Intelligent Materials Pooling

Evolving a Profitable Technical Metabolism

By Michael Braungart

Intelligent Materials Pooling (IMP) is a collaborative, business-to-business approach to managing the industrial metabolism. Partners in an intelligent materials pool agree to share access to a common supply of a particular high-tech, high-quality material, pooling information and purchasing power to generate a healthy system of closed loop material flows. As partners share knowledge and resources, they develop a shared commitment to using the healthiest, highest quality materials in all of their products. Together they form a value-based business community focused on eliminating the concept of waste from manufacturing cycles. Ultimately, Intelligent Materials Pooling creates life support systems for sustainable business.

IMP is built on MBDC's Cradle to Cradle Design[SM], which recognizes materials as *nutrients* that cycle through either the *biological metabolism* or the *technical metabolism*. The biological metabolism is made up of natural processes that circulate the pool of materials or nutrients—water, oxygen, soil, CO2—that support life on Earth. The technical metabolism, designed to mirror natural nutrient cycles, is a closed loop system in which valuable, high-tech synthetics and mineral resources circulate in an endless cycle of production, recovery and reuse. Following MBDC's Protocol, companies are creating products and materials designed as biological or technical nutrients, which either safely biodegrade or provide high-quality resources for subsequent generations of products. While nature manages the cycles of the biological metabolism, an IMP is a *nutrient management system* for the technical metabolism.

Business-to-Business Support

The evolution of an intelligent materials pool follows the same steps as almost any kind of community or nation building: The community decides what it *does not* want; it chooses what it *does* want; its members support each other against those who endanger the community; a culture bound by shared values forms. The result: a life support system for sustainable commerce; a community supported by, and committed to, Cradle to Cradle Design.

From a business perspective, the process begins with an agreement to phase out a hazardous material, such as PVC, common to a number of companies. Out of this shared commitment to intelligent design comes a community of companies with the market strength to effectively engineer the phase-out and develop innovative alternative materials. Together, they specify for preferred materials, establish defined-use periods for products and services, and create an intelligent materials bank from which each partner deposits and withdraws. This business support system, built on cradle-to-cradle principles and embodied in the materials bank, gives companies the strength and know-how to make material flows management an ongoing harvest of assets rather than an endless exercise in managing liabilities.

Origins: A Materials Pooling Metaphor

Fly-fishing is a great way to get a visceral understanding of industrial material flows. I realized this while standing hip-deep in a cold Icelandic stream as my friend, colleague and fishing partner, Darcy Winslow, gently removed the hook from a salmon she had just caught and released it back into the pool. The fish wriggled on the surface for a moment, seemingly getting oriented, and then darted away, joining a dozen other healthy salmon at the bottom of the stream. Darcy handed me the fishing rod we were sharing. It was my turn now, and as I cast, I knew that if I were half as good at fly-fishing as Darcy, I had an equal chance of catching a fish; there were a dozen in the pool when we started and their were a dozen now. With support from my fishing partner—tips on technique and choice of fly, where the fish were biting—my chances were even better.

This is essentially how Intelligent Materials Pooling works. Like salmon, resources for high-quality technical materials—the cadmium used in solar collectors, for example—are rare and precious. To catch and eat salmon at will would likely end their time on Earth. The same is true for rare mineral resources; to use and discard them mortgages the future. But if materials are used in a system that echoes catch-and-

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release fishing, they can be used for a defined period and then returned to a common pool, providing technical resources for the next generation of high quality, high-tech products.

In a materials pool, multiple companies using a common, standardized ingredient, such as nylon, are creating a *materials bank*. As partners draw materials from the bank to create new products, they also replenish it with used products they have recovered and returned for recycling. An athletic shoe manufacturer, a furniture design firm, and a high-tech materials company might together create a nylon bank and a support system that gives them the market strength not only to profitably manage their common supply chain, but to be effective innovators as well. Creating a community of shared values gives the partners far more strength than they could ever have alone.

From Metaphor to Practical Vision

This is precisely what I discussed with Darcy Winslow as we navigated the riffles of that chilly Icelandic stream. Darcy (Director of Nike's Women's Footwear Division), along with Keith Winn (Herman Miller's Advance Projects Program Manager at the time, and now principal of Catalyst Partners) and Ed Guerini (BASF's Director of Innovative Business Solutions), had joined my colleague Bill McDonough and me to spend some time relaxing together in the outdoors and talking about the future of manufacturing and commerce. Imagine, I suggested, if Nike, Herman Miller, and BASF created a materials pool and shared access to high-quality nylon. Nike and Herman Miller would enjoy the cost savings generated by their ability to generate purchases in larger volumes than either company could generate alone, while BASF, the nylon manufacturer and bank, would be supported in its efforts to develop innovative, ecologically intelligent polymers. Nike and Herman Miller would also be able to depend on the high quality of the nylon circulating through the pool and use it for a variety of new purposes as they learned about its qualities. The more the material is used, the more information is gained and shared, which would optimize its processing, recovery and re-use. With mutual support, the companies could begin co-branding, creating a strong, shared identity built on a cradle-to-cradle vision of quality, which in turn would generate a strong and valuable market identity.

In this scenario, the information about the material becomes as important as the material itself, making the distinction between the old and new economy obsolete. BASF would in effect become a high-tech communications company, materializing information. That is, it would provide material intelligence as it gained technical information from processing and reprocessing a material over time. Rather than *downcycling* a material for use in a product of lesser value, BASF would be *upcycling,* adding value and information to a material as it cycled through the bank. Together, the companies could create an ecologically intelligent culture of innovation. They wouldn't eat the fish; they'd share materials, information and success.

Eliminating the Concept Waste: A Philosophical Framework

While Nike, BASF, and Herman Miller might benefit from our hypothetical nylon Intelligent Materials Pool, companies from a variety of manufacturing sectors could collaborate to create material banks for nearly every valuable commodity, from chemicals to steel to advanced polymers. To do so, the goal of materials pooling can be nothing less than eliminating the concept of waste.

Eliminating the concept of waste means recognizing materials as *nutrients* that cycle through either the *biological metabolism* or the *technical metabolism*. The biological metabolism is made up of natural processes that circulate the pool of materials or nutrients—water, oxygen, soil, CO2—that support life on Earth. The technical metabolism, designed to mirror natural nutrient cycles, is a closed loop system in which valuable, high-tech synthetics and mineral resources circulate in an endless cycle of production, recovery and reuse.

Intelligent Products

I first outlined this model of industry in 1992 as the Intelligent Product System (IPS), which is a framework for creating materials and goods that flow safely and productively within these closed-loop systems. In the IPS, design emulates nature's material flows. Every product ingredient is designed to be safe and beneficial; to naturally biodegrade and restore the soil or to provide high quality resources for the next

generation of products. In short, every material is conceived as a nutrient and ultimately, every product as a service.

This insight emerged from an EPEA chemical assessment of a television set that found 4,360 different chemicals, many of them hazardous, in its various components. Why own hazardous waste when what you really want is to watch TV? And, from a business perspective, why sell televisions and lose their value forever when you can provide the service of television viewing and recover your valuable technical materials when your customer wants a new model? When a television, or a car, or a computer is conceived as a *product of service*, its materials can be designed as nutrients that nourish a business again and again.

The Cradle to Cradle Design[SM] Protocol
The fundamental understanding of materials as nutrients is also the foundation of MBDC's Cradle to Cradle Design Protocol, an ecologically intelligent industrial design process William McDonough and I have been developing since 1992. Following the steps of the Protocol, manufacturing companies worldwide are creating products and materials designed as biological or technical nutrients. Products such as these are the cornerstones of *nutrient recovery systems*.

The nutrient recovery system of the biological metabolism is ubiquitous: the natural processes go on around us all the time. Products designed to naturally biodegrade, such as the fabrics we've designed with Rohner Textil, DesignTex, and Pendleton, are made of renewable materials and can be used as mulch when they wear out. As long as every ingredient in a product designed for the biological metabolism is healthful, it can flow safely back into the earth's nutrient cycles to feed the growth of new biological materials. Appropriate systems for returning these nutrients to the soil are becoming more common as municipalities develop composting facilities to complement traditional waste management strategies.

Managing the Technical Metabolism
While nature manages the cycles of the biological metabolism, an Intelligent Materials Pool is the management system for the technical metabolism. Traditionally, materials have not been defined as nutrients, and technical and biological materials have been mixed and discarded, contaminating each sphere. Instead of polluting the biosphere and dumping valuable technical materials, losing their value forever, why not close the industrial loop and make these rare ingredients perpetually available to industry for a variety of technical purposes?

To do so, technical materials like alloys, stabilizers and polymers must be designed to be used again and again. Intelligent materials make this possible. Some polymers, for instance, can be recycled more than 90 times without losing performance quality. Intelligently designed steel can be recycled endlessly. As products and materials are increasingly designed as nutrients, Intelligent Materials Pooling offers a system designed to maximize their value through many product life cycles. It's a *technical nutrient management system* that generates material assets rather than material liabilities—it eliminates the concept of waste.

Creating Material Pools with Industrial Partners
Companies can begin to develop and benefit from Intelligent Materials Pooling by following a step-by-step process that generates a community of businesses sharing nutrients, information and values. As we have seen, the process follows the same steps as almost any kind of community building: As members find common cause and provide support for one another, the separate elements of the community begin to gel, forming a shared identity grounded in mutual trust.

The key steps in the development of a community of shared values bear repeating: The community decides what it *does not* want; it chooses what it *does* want; its members support each other against those who endanger the community; a culture bound by shared values forms.

From an industrial design perspective, the community would come together out of a mutual interest in the values and principles of Cradle to Cradle Design—eco-effectiveness, eliminating the concept of waste,

supporting life—and the steps of the Protocol, which would provide partners with the practical tools for success. The process looks something like this:

Phase 1: Creating Community
- Identify shared values: Cradle to Cradle Design, eliminating the concept of waste
- Identify willing industrial partners
- Target specific toxic chemicals for replacement

Phase 2: Utilizing Market Strength
- Share list of materials targeted for reduction and elimination
- Develop a positive purchasing and procurement list of preferred intelligent chemicals

Phase 3: Defining Material Flows
- Specify for and design with preferred materials
- Define use periods for products and services
- Create a materials bank
- Design a technical metabolism for preferred materials

Phase 4: Ongoing Support
- Create preferred business partner agreements among members
- Share information gained from material use and research
- Develop co-branding strategies
- Support the mechanisms of the technical metabolism

Finding willing partners might be hard to imagine in the competitive world of business but it is hardly unprecedented. In the textile industry innovative mills like Victor Innovatex and Rohner Textil, along with MBDC and DesignTex, have profitably collaborated on the design and production of ecologically intelligent fabrics. In the textile and apparel industry at large, several companies we have worked with have expressed deep interest in joining together to create a "polyester coalition." With the technology for truly recycling polyester in development, a polyester collective could begin to close the loop on the flow of this widely used industrial material.

An Intelligent Polyester Pool

Here's how a polyester cooperative might work: Willing partners would first agree on their shared commitment to product quality. Though partners might represent different industries and perspectives, they would be bound by common values. As with all new communities, a polyester pool would have to develop a framework of governance to set up the standards and protocols of working together. One could imagine the process as a kind of nation building and the framework as a constitution that outlines the rights and responsibilities of all partners, which all would agree to in a spirit of mutual trust. This exercise in community building would lay the foundation for future work.

With common ground established, the coalition partners would begin to create a list of specific chemicals used in the manufacture of polyester that are widely known to be harmful. These would be targeted for elimination or replacement. Participating companies would then generate a list of preferred intelligent materials—the ingredients they would ultimately like to use to create an ecologically intelligent polyester. Victor Innovatex, with MBDC, have already developed such a material.

After developing common specifications for intelligent polyester, the members of the coalition would begin to specify it as a product ingredient. With the power of its pooled market, the coalition could approach a polyester producer and invite it to become a partner. Ideally, the producer would be equipped with a chemical recycling system, which would effectively allow it to become the polyester bank. The coalition would agree to purchase all of its polyester from the producer and the producer would agree to manufacture intelligent polyester and take back and recycle all of the materials the coalition returned. The companies would define the use periods for their products and individually set up take back programs to replenish the material bank. A polyester loop would be effectively closed, eliminating waste from the technical metabolism of the coalition.

This process could be widely applied. In the steel industry, for example, value is often lost when a range of grades are mixed in recycling. A materials pool could preserve the value of steel over many life-cycles by specifying the separation of different grades in the technical metabolism. When high-quality steel is recycled with high-quality steel the metal retains its structural integrity. With cooperation between steel-makers and the manufacturers of a wide variety of products, from automobiles to trains to refrigerators, the steel loop could begin to be closed and the value of its nutrients preserved over time.

Seeding Material Pools

Following the outlines of our *product of service* concept, some companies have already begun to develop material pools by selling the service a product provides rather than the product itself. Carpet companies, for example, lease to their customers the service of floor covering. When the carpet wears out, or the customer decides to try a new style, the carpet is retrieved by the manufacturer and its materials are reused in new carpets. This strategy can be applied to any product: Car makers can provide the service of mobility; washing machine manufacturers can provide the service of clean clothes; computer distributors can provide the service of information and instant contact with the world, and so on.

Providing a service rather than a product has many benefits. First, it seeds the development of material pools. Companies maintain ownership of their materials while profiting from the services they offer. When the product is returned, its ingredients, if intelligently designed, can be used again in new products. Designing for recovery and reuse also gives companies the opportunity to specify high-quality materials—they will never lose their investment—and to design products with built in flexibility. Products designed for disassembly, for example, might contain high-tech parts that can be easily re-used in the next generation of evolving high-tech machinery. All of this, of course, results in the intelligent and effective use of valuable materials.

A Promising Future

Products of service are already a part of the industrial landscape, seeding material pools in evolving industries. Hints of business-to-business cooperation are also emerging as innovative companies explore the future of intelligent materials. There are, perhaps, many success stories on the horizon. To be truly successful on a large scale, however, material banks will have to be adopted throughout industry.

Closing the loop on material flows is the key to intelligent design and regenerative commerce. When industrial systems accrue value with healthy products, we can all celebrate human productivity and ingenuity rather than lamenting our impact on the world. As we move toward this goal with positive aspirations, modeling industry on the elegant designs of the natural world, we can begin to create the intelligent products and intelligent support systems that will allow both business and nature to thrive and grow. In such a world, where salmon are healthy and their habitats plentiful, we could enjoy the enduring health of the salmon species and have one for lunch, too.