making.

Product Stewardship

Product stewardship describes the engaged management of product environmental impacts, with emphasis on active participation by actors associated with a particular phase of the product life cycle. Extended producer responsibility is a form of product stewardship, albeit one that takes a more limited view about how companies will be involved in product sustainability.

Sustainable Manufacturing

Closely related to sustainable product design, sustainable manufacturing describes environmental improvements during the production stages of the product life cycle. Reducing raw material and energy usage, minimizing waste, and reducing toxicity are examples of activities that contribute to sustainable manufacturing.

Cleaner Production is an integrated approach to preventing environmental impacts. Often focusing on production efficiency, it encourages ongoing analysis of material and energy flows and non-product/waste output. It is closely related to pollution prevention and source reduction and has been more commonly used outside the United States.

An *Environmental Management System (EMS)* is a management program that delineates and clarifies an organization's environmental responsibilities. The purpose of an EMS is to add coherency and comprehensiveness to an organization's environmental operations, to improve implementation of environmental policies, strategies and goals, and to improve overall environmental performance. An EMS has conventionally focused on management of manufacturing operations, but some companies, such as Lucent Technologies, have adapted the idea to create product-based environmental management systems (PB-EMS).[30]

Pollution Prevention describes efforts to develop, manage and redevelop manufacturing processes to reduce pollution. This approach emphasizes process redesign and optimization, rather than adding pollution control equipment. It has been more widely pursued in the United States than cleaner production.

Sustainable Manufacturing Standards

There are numerous sustainable manufacturing standards that could be components of a sustainable product design program.

ISO 14000 is a series of environmental management standards governed through the International Organization for Standardization (ISO). ISO 14001 is designed to help organizations identify environmental aspects, continuously improve in their overall environmental performance, and develop a systematic approach to environmental management and communication.

OHSAS 18000 is a series of occupational health and safety management standards. Mirroring the ISO 14000 series of management standards, OHSAS is designed to help companies examine and manage the health and safety of their workplaces systematically, with the goal of continuous improvement.

Social Accountability 8000 (SA8000) is a social accountability standard and verification system to improve labor relations and working conditions. Developed and overseen by Social Accountability International (www.sa-intl.org), the standard incorporates widely accepted international labor rights. It encourages a continuous-improvement approach to factory management and stakeholder involvement to improve the quality of the program.

AccountAbility 1000 (AA1000) is a standard developed by AccountAbility (www.accountability21.net) to encourage ethical behavior in organizations. The standard is based on social and ethical accounting, auditing and reporting, and is designed to help users improve social performance, transparency and stakeholder responsiveness.

Zero Emissions

Zero emissions is a concept emphasizing balance between the rate of industrial uptake of resources and release of wastes within "natural limits." Grounded in engineering analysis, it encourages systems analysis focused on integration and optimization. The concept emerged from work at United Nations University and was launched as a program at the UN in the mid 1990s.

Zero Waste

The zero waste concept encourages beyond-recycling thinking. Rather than just encouraging the recovery of waste products, zero waste encourages redesign that cuts out excess material and energy. It can focus on conserving resource inputs or turning industrial metabolites or leftovers into feedstocks for other operations. While both approaches reduce expenses associated with waste management, the former also reduces the costs of input materials. Practically, zero waste means more advanced materials planning and production integration to make product and processes more efficient. It is related to other planning tools like Zero Defect (from Total Quality Management) and Zero Inventory (i.e., Just-In-Time manufacturing).

VIII. Notes and References

[1] See the European Union (EU) Commission Directive 2002/95/EC of 27 January 2003 of the European Parliament and of the Council on The Restriction of the Use of Certain Hazardous Substances in Electrical and Electronic Equipment (RoHS), effective date 1 July 2006; Directive 2002/96/EC of 27 January 2003 on Waste Electrical and Electronic Equipment (WEEE), effective date 13 August 2005, amended by member states until 1 January 2006; and Directive 2006/121/EC of and Regulation No. 1907/2006 of the European Parliament and of the Council on Registration, Evaluation and Authorisation of Chemicals (REACH). For a discussion of REACH, see the BSR issue brief (October 2007), "Achieving Effective REACH Implementation" (available at www.bsr.org/reports/BSR_Reach.pdf).

[2] Michael P. Wilson, Megan R. Schwarzman, Timothy F. Malloy, Elinor W. Fanning, and Peter J. Sinsheimer (2008), "Green Chemistry: Cornerstone to a Sustainable California." The Centers for Occupational and Environmental Health, University of California. Available at http://coeh.berkeley.edu/greenchemistry/briefing.

[3] BSR (August 2007), "Perspectives on Information Management in Supply Chains" (available at www.bsr.org/reports/BSR_Info-Management-Supply-Chains.pdf).

[4] "In 3rd Recall, Mattel Says More Toys Include Lead," *New York Times*, September 5, 2007; "Thomas the Tank Engine Toys Recalled Because of Lead Paint," *New York Times*, June 15, 2007; "Melamine in Pet Food, Wheat Gluten from China," Reuters, March 30, 2007; "USDA Orders Largest Meat Recall in U.S. History," *Washington Post*, February 18, 2008.

[5] For a discussion of credibility concerns, see TerraChoice Environmental Marketing Inc. (November 2007), "The Six Sins of Greenwashing: A Study of Environmental Claims in North American Consumer Markets" (available at www.terrachoice.com/Home/Six%20Sins%20of%20Greenwashing) and BSR with Forum for the Future (April 2008) "Eco-Promising: Communicating the Environmental Credentials of Your Products and Services" (available at www.bsr.org/reports/BSR_eco-promising_April_2008.pdf). For interesting thoughts about the boycott issue, see also Monroe Friedman (2001), "Ethical Dilemmas Associated with Consumer Boycotts," *Journal of Social Philosophy* 32 (2): 232–240.

[6] Dara O'Rourke (2005), "Market Movements: Nongovernmental Organization Strategies to Influence Global Production and Consumption," *Journal of Industrial Ecology,* volume 9, issue 1-2: 115-128. Consider as additional examples: Rainforest Action Network's campaign against Home Depot's selling of old-growth timber (www.ran.org); the ongoing work of UNITE HERE as part of the anti-sweatshop movement (www.unitehere.org); and the Basel Action Network's efforts to stop the international transport of e-waste (www.ban.org).

[7] Leading thinkers eloquently make this point again and again. For example, see Karlson Hargroves and Michael H. Smith (eds.) (2006), *The Natural Advantage of Nations: Business Opportunities, Innovation and Governance in the 21st Century*; Paul Hawken, Amory Lovins, and L. Hunter Lovins (1999), *Natural Capitalism: Creating the Next Industrial Revolution*; and Daniel Esty and Andrew Winston (2006), *Green to Gold: How Smart Companies Use Environmental Strategy to Innovate, Create Value, and Build Competitive Advantage*.

[8] See Kleanthous and Peck (2006). "Let Them Eat Cake: Satisfying the New Consumer Appetite for Responsible Brands" (available at www.wwf.org.uk/filelibrary/pdf/let_them_eat_cake_abridged.pdf).

[9] See BSR with Forum for the Future (April 2008) "Eco-Promising: Communicating the Environmental Credentials of Your Products and Services" (available at www.bsr.org/reports/BSR_eco-promising_April_2008.pdf).

[10] Stuart Hart advances this argument in his 1995 article, "A Natural Resource-Based View of the Firm," *Academy of Management Review*, 20/4: 986–1014.

[11] See William McDonough and Michael Braungart (2002), *Cradle-to-Cradle: Remaking the Way We Make Things*, North Point Press.

[12] For a discussion about partnerships in the building and interior design process, see Sandra Mendler, William Odell, and Mary Ann Lazarus (2006), *The HOK Guidebook to Sustainable Design*, Second Edition, John Wiley & Sons, Hoboken, NJ, or ASID (2007), "ASID Research Series on Sustainability: Interior Design and Global Impacts" (available at www.asid.org/designknowledge/publications/center/2006/idandgi.htm).

[13] See the article by Simone Pulver (2005), "Making Sense of Corporate Environmentalism: An Environmental Contestation Approach to Analyzing the Causes and Consequences of the Climate Change Policy Split in the Oil Industry," *Organization & Environment* 20: 44-83.

[14] Nike (2001), Corporate Responsibility Report (available for download at http://nikeresponsibility.com/#crreport/fy01_cr_report). This report notes that members of NEAT were particularly inspired by Paul Hawken's thoughts in *The Ecology of Commerce*.

[15] See Nike (2007), "Innovate for a Better World: Nike FY05-06 Corporate Responsibility Report"; Nike (2004), Corporate Responsibility Report; and Nike (2001), Corporate Responsibility Report (all available for download at http://nikeresponsibility.com/#crreport/main).

[16] In addition to interviews, material from this case study was also collected from William McDonough and Michael Braungart, "Anatomy of a Transformation: Herman Miller's Journey to Sustainability," (available at www.mcdonough.com/writings/anatomy_transformation.htm and last accessed May 2008); and "Specifying It: Herman Miller's Scott Charon and Susan Lyons @ ICFF 2007," from the 2007 Metropolis Conference, Design Entrepreneurs: Rethinking Energy (available at www.metropolismag.com/cda/story.php?artid=2908 and last accessed May 2008).

[17] The content of this appendix has been borrowed and adapted from Mandana MacPherson (2004), "Sustainability for Designers," a report from The Natural Step – US, San Francisco, CA.

[18] See Robert A. Frosch and Nicholas E. Gallopoulos (September 1989), "Strategies for Manufacturing," *Scientific American* 261 (3): 144-152 and Thomas Graedel and Braden Allenby (1995), Industrial Ecology, Prentice Hall, Inglewood Cliffs, NJ.

[19] William McDonough and Michael Braungart (2002), *Cradle-to-Cradle: Remaking the Way We Make Things*, North Point Press.

[20] See Fussler, C. and James, P. (1996), *Driving Eco-Innovation: A Breakthrough Discipline for Innovation and Sustainability*, London, Pitman Publishing.

[21] See Mathis Wackernagel and William Rees (1995), *Our Ecological Footprint: Reducing Human Impact on the Earth*, New Society Publishers.

[22] See, for example, the European Union directive on Waste Electrical and Electronic Equipment (WEEE), which requires manufacturers to take back and manage electrical and electronic products from consumers.

[23] Ernst Ulrich von Weizsäcker, Amory B. Lovins, and L. Hunter Lovins, 1997. *Factor Four – Doubling Wealth, Halving Resource Use*, Earthscan, London.

[24] See Robert U. Ayres (1994), "Industrial Metabolism: Theory and Policy." In R. U. Ayres and U. K. Simonis, (eds.), *Industrial Metabolism: Restructuring for Sustainable Development*, United Nations University Press, Tokyo. See also www.materialflows.net.

[25] See Hur T., Lee J., Ryu J., and Kwon E. (2005), "Simplified LCA and matrix methods in identifying the environmental aspects of a product system," *Journal of Environmental Management* 75(3): 229-37.

[26] See Mattias Lindahl (1999), "E-FME – A new promising tool for efficient design for environment," in Proceedings of Eco-design '99, First International Symposium on Environmental Conscious Design and Inverse Manufacturing, Tokyo, Japan, ISBN 0-7695-007-2, and Mattias Lindahl, C. Jensen and J. Tingström (2000), "A comparison between the environmental effect analysis and the life-cycle assessment methods based on four case studies," in Proceedings of the 7th International Seminar on Life Cycle Engineering, Life Cycle Planning, Design and Management for Eco-Products and Systems, November 27-29, Tokyo. For a practical guide, see also Carsten Jensen, Måns Johansson, Mattias Lindahl, and Thomas Magnusson, "Environmental Effect Analysis (EEA) – Principles and Structure" (available at http://www.eea.nu/ENGD_583.pdf).

[27] See Friedrich Schmidt-Bleck, "The Factor 10/MIPS-Concept: Bridging Ecological, Economic, and Social Dimensions with Sustainability Indicators," presented in conjunction with the Zero Emissions Forum at the United Nations University. Available online at www.unu.edu/zef/publications_e/ZEF_EN_1999_03_D.pdf.

[28] See Karen G. Shapiro and Allen L. White, 1999. "Right from the Start: Product Stewardship Through Life-Cycle Design," *Corporate Environmental Strategy* 6(1): 15-23.

[29] See Mandana MacPherson (2004), "Sustainability for Designers," a report from The Natural Step – US, San Francisco, CA.

[30] See Kathleen Donnelly, Roger Olds, Fred Blechinger, Debbie Reynolds, and Zoe Beckett-Furnell (2004), "ISO 14001 – Effective Management of Sustainable Design," *The Journal of Sustainable Product Design* 4: 43–54.