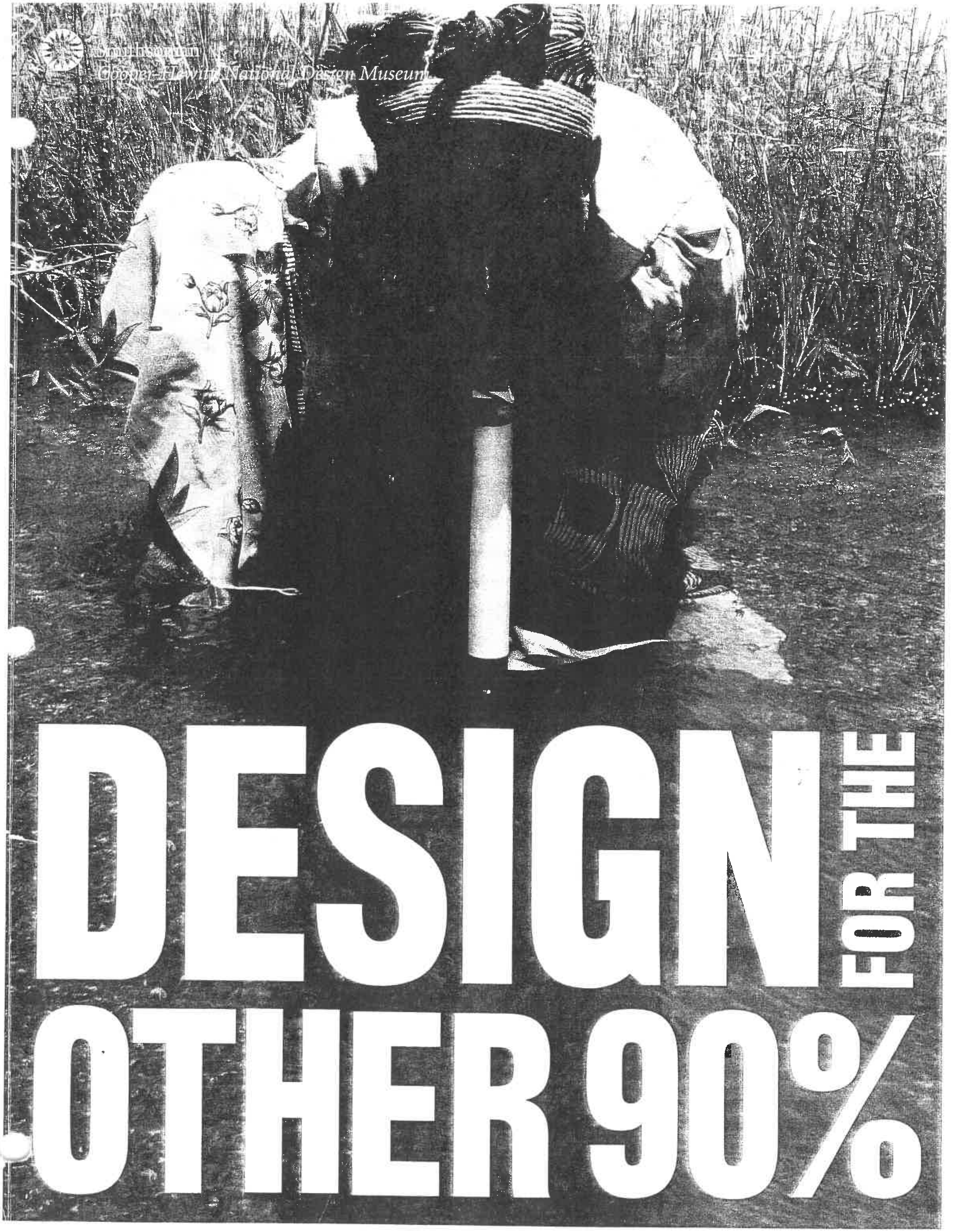

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DESIGN FOR THE OTHER 90%

DESIGN FOR THE OTHER NINETY PERCENT

PAUL POLAK

Ninety-five percent of the world's designers focus all of their efforts on developing products and services exclusively for the richest ten percent of the world's customers. Nothing less than a revolution in design is needed to reach the other ninety percent.

Transport engineers work hard to create elegant shapes for modern cars while the majority of people in the world can only dream about buying a used bicycle. As designers make products ever more stylish, efficient, and durable, their products' prices go up, but people with money are both able and willing to pay. In contrast, the poor in developing countries—who outnumber their rich counterparts by twenty to one—have only pennies to spend on hundreds of critical necessities. They are ready and willing to make any reasonable compromise in quality for the sake of affordability, but again and again, nothing is available in the marketplace that meets their needs.

The fact that the work of most modern designers has almost no impact on most of the people in the world is not lost on those entering the field. Bernard Amadei, an engineering professor at the University of Colorado in Boulder, tells me that engineering students all over the United States are flocking to take advantage of opportunities made available by organizations like Engineers Without Borders to work on problems such as designing and building affordable rural water-supply systems in poor countries. If students can make meaningful contributions in designing specifically for poor customers, why do designers continue to ignore this area? Is it because it is much more difficult than designing products for rich customers? Is it because they perceive that there is no money to be made? I do not agree.

6. A micro-sprinkler in use on a small-plot farm in Nepal.

HOW COMPLICATED IS IT TO DESIGN FOR THE POOR?

You do not need a degree in engineering or architecture to learn how to talk and listen to poor people as customers. I have been doing it for more than twenty years. The things they need are so simple and so obvious, it is relatively easy to come up with new income-generating products that they are happy to pay for. But they have to be affordable.

Twenty-three years ago, in Somalia, International Development Enterprises (IDE), the organization I founded, undertook its first project by helping refugee blacksmiths build and sell 500 donkey carts to their fellow refugees. However, in Somalia, there are a lot of thorns in the dirt roads they traveled on, and nowhere a donkey-cart owner could buy tools to fix flat tires. So I went to Nairobi, Kenya, and bought tube patch kits and lug wrenches. I bought quite a number of good-quality, British-made wrenches that carried a virtual lifetime guarantee for $12 each, as well as a few $6 Chinese-made models that would be lucky to last six months. I offered both types of lug wrenches for sale to donkey-cart owners at cost plus transportation.

To my amazement, the Chinese lug wrenches sold like hotcakes while I failed to sell a single British model. How could this be? After talking to a lot of donkey-cart owners, I finally realized an operator could generate enough income in one month to buy ten British-made lug wrenches, but if he did not have the money to buy a lug wrench today to fix a flat tire, he would earn nothing and might end up losing his donkey cart. So he bought the wrench he could afford today to stay in business and earn more money for tomorrow. I have heard the same story repeated over and over by the poor people I've talked to. For the 2.7 billion people in the world who earn less than $2 a day, affordability rules.

THE RUTHLESS PURSUIT OF AFFORDABILITY

Vince Lombardi, the famous coach of the Green Bay Packers, often said to his football players, "Winning isn't everything; it's the only thing." With one word change, the same sentiment applies to the process of designing products to serve poor customers: Affordability isn't everything; it's the only thing.

I have to confess that I am a born cheapskate, so the notion of putting affordability first comes naturally to me. When I need an umbrella, instead of buying a $38 designer model in the department store, I opt for a functional black one bought for $1 at the local Dollarama, where everything costs a dollar or less. I know the $38 model would last a lot longer, but I also know that I would probably forget it somewhere within a month. If that $1 umbrella keeps my head dry for just one rain shower or, better still, for a couple of months before I lose it, I've saved myself $37.

The rural poor think in much the same way, with one critical difference—they will keep that $1 umbrella in good working order for seven years, at the end of which it will have many patches on it and three or four improvised splints on the handle, yet still be usable. But there is another big difference. To earn a single dollar, an unskilled laborer in the United States only needs to work about ten minutes, while his counterpart in Bangladesh or Zimbabwe must work for two full days. To learn how to come up with affordable products for poor customers in developing countries, Western designers would do well to start with a brainstorming exercise to come up with a serviceable ten-cent umbrella.

HOW MANY ANTS DOES IT TAKE TO MAKE A HORSE?

Put yourself in the shoes of Peter Mukula, a poor farmer who lives along a dusty road twenty-five kilometers from Livingstone, in southern Zambia. If he could afford to buy a packhorse, he could make an extra $600 a year hauling vegetables to the Livingstone market. But there is no way he can beg for, borrow, or steal the $500 it would take to buy one. Can you think of a practical solution to Peter's dilemma?

Let me throw out a crazy idea: What if Peter could buy a quarter horse? Not a purebred quarter horse, but a horse that is a quarter the size of a regular packhorse. Let's assume that you could buy one of these miniature horses for $150 and that it could pack sixty kilograms. Would that work? Peter would earn less money each trip, but he could gradually use his profits to buy more miniature horses. Once he owned four of them, they would be hauling the same 240 kilos as a full-sized packhorse.

But even if a horse a quarter of the size of a packhorse were available, $150 is still far more than what he could afford out of his $300 yearly income. To make it affordable, Peter would need a miniature horse that is more like one-twelfth of a horse, which could carry twenty kilos and cost less than $50. Peter would probably have to carry another twenty kilos on his back to help make up the difference. After five years, he might be able to expand to a string of twelve pygmy horses. Only then could he earn the $600 a year that the packhorse he dreams of would provide.

Here is an even crazier idea: Suppose we could invent a way to harness the remarkable strength-to-weight ratio of the common forest ant. An engineering class in Germany designed tiny weights that could be attached to an ant's back and determined that forest ants can carry as much as thirty times their own weight. (A human can only carry about double.) How many ants would it take to carry the same load as a packhorse? An ant weighs about ten milligrams; if it can carry twenty times its weight, it can pack 200 milligrams. It would take one and a quarter million ants to carry Peter's 240 kilos. A million and a quarter ants would come pretty cheap, but designing the harness would be quite a challenge.

I have taken you through this imaginary design scenario to illustrate the central task of design for poor customers—coming up with breakthroughs in both miniaturization and affordability. The next step in the holy trinity of affordable design is to make the new product infinitely expandable.

FROM FOREST ANTS TO THE ASWAN DAM

If you think the process of breaking a horse into twelve affordable pieces is complicated, try wrapping your mind around the problem of breaking the Aswan Dam in Egypt down into millions of ant-sized pieces representing the small farms that could be nourished by the water stored in Lake Nasser. Big dams like Aswan are built to provide answers to the twin global problems of flooding and water scarcity. But when it comes to delivering irrigation water, extremely poor, one-acre farmers are usually left on the outside looking in.

THE NAWSA MAD SYSTEM

You may be wondering where the term Nawsa Mad comes from; it is Aswan Dam spelled backwards. It addresses perennial flooding and drought with exactly the same strategy used by the Aswan Dam, but shrunk down to one-four-millionth of its size so that it fits onto a two-acre farm and into a small farmer's pocketbook. Put another way, it is the ant to the Aswan Dam's horse.

Like most things in my life, I stumbled into the Nawsa Mad concept backwards. In May 2003, I was interviewing farmers in Maharastra, India, who were using low-cost drip systems to make the water in their open wells stretch a lot further than the flood irrigation they had been using.

But the sixty-foot-deep, twenty-five-foot-wide wells that were the only source of irrigation water during the dry season cost 100,000 rupees (about $2,000) to build. Because they were so expensive, only twenty-five to forty percent of the farmers in Maharastra owned a well. The rest earned a paltry income from rain-fed farming and survived by finding work outside the farm. However, rainwater ran off their fields in sheets during the summer monsoon season.

Could we find a cheap, simple way to trap some of this monsoon rainwater and store it to irrigate crops during the dry season, from March to May, when vegetable and fruit prices were at their peak? To create a miniaturized, on-farm version of the Aswan Dam, we had to find ways to: 1) collect monsoon rainwater on individual farms; 2) settle out the silt and mud in the water; 3) store it for nine months with no evaporation; 4) deliver it from storage to crops without wasting a drop; and, most important, 5) develop the whole system to be affordable enough for a poor farm family living on $300 a year, profitable enough to pay for itself in the first year, and infinitely expandable using the profits it generated.

Solutions for 1, 2, and 4 were easy. There are already all kinds of rainwater-harvesting systems in place that collect, settle, and store rainwater, and the low-cost drip-irrigation system designed by IDE could provide the means to deliver it efficiently to crops. The critical missing link was an enclosed, zero-evaporation water-storage system for individual farms that was cheap enough to pay for itself in the first growing season. We estimated that a farmer could reasonably be expected to clear $50 from drip-irrigated, high-value crops grown in the dry season using 10,000 liters of stored water. So we set a retail price target of $40 for the 10,000-liter enclosed storage tank. This was a daunting target since the cost of a 10,000-liter ferro-cement tank in India starts at $250. But we had already made progress toward finding an affordable solution.

People all over India were using open pits lined with plastic to store water for short periods. This was not a solution for us because most of the water would evaporate over six months in such a hot and dry climate. But the lined pits gave me the idea of placing a fatter version of an enclosed water bag into a pit. Jack Keller, an IDE Board member and internationally renowned water expert, closed the circle by pointing out that the optimal surface-to-volume ratio would be provided by a cylinder. So we came up with the idea of a ten-meter-long, double-walled plastic sausage in an earth trench (fig. 1). By using the earth for structural support, we reached our price objective of $40 for a 10,000-liter storage tank.

The fact is, of the 1.2 billion people in the world who earn less than $1 a day, some 900 million are small farmers who earn most of their living from what they can grow on their two-acre farms, split into four or five plots. Very few of them have access to irrigation water from big dams. Most of them live in climates with distinct monsoon and dry seasons, where affordable on-farm water storage and drip irrigation systems could enable them to produce income-generating, high-value crops in the dry season.

A $3 DRIP IRRIGATION SYSTEM

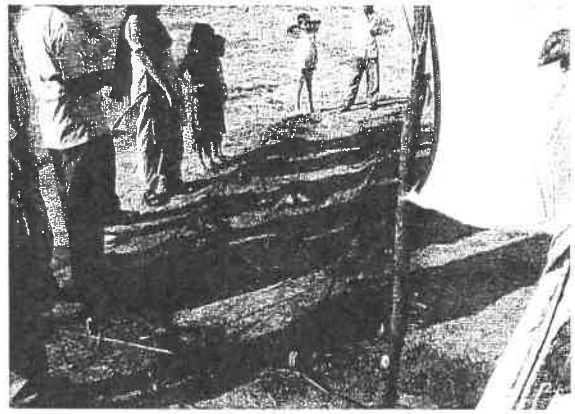
Almond growers in California invest millions of dollars in state-of-the-art drip-irrigation systems because they improve crop yield and quality as well as provide a miserly way to deliver water to the roots of plants. My colleagues and I at IDE have come up with something at the other end of the affordability scale—a kitchen garden drip kit that sells for $3 in India (fig. 2).

Larger low-cost drip systems now sell for $160 an acre in India—one-fifth the cost of conventional systems. The direct application of the building blocks of affordable design made this dramatic drop in price possible, and low-cost drip is rapidly establishing a massive new market for efficient, productive irrigation on small plots in India and other countries in Asia and Africa.

There is no need to maintain high pressure in the short plastic pipes that deliver water to quarter-acre plots. Cutting the pressure by eighty percent allowed us to cut the wall thickness of the pipes, thereby lowering the cost of material by eighty percent. The farmers themselves taught us how to make the walls even thinner and to provide a choice of wall thicknesses so they could pick a system that would last however long they wanted. We replaced expensive sand trap filters that prevent clogging with more simple and affordable filters, and we changed expensive high-tech emitters at drip points with simple plastic tubes that did not clog easily. We traded capital for labor by making drip lines moveable from one row of plants to the next. Finally, a farmer could start with a 20-square-meter system for $3 and expand it systematically to five acres by reinvesting his profits, highlighting the principles of affordability, miniaturization, and expandability I outlined earlier.

Mohan Nitin inherited his family's two-acre farm in Maharastra, an open well, and a five-horsepower diesel pump. But the well could only produce a quarter acre of flood-irrigated vegetables in the dry season, when prices are high. Mohan and his wife, his mother, and his two daughters, aged eight and eleven, were able to survive only by finding occasional work on neighboring farms.

Two weeks before my visit, Mohan's family invested $160 in an IDE Drip System for one and a quarter acres. This was only about one seventh of what he would have had to pay for a high-tech drip system of the same size; nevertheless, his mother had to sell family jewelry to pay for it. She beamed as she told me this because she now believes her family's poverty will end. Mohan and his family have planted sweet limes intercropped with eggplant as well as a variety of vegetables, and plan to add intercropped pomegranate. He believes he can earn more than $1,000 in the dry season alone, compared to the $150 or so he was earning before.



1. Trench-supported 10,000-l water storage bag undergoin ing in India.

2. A $3 drip irrigation kit.

3. A drip-irrigated plot locate side Harare, Zimbabwe.

The dramatic drop in price for drip irrigation has now made it profitable for small farmers to start using drip on lower-value crops like cotton and sugarcane, and some of them are even irrigating alfalfa for their milk buffalos (fig. 3). I believe that low-cost drip systems like those developed by IDE will, over the next ten years, take over the majority of the world market for drip irrigation.

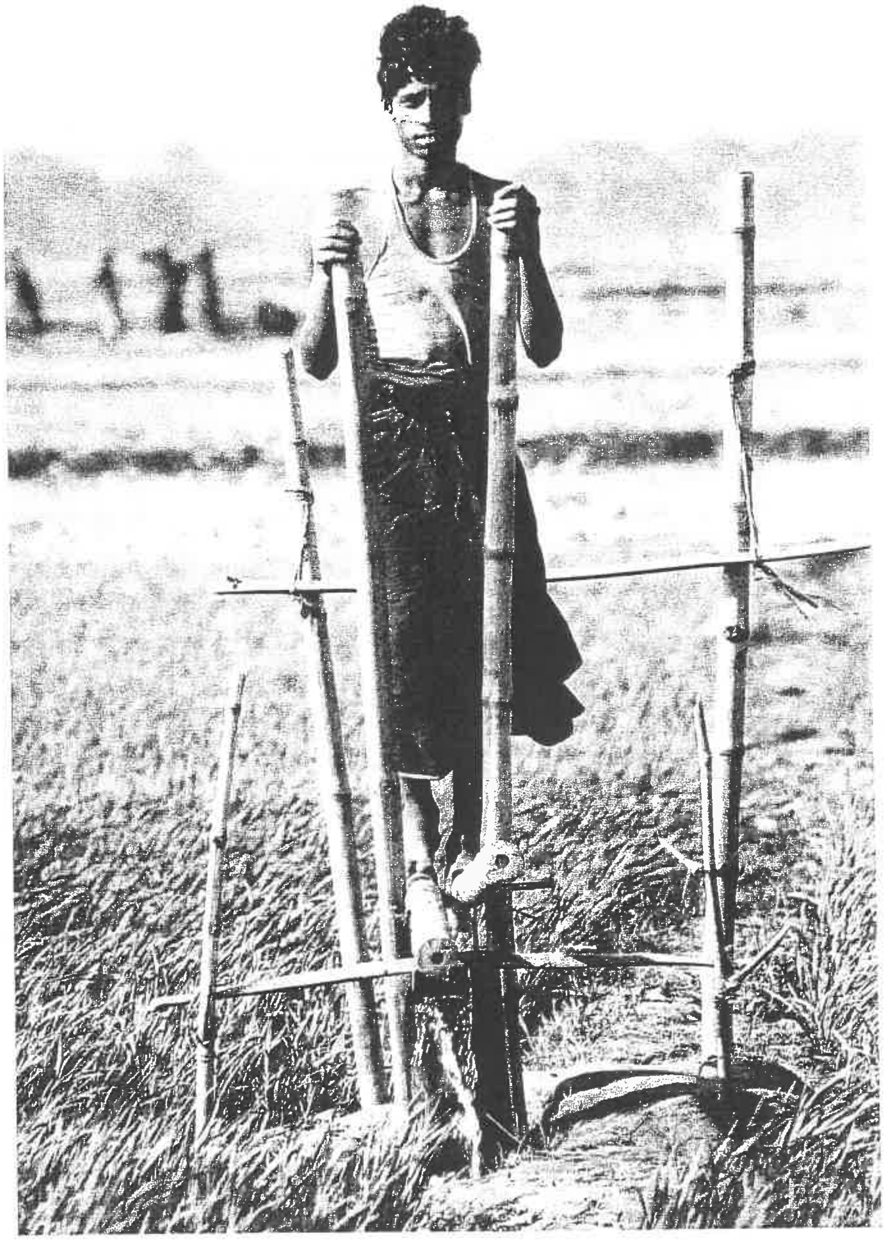
PEDALING TO PROSPERITY

This may sound like a large claim, but the enormous market potential for affordable technologies like IDE Drip has already been demonstrated in a powerful way. The proof lies in the phenomenal impact of the treadle pump, a simple, step-action pump that resembles a Stairmaster and can lift water from up to seven meters below ground (fig. 4). While IDE did not invent the treadle pump, we have reengineered it to be affordable for our rural, dollar-a-day customers. (On average, IDE's treadle pumps currently retail for about $40 in Asia and $90 in Africa.) Since IDE first began marketing treadle pumps in Bangladesh some twenty years ago, more than 1.23 million units have been purchased and installed by small farmers at an unsubsidized, fair-market price. Using these pumps, many farmers have been able to double their net annual incomes, ensuring a better life and long-term prosperity for their families.

A $100 HOUSE

What dollar-a-day people in rural areas desperately need is a starter kit for a 200-square-foot house that they could borrow money on or sell if they had to, and which they could build for no more than $100. Homes in the United States and Europe are getting so expensive, it is becoming harder and harder for people to own one; remarkably, most of the 800 million or so people in the world who earn less than $1 a day and live in rural areas actually own the home they live in. But if they tried to sell it, they would get no money for it, and if they took it to a local banker as collateral for a loan, they would get nowhere. This is because many of these homes are made of sticks and wattle, with a thatched roof and dung floor, and have no value in the local market. Their owners have no opportunity to build something with real value at a price they can afford (fig. 5).

4. Bamboo treadle pump in use in Maharashtra State, India.



But in every village, there are a few families who have a house built out of brick or cement block and a tile roof, and these houses have both sales and collateral value. They accomplish this not by building it a little bit at a time, because that is all the money they have to spend, and construction loans simply are not available. I have seen far too many designs from Western architects for refugee shelters and rural dwellings that look elegant to the Western eye and start at $900, which is totally out of the refugees' and poor rural families' price range.

The no-value, stick-and-thatch home has a major flaw: it lacks a stable foundation and durable skeleton. All we need to start a salable, bankable 20-square-meter home is eight strong beams and a solid roof that does not leak. Initially, this durable structural skeleton can be filled in with local materials, for example, sticks covered with mud for the walls and thatch for the roof. Then, as there is money, the stick walls can be replaced with cement block or brick, twenty-five bricks at a time.

Access to affordable irrigation, seeds, ways to grow high-value crops, and profitable markets will speed up the home-building process. If, from the very beginning, the house is specifically designed to accept added modules, like a LEGO set, the family who lives in it can eventually own a house as big as they can afford. When the bankable house is completed, the family has a source of collateral so they can borrow money they need for inputs, implements, and livestock capable of increasing the income they earn from farming.

BUILDING MEMORIES

The fact that you do not need a degree in engineering or architecture to design life-changing products and services for poor people was amply demonstrated by Anne Willoughby, founder of Willoughby Design, a firm in Kansas City, Missouri, at the Aspen Design Summit in June 2006. "Your house is burning down," she said to the women in the audience after a two-day design studio for poor customers, "your family is safe, and you only have time to carry one thing out of your house. What would you save?"

The response from ninety percent of the audience was photo albums or other important family mementos. But most of the women in poor villages have no pictures of family members or of important events such as weddings and births. So she and two other Summit participants put their heads together and came up with the idea of creating a small army of village photo entrepreneurs. Women in villages would be given an opportunity to borrow funds to cover the costs of a starter camera, two memory chips, and a bicycle. They would go to neighboring villages, take family pictures, send a chip to town to be developed, and charge twenty cents a picture, or ten cents over their production cost.

Willoughby and her team had a vision of thousands of photo entrepreneurs making a living by providing family memories. They could also be trained to provide other important services, like seeds, drip kits, and training, so that poor women could grow profitable kitchen gardens in one region or provide health information and services in another.

THE PRINCIPLES OF DESIGNING CHEAP

My dream is to establish a platform for ten thousand of the world's best designers to come up with practical solutions to the real-life problems of the poor people of the world by following a few basic principles and practices. Miniaturization, the ruthless pursuit of affordability, and infinite expandability are the three building blocks necessary to design cheap. Now here is some music to go with the lyrics.

Thinking of poor people as customers, instead of recipients of charity, radically changes the design process. The process of affordable design starts by learning everything there is to learn about poor people as customers and what they are able and willing to pay for something that meets their needs. When in doubt, I resort to the "don't bother" trilogy:

- If you haven't had good conversations with your eyes open with at least twenty-five poor people before you start designing, don't bother.
- If what you design won't at least pay for itself in the first year, don't bother.
- If you don't think you can sell at least a million units at an unsubsidized price to poor customers after the design process is over, don't bother.

E. F. Schumacher was right on target by writing beautifully about smallness', even though he did not focus enough on affordability and marketability. A modern combine does not even have room to turn around on a typical quarter-acre plot of a small farmer, much less harvest it. Seventy-five percent of all farms in Bangladesh and India are smaller than five acres, and in China, half an acre. Since most of these small farms are further divided into several quarter-acre plots, this is the gauge against which any new technology for small farmers must be evaluated.

For those trying to survive on a one-acre farm, a pinch of seed is much better than a bagful. For a long time, economists have talked about the "divisibility" of technology. You cannot take a tractor and cut it up into little pieces, so economists give it the rather curious but descriptive label of "lumpy input." [He needs to cite his sources for this.] But a twenty-kilo bag of carrot seeds can be easily divided into packets just the right size to plant two rows in a kitchen garden. Doing the same thing with mechanical technologies like irrigation, tilling, and harvesting devices is probably the most important challenge in designing cheap. A center-pivot sprinkler system is very efficient, costs a ton of money, and is designed to fit a 160-acre field. An Israeli drip-irrigation system (the first practical surface drip-irrigation system was developed in 1959 by Simcha Blass in Israel) is very efficient, costs a ton of money, and is designed to fit fields larger than five acres. How do we design a drip irrigation system that is just about as efficient as the Israeli system, costs less than $25, and fits perfectly into a quarter acre plot (fig. 6)? IDE has made great strides in solving these design problems, but there are thousands more like them that have yet to be addressed.

Affordability is the most important consideration in providing small farmers with access to income-generating technologies. Here are some guidelines I have created for designing cheap:

PUT TOOLS ON A RADICAL WEIGHT-LOSS DIET. You can cut the cost if you can find a way of cutting the weight. A good example of this is the one given earlier of the small drip-irrigation system where we cut the weight and the price of pipe by cutting system pressure by eighty percent. Doing this allowed us to also cut the wall thickness and weight of the plastic by eighty percent, with a corresponding drop in price.

MAKE REDUNDANCY REDUNDANT. Start out by asking potential customers how long they need the tool to last and how much they are willing to pay to make it last longer, and eliminate the redundancies that Western designers and engineers often take for granted.

MOVE FORWARD BY DESIGNING BACKWARD. Often, the most effective way of optimizing affordability is by going back through the history which leads to the modern form of the technology.

UPDATE THE OLD PACKAGE WITH CUTTING-EDGE MATERIALS. Revise outmoded designs with any new materials that may have become available, as long as affordability is not compromised.

MAKE IT INFINITELY EXPANDABLE. If a farmer can only afford a drip system that irrigates a sixteenth of an acre, design it so he can use the income it generates to seamlessly double or triple its size the next year.

5. A typical zero-value, zero-collateral home on a small farm in Zambia.

Here are some basic steps that I have found can cut the price of almost any expensive technology by at least half:

- Analyze what the technology does.
- Set specific cost targets.
- Identify key contributors to cost for the existing product.
- Design around each of the key contributors to cost by finding acceptable tradeoffs.
- For the poor, the key affordability tradeoffs are: capital for labor, and quality for affordability.
- Make your changes based on field test experience.
- If you want to move your technology to a new area, adapt it through field tests.

THAT'S WHERE THE MONEY WILL BE

I keep asking why ninety percent of the world's designers work exclusively on products for the richest ten percent of the world's customers. Willie Sutton, the infamous bank robber, was once asked why he robbed banks. "Because that's where the money is," he replied. I suspect my question about the world's designers has exactly the same answer.

Don't get me wrong. I really have no problem with people who make money by designing products for the rich. Entrepreneurial brilliance deserves to be rewarded. What astonishes me is that a huge, unexploited market, which includes billions of poor customers, continues to be ignored by designers and the companies they work for. In this, however, they are following a well-established tradition.

Today, you could ask the executives of Netafim, the world's biggest drip-irrigation company, why more than ninety-five percent of its products go to the richest five percent of the world's farmers, and they would probably reply, "Because that's where the money is." But think about this: If a hundred million small farmers in the world each bought a quarter-acre drip system for $50—a total investment on their part of $5 billion—it would amount to more than ten times the current annual global sales of drip-irrigation equipment. These millions of small farmers could put ten million additional hectares under drip irrigation and increase current global acreage under drip irrigation by a factor of five.

It is laudable that a small but growing group of designers is beginning to develop affordable products because they want to improve the lives of the world's poor. But there is only one truly sustainable engine for driving the process of designing cheap.

Because that's where the money *will be*.

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Published by
Cooper-Hewitt, National Design Museum
Smithsonian Institution
2 East 91st Street
New York, NY 10128, USA
www.cooperhewitt.org

Published on the occasion of the exhibition
Design for the Other 90%
at Cooper-Hewitt, National Design Museum,
Smithsonian Institution,
May 4–September 23, 2007.

Distributed to the trade worldwide by
Assouline Publishing
601 West 26th Street, 18th floor
New York, NY 10001, USA
www.assouline.com

Design for the Other 90% is made possible by The Lemelson Foundation. Additional funding is provided by public funds from the New York State Council on the Arts, a State agency, the Esme Usdan Exhibition Endowment Fund, and the Ehrenkranz Fund.

This publication is made possible in part by The Andrew W. Mellon Foundation.

First edition: May 2007
ISBN: 0-910503-97-4

Library of Congress CIP data available from the publisher.

Museum Editor: Chul R. Kim, Head of Publications
Design: Tsang Seymour Design, Inc.
Printed in China on 100% recycled paper by Oceanic Graphic Printing.