

“INVENTION AND INNOVATION FOR SUSTAINABLE DEVELOPMENT”

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THE LEMELSON-MIT PROGRAM
School of Engineering
Massachusetts Institute of Technology

Workshop Participants

Julia Marton-Lefèvre, Chair, LEAD International, UK

Merton C. Flemings, Vice-Chair, Massachusetts Institute of Technology, USA

Evan I. Schwartz, Rapporteur, Author and Independent Journalist, USA

Shereen El Feki, The Economist, UK

David Grimshaw, Intermediate Technology Development Group, UK

Pamela Hartigan, Schwab Foundation for Social Entrepreneurship, Switzerland

Ashok Khosla, Development Alternatives, India

Ehsan Masood, LEAD International, UK

Penelope Mawson, LEAD International, UK

Nick Moon, ApproTEC, Kenya

Adil Najam, Fletcher School, Tufts University, USA

Julia Novy-Hildesley, Lemelson Foundation, USA

Anna Richell, Design Council, UK

Ammon Salter, Imperial College London, UK

Eugenio de Motta Singer, ERM, Brazil

Rory Stear, Freeplay Energy Corp., UK

Zhang Lubiao, Institute of Agricultural Economics, China

Foreword

This draft document comprises Recommendations and a Summary of the discussion from a workshop held at the secretariat of LEAD International in London in November 2003, as part of a larger study on invention and inventiveness. The study will culminate in an “Invention Assembly” in Washington D.C. in April 2004. The study is supported by the Lemelson-MIT Program and by the National Science Foundation. The Assembly will be hosted by the National Academy of Engineering.

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KEY FINDINGS AND RECOMMENDATIONS

Overall summary of findings

1) Invention and innovation have proven to be crucial components for the development of modern societies. However, 1.3 billion people who currently live on less than a dollar a day do not enjoy the benefits that many modern inventions have brought. At the same time some key new technologies are known to have caused enormous damage to the global environment.

2) Sustainable development is the practice of protecting the environment while improving living standards for all, and invention and innovation is key to its success. Invention and innovation for sustainable development isn't just about developing new technology, but includes new processes and new ways of solving old problems—creative thinking is the rubric.

3) Despite the fact that people everywhere have an innate ability to be creative, rich countries are not doing enough to stimulate and harness invention and creative thinking, and poor countries tend to stifle innovation and creativity outright. This is typically due to a combination of factors: insufficient financial resources, lack of role models, education systems that don't inspire or value creativity, and social/political environments that discourage creativity, invention and entrepreneurship.

4) Innovation to help achieve the goals of sustainable development can start in many ways, including: “copy-cattin” (i.e. Japan, Korea and China first mimicking manufacturing techniques and then becoming world leaders.); “piggy-backing” (i.e. India performing service work for rich countries and adapting information technology to local needs); and “leap-frogging” (skipping over technologies that are inappropriate in a given place and time and adopting more sustainable solutions).

Recommendations for the short-term

1) We need to learn from successful case studies of social enterprise and from successful models for stimulating inventions/innovations that are making a difference to the poor while fostering sustainable development. Using this knowledge, we need to create the incentives that cultivate creativity on a local level all over the world and to encourage the application of human talents to that end.

2) International development assistance should focus more on providing incentives for building ‘sustainable livelihoods’—jobs that produce basic products and services for the

local economy, generate income and purchasing power, and also provide dignity and meaning to people's lives.

3) Awards and prizes with large cash sums should be established to motivate inventors and innovators everywhere to focus on sustainable development. Prizes could be sponsored by well-known institutions, and should be given high visibility through media channels. Prizes should focus on serving as incentives for solutions to large problems, and the prize money should also be applied to the commercialization and dissemination of the new solution. For maximum impact, lobbying could be directed to establishing a new Nobel Prize for the environment and sustainable development, just as one in economics was added in 1969.

4) Networks of innovators and social entrepreneurs should be strengthened and supported (possibly using a model similar to CGIAR, the Consultative Group for International Agricultural Research). More cross-cultural teams and relationships should be formed and funded, to promote knowledge sharing across both North-South as well as South-South cultures.

5) More invention and innovation needs to be directed to waste management, clean air and water solutions, as well as the spreading of renewable energy technologies worldwide.

Recommendations for the medium-to-long-term

1) Education reform must be a top priority – replacing rote learning with a focus on initiatives to stimulate creativity, entrepreneurship, sustainability, interdisciplinary research, hands-on learning, ethics, values and original thinking. Institutions of learning in all countries, as well as intergovernmental organizations should be leading the charge for reform.

2) Donor awareness – More attention needs to be directed to the long-term benefits of investing in local innovation capabilities. USAID and other bilateral donors should encourage and support invention and innovation through education and social entrepreneurship in poor countries throughout the world and stimulate its counterpart agencies to do the same.

3) Cultivating the corporations – Many companies already invest in innovation; many also do a lot for poor communities. But they must do more. Multinational corporations and firms based in developing countries can actually benefit by contributing to sustainable development, by providing mentoring, technical, and financial support to social entrepreneurs worldwide that provide key entry points to new markets.

4) Financing – Resources for social enterprises and for the entire innovation cycle should be vastly increased, with emphasis on downstream links in the cycle that get new tools and technologies into the hands of people who need them most. All sources must be

enlisted, including multi-lateral and bi-lateral organizations, the venture capital community, and foundations from developed countries. Local entrepreneurship and invention funds need to be established worldwide.

5) Intellectual property reforms – New models of intellectual property protection that stimulate creativity as well as technology and healthcare product diffusion to all areas of the world need to be devised. To make intellectual property protection more affordable, the U.S., European, and Japanese patent offices should reduce fees for inventors and entrepreneurs in developing nations who are creating products that promote sustainable development. Inventors and innovators everywhere should be given incentives to share their knowledge and market their products as widely as possible, in order to globalize the best ideas for sustainable development. Perhaps this could be accomplished through patent pools offering low-cost technology access to developing countries.

6) Trade and market access – Innovators in poor countries need fairer terms of trade if they are to make the leap from small-producers to mass-marketers. Dissemination of invention and innovation should be considered a “scaling-out” process that gets technologies into the hands of those who most need it, not a “scaling-up” process to just continually improve the technology for a limited few. Trade barriers that protect industries in developed countries but destroy the development of livelihoods elsewhere in developing countries should be immediately reduced and eventually eliminated.

7) Social and political environments – Creativity is stifled in countries that don’t respect human rights, freedom of speech, justice, and the rule of law. Sustainable development initiatives will be less effective in those countries that do not carry out social and political reforms. At the same time, developed countries need to understand the impact their lifestyles are having on societies in need of such transformation. Consumers and voters in rich countries should be mobilized to pressure corporations and governments to reshape their practices.

Introduction

Sustainable development—the practice of improving human life while protecting the environment—is perhaps the most important and the most daunting long-term challenge that the world faces. In conjunction with LEAD International, an organization dedicated to leadership for environment and development, the Lemelson-MIT Program in November 2003 held a workshop on “invention and innovation for sustainable development” at LEAD’s headquarters at Imperial College London. This workshop was convened to focus on invention and innovation as the source for solving some of the world’s most urgent problems. The workshop’s participants included those who are studying and reporting on sustainable development and also those who are practicing it in various regions of the world.

The basic premise driving the discussion is this: creative thinking has always been integral for improving well-being. New inventions and innovations in agriculture, mass production, transportation and communication during the Industrial Revolution were largely responsible for proving wrong English economist Thomas Malthus, who predicted that the world couldn’t support an exponentially increasing population. In the same vein, today’s inventors and innovators could very well prove wrong the skeptics who say that economic development and environmental protection cannot possibly go hand in hand. Drawing on cases showing what is possible when creative thinking and focused effort is put into practice, our participants asked and responded to a range of key questions, including: What kinds of new products and services are needed to create sustainable livelihoods worldwide? How can we stimulate creative thinking in local environments in response to local needs? How can we raise the level of awareness of invention and innovation as an answer to the problems stemming from sustainable development?

Sustainable development has different meanings and implications in different parts of the world. As noted by workshop chair Julia Marton-Lefèvre, executive director of LEAD International, we need to understand the challenges and ramifications “not only in London and Paris and New York, but also in tiny villages in Nigeria and Indonesia and

China.” Sustainable development is for all countries, not just developing ones. While rich countries need to develop alternative sources of energy and other technologies that reduce their own impact on the environment, poor countries need to develop their own innovation capacity, in order to address their own particular needs. This workshop, therefore, took an international perspective, due to the global nature of this challenge. All countries stand to gain if we can unleash the creative potential of inventors in all regions of the world.

Forming the heart of the workshop’s discussion were case studies showing how sustainable development happens and examples of inventions and innovations that can change lives. Showing off a couple tangible examples of how human creativity responds to sustainable development needs across the globe, Marton-Lefèvre held up a plastic container made entirely of corn instead of petroleum and a square of biodegradable carpeting. But these are just simple examples, she said. Sustainable development not only requires inventions for conserving energy and reducing pollution but innovations that give impoverished people around the world the tools they need to create what our workshop participants call “sustainable livelihoods”—jobs that produce basic products and services for the local economy, generate income and purchasing power, and also provide dignity and meaning to peoples’ lives. With these aims in mind, our participants began by defining the role of invention and innovation in sustainable development.

The role of invention and innovation

Invention stimulates entrepreneurship and overall economic activity, according to Merton Flemings, director of the Lemelson-MIT Program. He defines *invention* as a focused application of the human mind to the world that yields an original creation with practical use. Inventions are typically patentable, but patents aren't necessary to make it an invention. *Innovation*, as defined here, is the practice of bringing inventions into widespread usage, through creative thinking, investment, and marketing. That's why basic invention is typically needed to spur innovative activity. "Invention is that spark where it all begins," said Flemings.

To stimulate invention, we have to pay careful attention to education. "Invention requires a lot of knowledge," said Flemings, who taught engineering at MIT for four decades. "We teachers feel we have to stuff knowledge into people's mind and brains. But we also have to pay attention to the freedom of inquiry, to allow students to find their own ways and to develop their own creative minds." This balance is particularly important, he said, when it comes to enhancing inventiveness in developing countries. In addition to education, we need to stimulate invention and innovation worldwide by showing that society values those who succeed in these fields. "We need to raise the stature of inventors," said Flemings, "so that we come to think about inventors on the same level as rock stars or sports stars."

Ammon Salter, research fellow in the Innovation Studies Center at Imperial College, said that invention is not a linear process, from idea to product to economic impact. Rather, invention is a complex interaction between human creativity, technology and the marketplace, and iteration must typically happen between all three realms before an invention has a significant economic impact. Salter's studies relate to the practice of technology diffusion: How are new technologies propagated through a marketplace, and how good are certain societies at not only creating but diffusing those technologies. In this realm, Salter said, there is good news and bad news. The bad news is that only a small minority of the world's countries are practicing a significant level of invention and innovation. The good news is that this list of countries is growing and is now up to about two dozen. The two most populous countries, China and India, are in the process of becoming world leaders.¹

Ashok Khosla, president of New Delhi-based Development Alternatives, said that the story of how all inventions and innovations get to the big time, from Coca-Cola to the Sony Walkman, can be understood through showing how much money was invested at each stage of a product's development and diffusion. "It's a numbers game," he said. The same process of studying economic returns must be applied to investment in the developing world. "A dam built for \$8,000 transforms life for 20,000 people," Khosla emphasized. With a dam in place, people no longer have to spend much of their day walking to a well, and so they can perform more productive work. Meanwhile, the water from the dam irrigates crops that can sustain entire villages and towns.

In the developing world, however, innovations such as dams are typically planned and funded by governments or international organizations such as the World Bank, noted Adil Najam, associate professor of international negotiation and diplomacy at Tufts University's Fletcher School. As a result, local inhabitants sometimes fall into the trap of thinking that new technologies are things that are provided to them rather than something they create on their own. "They say, 'This is a World Bank dam,'" said Najam. That's why it's so important for invention and creativity to be nurtured on the local level. As noted by Mert Flemings, an invention can be a little thing that helps a small village. It doesn't have to be a scientific breakthrough like the laser. It can be a simple tool adapted to local needs in developing countries, such as the micro-irrigation pumps supplied by one of the workshop's participants, Nick Moon, co-founder of ApproTEC.

That's why "technology push" is often not a good way to do things, said Adil Najam, and why "technology pull," identifying demand in local markets, is so crucial. "What is a winning product?" Najam asks, "A StairMaster is a winning product in the developed world but not in developing world." Yes, Coca-Cola can sell sugar water to anyone, but a fresh lime drink may end up being more popular in certain locations. Highlighting the differences between markets, Nick Moon noted that capital is cheap in the developed world, while time and labor are expensive. In the developing world, however, capital is so expensive as to be practically unavailable, while time and labor are cheap.

These stark differences were highlighted in Najam's studies of sustainable development and technology diffusion around the world during the past ten years. Collecting more than a thousand stories from around the world, including India, Pakistan,

Bangladesh, Zimbabwe, Chile and the United States, Najam and his colleagues focused on 100 of the most compelling stories and published them in a series of seven volumes.² A consistent finding was that successful innovation involves reducing unit costs of new products, a process requiring at the outset a significant investment of capital, labor or both. While the conventional wisdom is that there has been very little achieved in the environmental arena since the high-profile Earth Summit in Rio de Janeiro in 1992, “we found amazing things happening at the micro level,” Najam says. “You can have lots of small things happening village by village, and that is what we have noticed here.”

Among the lessons and findings his study unearthed were the following:

- There is a “civic will” for change worldwide, a distinct motivation to improve human life apart from any profit motive.
- Imagination is key. As Einstein said, “Imagination is more important than knowledge,” and any improvement in human conditions begins when the human mind imagines the possibilities.
- There are three basic metaphors for accomplishing sustainable development projects: A) Buildings – start with the end in mind and create an overall blueprint for change. B) Rivers – different projects combine together, just as drops and streams merge together to form mighty rivers. C) Forests – trees don’t just keep growing into bigger and bigger trees but their seeds spawn more trees which form vast forests.
- You can “push” for change, as the demonstrators at the Seattle trade summit did in 2001, but perhaps more effective is the “pull” for change, such as the Pakistan national conservation strategy, which came from the demands of local markets.
- Successful sustainable development is rooted in communities, involves wise use of local resources, has ecological integrity, involves connectedness and partnerships, and promotes widespread understanding of how things get done.
- Ideas spread – A company that started an idea can go away, but a good idea that is adaptable to a market can live on.

- Raising small amounts of capital is one of the most difficult challenges. “There are places to go for \$1 million,” said Najam, “but where do you go for \$100 or \$5,000?”
- Invest in imitation – Replication of a successful product or project is a good thing because imitators typically add something of their own.
- “Listen and learn” – We need to know more about how successful sustainable development happens. “Propagate” – Half may do it wrong but half may do it right. “Nurture” – Incubate innovation through structures such as venture capital and credit systems. Innovation doesn’t happen in a vacuum. Successful societies are always subsidized in some way.
- Innovation as a pure handout doesn’t work. Dignity comes from doing it yourself, with the support of others.

On a national level, different countries have employed different models for using invention and innovation to improve living standards. Ashok Khosla cites three overarching templates for turning a poor nation into a rich one: the *copycat*, the *piggyback*, and the *leapfrog*.

“Copycats” imitate ideas, technologies and techniques from other countries and improve and adapt them. During its first few decades, the United States took the key secrets of the Industrial Revolution from England, Scotland and France and launched its own industrial economy. Two centuries later, Japan and then Korea developed by adapting American manufacturing, raising the quality and lowering costs. These days, China is doing it with much success, moving up the innovation ladder at a rapid rate.

“Piggybackers” ride on the backs of rich nations by doing more and more of their manufacturing and service work at far lower costs. India is practicing the art of piggybacking right now, using advanced computing and communications technologies to perform software development, tele-services, and even high-level innovation at a fraction of the labor costs compared to performing the same jobs in the United States or Western Europe. A recent study showed that one in ten U.S. software jobs will be exported to places like India and China over the next five years.³

Finally, “leapfrogs” skip over inappropriate technologies and embrace new ones, such as Finland’s sudden break from Soviet domination and its rapid adoption and

development of new inventions like wireless networks. Khosla believes developing nations need to employ all three models at once. “Industrial countries have made some lousy technology choices,” he said. “Why should we adopt what we already know is bad? We need to invent on our own, thinking everything through from scratch.” Transportation is a key example for the future. “A hundred years from now, we won’t have the internal combustion engine, so why adopt it now?”

Leapfrogging makes it sound so easy and elegant, noted Adil Najam. But putting in place technologies such as renewable energy, recycling, local water management, and creating appropriate construction materials, is more like heading down a long, rocky road. “It’s not so much a leap frog,” he said, “but more like a hard slog.”⁴

Case studies: Africa

Inventions and innovations adapted to local markets can improve lives in dramatic ways. Rory Stear, founder and CEO of Freeplay Energy Corp., has focused on the problem that many developing regions lack an electricity infrastructure. In 1994, he saw on BBC-TV a demonstration of a wind-up radio by its inventor, Trevor Bayliss. Bayliss said that major corporations rejected the idea of marketing the product. That gave Stear the idea of starting a company based on the fundamental concept of “storing human energy and releasing it slowly to power consumer electronics and other products,” he said. Stear bought the patent and marketing rights to the wind-up radio and launched Freeplay. His company is global, with its headquarters in South Africa, manufacturing operations in Asia, and major marketing channels in the United States and United Kingdom. He markets his products as high-priced specialty items in rich countries, which subsidizes the distribution of his products at no cost or low cost in poor nations.

Only about half of Africa is electrified, and batteries are many times more expensive than electricity from the grid. “So there is a big barrier in access to energy,” Stear said. With the AIDS pandemic spreading across Africa, countries in that region need a simple and inexpensive way to educate millions of people, many of whom don’t know how to read. Freeplay’s wind-up radio converts 30 seconds of hand cranking into energy that will last for 40 minutes of radio reception time. “We began selling these products at the Sharper Image, for camping and emergency preparedness,” he says. In 1998, before the

company was profitable, it began using that revenue to distribute its products in places like Zambia, Tanzania, Niger, Kenya, and Rwanda, where there are 65,000 child heads of household who need basic information on farming and about protecting their families from health threats. Freeplay has distributed about half a million of these wind-up radios for free to households, hospitals and schools, with the help of the Red Cross and United Nations.

Over the next few years, there's clear demand for 50 million cell phones in Africa. "How do you power those phones?" reflected Stear. Freeplay is working with big corporations such as Vodaphone, to develop and distribute products run on rechargeable batteries, solar power, as well as hand cranked chargers. Stear has also enlisted a wide range of investors in his company, including Ben Cohen of Ben & Jerry's and Anita Roddick of the Body Shop. General Electric invested \$10 million for a ten percent ownership stake in Freeplay and offered research help through its Schenectady, N.Y. laboratory. Stear is in the process of taking the company public in the United Kingdom. Other current and future Freeplay products include foot powered starter motors for cars, low-energy medical instruments for hospitals, and \$100 computers that run the free Linux operating system.

The case of Freeplay shows that there are economically viable ways to use invention and innovation to improve lives even in the world's poorest areas. Stear said that the innovation practices of leading companies must be deployed. Freeplay protects its intellectual property by filing for patents in the United States and Europe, to fend off cheap knockoff products in developed markets. To spread its message to customers and investors, it doesn't spend money on ads but relies on public relations that has lead to free coverage on the BBC and in *Newsweek* and *The Wall Street Journal*. If sponsor companies want to put their brand logos on his products in order to pay for free distribution of those products in Africa, Stear is all for it. "We'll make red radios that say Coke on them," he said.

Nick Moon, co-founder of ApproTEC, said that getting the right tools in the hands of the right people is a crucial mission. "The old adage, 'if you give a man a fish, you feed him for a day; teach a man to fish, you feed him for a lifetime' does not go far enough," he said. "Because he also needs a fishing rod!" Based in Nairobi, Kenya, Moon has been

most focused on the needs of the people in his adopted country, where only 15 percent of the population have wage-paying employment, and most of those jobs are in government. That means 85 percent of the population is self-reliant. Many of those people become entrepreneurs, setting up road-side stands or repairing bicycles, but most are involved in farming. Kenya, for instance, is the top exporter of cut flowers to Western Europe.

Farmers need the right tools in order to increase their productivity to a level beyond subsistence. This way, they can sell their surplus goods and hire others to work for their enterprise, thus generating a free-market economy that supports the population. To this end, ApproTEC has developed a range of foot-powered “micro-irrigation” pumps that it has branded as “Money Maker” pumps. ApproTEC sells these pumps at a profit above its production costs, but those profits cannot fund all the necessary R&D to create new products, and they don’t cover all the necessary marketing and promotion. It raises the money for those costs through donations from around the world. Those donated funds are the “social investment” that not only fuel the enterprise but also provide a payback in terms of economic and social benefit that far exceeds the cost of the investment, said Moon.

The process of social entrepreneurship, similar to all entrepreneurship, begins with identifying a market opportunity. Developing a design for a product that exploits that opportunity comes next. “But after you have the technology, it’s all about marketing,” he said. “You also need to do impact monitoring, and you have to build that into your business model.” ApproTEC does this through its guarantee program. When customers register for their 12-month guarantee on their pump, “we know who bought the machine, when, and where. We take samples from the database and build a socio-economic profile of them. Eighteen months later, we go back and see them, and we visit again and again.” That provides market intelligence and feeds into R&D, because it gives the company ideas for follow-on technologies to sell to the same investors. Moon also has learned to cultivate multiple suppliers of parts, in order to negotiate the lowest possible prices, and he often has to train his manufacturing workers on quality control. “The local engineering companies were set up to assemble kits or to do repairs,” said Moon. “They don’t know about assembly-line production, something that Henry Ford introduced a long time ago. We charge manufacturers for training” in those methods.

Moon said that with a few million dollars in seed money donation, his products can create 250,000 enterprises across sub-Saharan Africa that provide livelihoods for several million people. He is raising some of that money by opening an office in places such as San Francisco, to solicit private donations, and also by winning recognition from such organizations as the Schwab Foundation for Social Entrepreneurship. “You can boil it down to dollars and cents,” Moon said. The ApproTEC program currently takes in about \$1.3 million in donations annually, and its products are generating \$33 million per year in increased wealth for households in sub-Saharan Africa, for a benefit-to-cost ratio of more than 20 to one.

The question is: Where does a farmer get the \$80 it typically costs to buy a Money Maker pump? In Kenya, there are virtually no credit markets for rural people, said Moon. “You need the invention before the credit markets materialize,” he said, “to show that the productivity does increase per acre,” thus justifying the loan. Moon refers to his customers as investors, because they are willing to invest their time, energy, skill, knowledge, and land “in any activity which promises to add value to their assets and increase their cash incomes,” he said.

Moon told one story of a Kenyan woman named Janet. An AIDS widow with six children, she was left with a small, two-acre cabbage farm. She was able to make ends meet before her husband died. But afterwards, with no cash income, her children had to drop out of school to help her work the farm. The family was making \$20 per month, not enough to advance beyond subsistence. One day, Janet saw a demonstration of one of ApproTEC’s micro-irrigation pumps on the back of a pickup truck in the local market. The machine cost \$65. She saw the value of it but didn’t have the money. She spent the next six months working for it, somehow putting away a large chunk of the family’s income over that time. “It was an enormous decision to make this investment in a pump,” said Moon. “But now go back and see Janet. She put the entire two acres under irrigation and she purchased six more acres. She now owns two cows and has hired four adult employees. She recognized the opportunity without the help of anyone else,” Moon said. There are now more than 36,000 Janets across Kenya and Tanzania.

Exposure as a Schwab social entrepreneur has allowed Moon to travel to other parts of Africa that could use his products and to develop ideas for new inventions. “Outside of

Africa, people have the wrong image,” Moon said. “Yes, there is an AIDS pandemic, but innovation is alive. In the past 10 or 15 years, the dictatorial and oppressive regimes have passed on. There are a few left. But Africans now have broader visions.”

Those visions begin with childhood inventiveness. “Kids as young as three or four years old are making things out of almost nothing, pieces of scrap,” Moon says. Kids with little to no education are using their imaginations to turn debris into “footballs and toys, tools and equipment, shelter, works of art. The notable thing is that these are more often the products of the imagination and the industry of under-educated, semi-literate people.”

Moon said that this practice of grass-roots invention and innovation is best suited to the local environments where he lives and visits. “Seven of ten people in sub-Saharan Africa are rural,” he said. “They don’t find opportunities in cities. Two million out of three million people in Nairobi live in slums. Until recently, most African economies were command economies. Most people were peasants, and they were subsidized by the government. Subsistence lifestyles were viable. They’d sell surplus for a few coins. All of this went out of the window in the early 1990s, a period of structural adjustment. With the global economy, countries had to throw out their subsidies” to local farmers. As a result, the global economy tilted away from small-scale farmers and toward giant agribusiness, which ironically are subsidized by the rich countries, making it tougher and tougher to establish the kind of enterprises ApproTEC is trying to create. “The world has been invited to take part in this global market,” Moon said, “but the playing field is not level.” In this environment, innovation is necessary for survival, he said, and “we need very different technologies in these situations.”

Case studies: India

As the world’s largest democracy, with a diverse population of more than one billion, India has become a key testing ground for sustainable development. Most of the media attention has been focused on the country’s pockets of urban, English-speaking university graduates who are “piggybacking,” capitalizing on the Internet and decreasing telecommunications costs to capture hundreds of thousands of software and customer

service jobs from overseas, at a fraction of American or European wages.⁷ The high-tech startups of Bangalore have been heralded in the press. Corporations such as GE and IBM have even opened R&D centers there, employing PhD-level engineers who are helping to invent and improve info tech, biotech and nanotech.

But Ashok Khosla, founder of Development Alternatives, is focused on the rural poor, the 70 percent of India's population who are almost completely untouched by any of this. He envisions bringing 700 million people in India out of poverty or subsistence living. Borrowing ideas he has seen all over the world, Development Alternatives has invented a series of new products, including:

- A hand-operated press that converts mud into hard bricks for low-cost housing.
- A vertical kiln that bakes on a continual basis bricks made from native clay.
- A machine for transforming industrial waste into cheap roofing tiles.
- A process for converting local weeds into a substitute for diesel fuel to make electricity.
- Woodstoves that dramatically reduce fuel smoke, thus reducing early cancer death.
- Hand-powered looms and paper-making machines made by modernizing centuries-old designs.

One of Khosla's most significant innovations is his franchising system. Borrowing a page from Ray Kroc of McDonald's, Khosla has created a network of dozens of profitable local telecenters – *TARAKendras*, business and community facilities that set up their own businesses training and supporting people in the use of dozens of these technologies. Just as important as creating jobs at the franchise level are the jobs that are created by the inventions themselves. Each of Khosla's products, once up and running, creates an enterprise that requires hiring from four to four dozen employees. The entrepreneurs who use credit to invest in the company's kilns, looms, paper-making units and energy systems now have a sustainable way to market products that people want, and can use or sell.

Such a systematic strategy gives people the chance to escape the cycle of poverty while having a negligible impact on the environment. Using its own mud bricks, Development Alternatives built its headquarters for 150 employees. The building consumes the same amount of electricity as a single American household. Using similar bricks, one of the organization's customers built the Indira Gandhi National Center for

the Arts in only 120 days. The cost was only \$40,000. The center has hosted dozens of national exhibitions over the past 15 years.

Development Alternatives is in the process of signing up franchises in new locations, providing a source of royalties and training fees that are invested back into the organization. It also generates income from data mining and by running an Internet portal, www.tarahaat.com, for communicating with franchisees and customers. “We are bringing the Internet to small villages,” he said.

Despite the fact that Khosla has been running his organization for more than 20 years, he struggles to raise capital. Traditional non-profits and for-profit investors typically don’t encounter social enterprises that generate income, and so they don’t know how to assess what he is doing. Non-profit donors, such as those in the international development community, are often reluctant to give money to anything but pure charities. While Development Alternatives is a non-profit organization, the companies that it operates, such as DESI Power Pvt. Ltd. and TARAhaat, are set up as for-profit enterprises that help pay for further research and development of new products and ideas at the parent company. This kind of model is alien to much of the traditional donor community. He also said that foreign aid and government grants often come with their own conditions and objectives, often making the acceptance of such funding counterproductive.

When it comes to raising money from private venture capitalists, there is a different disconnect. Venture firms are comfortable investing in software startups carrying out customer relationship management applications, but they aren’t familiar with hybrid enterprises that primarily focus on social value creation but also generate revenues.

Intellectual property is another sticking point. Venture firms typically look for protected intellectual property, such as patents, to assure that they can exclude lower cost rivals from markets, at least for a time. But patents aren’t easy to enforce in India. In addition, at least for Khosla, these have not been necessary to provide a motivation for commercialization, and so he hasn’t focused on protecting his organization’s inventions. In certain cases, however, his success has drawn imitators. After he sold more than 100,000 units of his TARA wood stoves, entrepreneurs in the rest of India and also as far away as Nigeria and Ghana took the stoves back to their shops and copied the products

exactly, including the TARA logo. “They didn’t know what made it work so well,” Khosla said. “So they copied everything.” Khosla said this is not necessarily bad for him. “People who copy us open new markets,” he said.

Lack of financing is the only obstacle Khosla cited, the only thing standing in the way of reaching his goal of reaching the mass markets. He said his overall objective is to “make a dent in the employment problem” in India. He said the country needs to create 15 million new jobs per year. The high-tech and outsourced jobs from overseas only contribute to a small fraction of that and are available only for a limited few. He said that this larger number of jobs is needed for several reasons beyond economic ones: psychologically, these jobs are needed to give people dignity. In terms of the environment, these jobs are also needed to avoid the temptation for people to make money by further damaging the soil, air and water. Khosla said that Gandhi himself had a lot to say about “sustainable technology” and how people relate to machines. Good technology, according to Gandhi’s principles, helps people reach their aspirations, liberates human potential, creates economic opportunity, and regenerates environmental resources. “Technology should be the servant of man, not his master,” said Gandhi.

When Khosla is assessing which kind of products and technologies to develop and market, he looks for those that can catch on in the marketplace quickly, those that can be embraced and replicated by new enterprises that work as his franchisees. “Viral multiplication,” he said. “This is the crucial term. It doesn’t matter how bleeding your heart is, if it doesn’t get out there, it doesn’t do any good.” He also looks for high social impact, large scale economic returns, environmental benefits, and customer opportunities. Finally, Khosla looks to “cluster” sets of technologies together, so that his franchisees can diversify and sell many products, not depending on just one for their own livelihoods. On its TARAhaat.com website, the company provides customer support and servicing, and its franchisees and customers trade tips and gossip. Typically, even small villages have phone and Internet connections in community centers and other public facilities. Khosla said that the Internet can enable him to scale out his system to hundreds or thousands of franchisees over time.

Despite all this success, the process is slow. “At the current rate we will be able to raise everyone out of poverty in India in 200 years,” Khosla pointed out.

Case studies: China

Perhaps nowhere is the challenge of sustainable development more pressing than in China. Due to shortages of energy and raw materials such as cement and steel, along with a sharp spike in deaths from industrial accidents, including the recent gas explosion that killed 200 people, the government of China has been moving to cool down an economy that many see as overheating. China has just surpassed Japan to become the world's second biggest consumer of oil.⁶ While its famous factory exports are growing at an annual rate of 33 percent, imports to satisfy the economic expansion in the world's most populous nation are growing even faster, at a rate of nearly 40 percent. Fleeing rural poverty, some eight million people annually are moving to China's cities. Arable land for feeding the population is decreasing, and surging industrial production is threatening the air and the water. This has created a paradox. China's citizens are only striving for the things that the middle classes of the United States, Western Europe and other developed societies already take for granted: rising living standards, virtually unlimited access to gasoline and electricity, and an increasing flow of imported goods.

China's economy is growing at a blistering rate of eight percent annually, and it has been moving from a rural agricultural society to an urban industrialized one at a fantastic rate. The surging Chinese economy has already pulled about 100 million people out of poverty in recent decades, noted Ammon Salter, of Imperial College. And perhaps 100 million more will attempt to make the same transition from peasant life to urban life over the next 10 to 15 years.

Zhang Lubiao, professor and deputy director-general of the Institute of Agricultural Economics of the Chinese Academy of Agricultural Science, noted that invention and innovation is playing a key role in getting China through this unprecedented period in its development. In particular, China needs to come up with better ways to feed itself, to avoid massive starvation. "China needs a breakthrough in agriculture," said Zhang. "We must achieve self-sufficiency. But arable land is decreasing."

Rice, China's staple food, has been the subject of the most intensive attention and funding. With available land for growing rice decreasing due to industrial development, and with fewer people willing to work as farmers, China needs to develop a new type of

rice adapted to its changing situation. As Zhang said, it is a food security issue. China's one child per family policy has kept its population growth in check. Nevertheless, its more than one billion people still require massive amounts of food. They now "consume more resources," Zhang said. "But with urbanization, we have land resource constraints."

The result is a government-led effort to breed a new form of "super rice," one that uses less land and water. The new super rice has to achieve at least a 20 percent gain in yield per unit of land but must match the taste and quality of existing rice. To meet these objectives, the government has enlisted Professor Yuan Longping, the father of hybrid rice. He first genetically engineered a superior strain of rice in the 1960s, and has since transferred his techniques to dozens of other countries. Professor Yuan is the past recipient of the State Supreme Science and Technology Prize, China's equivalent of a Nobel Prize.⁷ The Chinese government has invested 100 million yuan (about \$12 million) in a five-year effort to create the new super rice. Prof. Yuan assembled a team of top experts and drew together the collaboration of at least 10 major research centers across China. They have been pooling their crop varieties in order to invent the ultimate variety.

With 2005 as its rapidly approaching deadline, the Yuan team claims to have succeeded, but this remains to be seen. According to Zhang, it is not yet clear whether the Yuan's super rice team has met these difficult resource-saving goals. The scientists have declared that it tastes very good, but since the product is not yet on the market, the consumer has yet to express an opinion.

The super rice project is just one of many innovation efforts being undertaken across China. Before 1995, said Zhang, all scientific endeavors were directed and driven by the government. Since 1995, there has been a gradual diversification into the private sector, and "enterprise boomed." There are also many joint ventures between government and enterprise. But Zhang said that, in China, "enterprise innovation is still weak at present." But this is to be expected, because the country is still making the transition from a planned economy to market economy, he said. As a society, China is asking: "What kind of innovations do we need?" noted Zhang. "The government says there are three categories: basic, advanced and applied." Most of the current action is in applied innovation rather than basic or advanced research. "This is appropriate for developing countries," Zhang observed.

In conjunction with the effort to engineer new crops such as new varieties of rice, corn and soybean, the number one issue the country faces is water. He said scientists have learned about water-saving tools and techniques from countries such as Israel, which is considered number one in the world, “but at the grass roots level, farmers do not adopt it,” he said. “Why? From theory to practice, there is that big gap.” That is why, he said, “technology diffusion is the most important issue.”

As an example of how the country has attempted to diffuse new technologies, he cited the establishment of 400 Water User Associations (WUAs) under a project initiated in 1995 by the World Bank. The results of the effort have been promising and impressive. It drew the incentives and participation of the farmers in irrigation management, and improved the efficiency of water resource use in agriculture. In general, the project evaluation was very positive, although there exists some institutional problems. According to one independent survey by CAAS, about seventy percent of the WUA chairmen are village leaders, suggesting that water use and local politics are tied closely together. However, that is not to say that WUA is a wrong way and a failure, but it implies that institutional innovation needs time in a developing country, and it is not realistic to achieve the goals of self-sufficiency and self-management within a short period of time in China. Even though water charges have increased, and 98 percent of the WUAs have budget deficits, almost all of the farmers welcomed the introduction of WUAs, according to Zhang.

Overall, Zhang offers five principles for how developing countries can support innovation. 1) “freedom of thinking” – eliminating thinking barriers. 2) “personal aspiration” – enabling self motivation. 3) “resource endowment” – making money and other resources available for innovation projects. 4) “incentives” – such as prizes and award systems. 5) “teamworking” – assembling and managing groups of people with common aims. Pamela Hartigan remarked that this list is interesting in that these are the same set of issues important for Western Europe.

Case studies: Latin America

Latin America, like much of the rest of the developing world, has pressing needs for innovation and sustainable development. Some of the biggest cities in the region, such as Mexico City and São Paulo, are well known for their serious environmental problems. In Mexico, in particular, innovation has been neglected for so long that the economy is suffering for it, and some of the brightest scientific minds regularly leave the country in search of a more rewarding environment. According to a recent article in the *Los Angeles Times*, it is now “dawning on the government that its economic future may depend on improving its home-grown technology, and the care and feeding of its inventive scientists. President Vicente Fox has given innovation new emphasis since he took office in 2000, elevating to Cabinet level a federal commission that monitors and helps award \$400 million in research and development grants. A World Bank report published last month warns that Mexico must seek ‘creative policies to spur productive innovation and entrepreneurship’ or continue to watch jobs drain away.”⁸

Some of the countries in the region, such as Argentina, have highly educated populations, yet they cannot seem to move ahead economically. “Argentina was one of the richest countries in the world 100 years ago,” noted Adil Najam. Buenos Aires used to be known as the Paris of the South. But due to a variety of factors, including corruption and government mismanagement, Argentina has experienced a tragic economic fall.

That’s not to say that the people of the region do not show remarkable levels of innovation. “In Argentina,” said Najam, “when the currency and the economy collapsed in 2001, people bypassed the monetary system. They had no money but they had skills. In that situation, you barter your skill for someone else’s skill.” This showed an enormous amount of ad hoc innovation. Neighboring Brazil didn’t experience a similar economic collapse, but it, too, suffers from some of the same problems, including an enormous gap between rich and poor. The poor in Brazil show a great deal of innovation, wiring up their ramshackle favelas with pirated electricity stolen from the grid.

Pamela Hartigan, who grew up in Ecuador, said that in Latin America, “there’s such great inequity, that people are basically copping out of the capitalistic model, because they’re saying it just doesn’t work. And then you have a whole other explosive situation.

So it's not that the innovation isn't there, it's not that the entrepreneurship isn't there. It's that the conditions are such that it has a different dynamic and a different expression."

Eugenio de Motta Singer, a board member of ERM Brasil, an environmental consulting firm picked up on Adil Najam's models of economics, saying that in Latin America especially, "buildings, rivers and trees need to live together not apart." He noted that kids everywhere are naturally inventive and curious. They have the capacity to learn about anything, "about how to fix motorcycles, about drugs, about how to create a new musical instrument." But opportunities are limited by the range of choices they are given. It's a lot like being an average employee who works in a McDonald's. "Can you imagine someone creating a new hamburger at McDonalds?" Singer asked. "One has to go to the university of hamburger, and you need 15 years of training to create a new sandwich." When uniformity and quality are the goals of an organization that can serve to stamp out invention and innovation.

After gaining his PhD, Singer said he went to work in Brazil's power utility industry. He wanted to help move the industry to alternative sources of energy, such as biomass fuels and wind farms. But the industry resisted such innovation. These days, cities such as São Paulo, where he works, are horribly polluted and congested. The water is contaminated and the air is toxic. To alleviate the problem, his company is doing its part. Instead of having one central office and forcing all employees to brave the traffic to get there, ERM has created five "virtual offices" so that they can work relatively close to home.

He said such policies help motivate and retain employees, and ERM has less than a two percent turnover rate. "Employees are working not for highest salaries but for respect," Singer said. "That's why innovations don't often come—because of lack of respect. An inventor is more motivated by recognition than money." He said that invention also comes through toleration of failure. "Mistakes are very important," he said. "Lexus launched a car with zero defects by soliciting feedback on defects. We need to promote people to take a risk and not penalize them if they make a mistake."

Singer also said that the people of his region no longer trust international institutions, because of the gap between promises and implementation. When the World Bank states, "our mission is to alleviate poverty," people in the region now respond, "How can we

trust that?” Singer emphasized that people must be convinced that “sustainable development is not what the government does for people but what people do for themselves.”

The rise of social entrepreneurship

All of the examples cited above are instances of social entrepreneurship. While social entrepreneurs have existed since the beginning of time, the relatively recent surge of social entrepreneurship is part of a larger and more recent context, explained Pamela Hartigan. It is emerging at an historical juncture, when the traditional distinctions between business and civil society organizations, between who should provide public and private goods, are blurring.

Governments, the traditional purveyor of public goods, are increasingly unable to meet the needs of the poor, and the equity gap continues to increase in industrialized and emerging markets. Misconduct among a few highly visible corporations has affected all corporations, igniting consumer outrage and eroding shareholder confidence. In addition, with so many similar goods and services to choose from, the consumer wields unprecedented power. And so the corporate world has begun to respond to social and environmental imperatives, if anything, to generate good will and retain customers and employees. Non-profit organizations have mushroomed in the last 25 years to address unfulfilled needs. They are increasingly being held to performance criteria adapted from the business sector: effectiveness of resource allocation, transparency, accountability and effective governance. As the citizen sector and its organizations grow in number, funding becomes tighter, competition greater, and the search for sustainable sources of income is a daily challenge.

Hartigan said that social entrepreneurship is catching on in unexpected places in unexpected ways, and one reason that we’re able to identify and track these pockets of progress is that the term “social entrepreneur” itself is being embraced. “I think that it’s actually because of a combination of things, but particularly because of the mental models of entrepreneurship have taken hold in these past 20 to 25 years,” she said. Creating social entrepreneurs is tricky, she said. “This hasn’t become a science until very recently, and I wonder if it’s ever a science, but it’s beginning to happen,” Hartigan said.

“There are many different schools now teaching social entrepreneurship.” Hartigan herself teaches such a course at the University of Geneva. “I think that you can help social entrepreneurs be better at many things,” she said. “But if you hang around the social entrepreneur, you realize that they can't help being the way they are; and that there is something about the way these folks are wired.”

The social entrepreneur is a creature of his or her time—a hybrid that combines the driving passion to improve the lot of excluded groups with the practical, innovative and opportunistic traits of the entrepreneur. Social entrepreneurs are focused on the delivery of public goods using business approaches. They will rarely be found among the activists who invest their time organizing to protest against the pernicious effects of globalization. Social entrepreneurs are too busy finding the solutions that will allow all people to participate as active producers and consumers, in the local, national and global economies.

The Schwab Foundation for Social Entrepreneurship exists to disseminate globally the concept and practice of social entrepreneurship as a critical contributor to sustainable development through innovation and transformational social change. Among its activities, the Foundation identifies the most outstanding social entrepreneurs worldwide, as role models for others to emulate with practical approaches to social problems that can be adapted to other contexts.

Ashok Khosla, Nick Moon and Rory Stear are three that have been selected to the Schwab Foundation's network of outstanding social entrepreneurs. Until he became a Schwab social entrepreneur, Moon said, “I had no idea I was a social entrepreneur.” Yet he and the others are excellent illustrations of the hybrid nature of social entrepreneurs, combining business models with socially-motivated goals. Many social entrepreneurs seem to model their efforts after David, taking on the many Goliaths that the world has constructed. Hartigan added that such role models are extremely important for stimulating invention worldwide. “Youth don't even know about the possibility of being a social entrepreneur” until they see someone getting recognition for it, and that so rarely happens. In her home country of Ecuador, mostly what people see is the “tremendous inequity” in society. That's why she is focused on the successful case studies.

In Mexico, for instance, American-grown corn is being dumped and sold at 25 percent less than its costs, affecting 1.3 million small grain farmers in that country. In response, a social entrepreneur named Victor Suarez formed ANEC, a membership organization, to empower small scale commercial grain farmers to compete in the mass production-dominated global economy. ANEC mobilizes its members to collectively market their crops through regional enterprises. It disseminates market research to its members every week, allowing them to secure prices that are 15 to 20 percent higher than the market, whilst selling all their produce. ANEC, which also provides grain storage facilities for surplus products, provides access to financing and to secondary processing of raw grains into food products. Beginning with 250 members in three states, the alliance now has 120,000 members in 23 states. “It’s a social enterprise,” Hartigan said.

She cited another example, NOVICA, a for-profit entity founded by two social entrepreneurs who aimed to create viable livelihoods for some of the world’s most endangered human talent—the artists and artisans in developing countries. “Artists abandon their craft for two reasons,” she said. “geographical distance and multiple layers of middlemen.” NOVICA works directly with the best artists and artisans in developing countries through its regional offices. Artisans set their own prices, and by cutting out the middlemen, they can earn 10 to 50 percent more than the local going rate. The consumer pays below market prices for their own country—by establishing direct contact with the artist who made the craft.

NOVICA is more than a website. It is a network where artisans in emerging markets can showcase their best wares and relate their own life journey to consumers who buy their wares. So far, more than 20,000 artists sell their ceramics, jewelry and household goods through NOVICA, which has tapped into a growing market for handcrafted home décor that in the United States alone is worth more than \$10 billion annually.

Hartigan concluded with an example from Asia, where in Dakar City, Bangladesh, more than 3,000 tons of garbage is produced a day, 80 percent of which is organic. The municipal government has the capacity to collect only half of that, the rest lying in the streets, in empty lots and along riverbeds. Aside from the stench and unsightliness, the public health hazards are enormous. Iftekhar Enayetullah and Maqsood Sinha were two university students who met while doing a project on waste management. Both had

engineering backgrounds and were committed to finding a solution to the organic waste challenge in their city. The young men knew that Bangladesh faced a severe problem of topsoil erosion because of the agricultural overuse of chemical pesticides and fertilizers. As all social entrepreneurs, they saw opportunities where others saw only problems. Instead of seeing garbage as garbage, they saw it as a goldmine.

Community-composting sites were the answer, they decided. These would give people jobs as house-to-house collectors or as workers in the composting plants where they would convert the waste into organic fertilizer. Given the fact that the waste and the topsoil problem fell in the public sector, the two social entrepreneurs naturally assumed that the government would be interested in collaborating to address the dual problem. After four years of attempts to galvanize municipal or federal interest, they decided to go at it alone. Today, Waste Concern is a huge international success. It has provided 50,000 jobs for the urban poor in eight municipalities, it produces 500 tons a year of compost with a rising demand from farmers estimated at 15,000 tons a year. It also generates considerable income by selling companies that buy and nationally market the compost-based enriched bio-fertilizer produced.

What is Waste Concern? Is it a business? It provides jobs, sells fertilizer and generates income to pay its workers. Is it a public sector entity? It certainly is doing the work of the public sector, instigating behavior change and managing health and environmental problems. But it is not a government agency. Is it a philanthropic organization? Hardly. Waste Concern is a social enterprise, a hybrid of the business and public sector, but its strength lies in its innovative approach to social and economic challenges. Such success stories show how social entrepreneurship holds promise for galvanizing human innovation and inventiveness for the global good.

An Agenda for Further Study

Given the resource base of the developed world, it is a tragedy that more economic development and poverty alleviation hasn't been accomplished over the past generation. As Adil Najam noted, "We have done a lot, but far less than we could have done." He summed it up by evoking the famous Marlon Brando movie line about lost opportunity. "I could have been somebody," cried Brando. "I could have been a contender."

But he said there is tremendous hope, and it lies in human ingenuity. One of the best things the rich countries can do for the poor ones, he said, is to get out of the way and let innovation take root. That said, our participants came up not only with the list of recommendations that begin this document but an agenda for further study of these key issues:

#1 – Education Reform:

Julia Novy-Hildesley of the Lemelson Foundation summed it up by saying that "the education system is very often a barrier." Even in the United States, standardized testing and other recent initiatives for enforcing base level standards are having negative effects on creativity and original thinking.⁹ Added Pamela Hartigan: "The formal education system knocks out curiosity and creativity." Said Eugenio de Motta Singer: "Our education system is not appropriate for this process. We impair creativity. We impair innovation."

Several of our participants suggested studying successful models for funding innovation in education, such the one led by Wendy Kopp, a Schwab social entrepreneur and founder of Teach for America, a program in which recent college graduates dedicate two years to teaching disadvantaged communities across the United States. Since 1990, according to the program's website, more than 10,000 individuals have taught more than 1.5 million kids under this program.

David Grimshaw, of the Intermediate Technology Development Group, said that a focus on science is particularly important: "I think it's imperative to understand how to change the mindset about doing science. We've virtually wiped out a whole generation of scientists. There are not enough young people going into science anymore." He says we need to study further the causes of that and set up incentives and rewards that encourage

more people to go into professions in which solving problems is the central focus.

#2 – An intellectual property framework for the developing world:

While it's clear that the most economically developed nations tend to have strong systems for protecting intellectual property, and while it's clear that private investors who finance innovation tend to place high value on patents and other protected ideas, there was wide disagreement among our participants as to the importance of intellectual property in stimulating invention, especially in the developing world.

"Patents aren't even close to being the most important thing," said Ammon Salter. "Trade secrets, complexity of design and being first to market—these are the three most important mechanisms firms have to protect their ideas in both developed and developing countries." He said that all the different countries of the world are unlikely to agree on a uniform system for protecting intellectual property, and that there are other issues, such as trade harmful subsidies that are more important. More study needs to be done as to whether there are beneficial ways to change intellectual property systems worldwide.

#3 – Attracting investment and financial resources:

Ashok Khosla said that developing countries lack the advantages that the United States put in place in the early part of the 20th century. The U.S. government massively subsidized universal electricity and telephone service virtually everywhere in the country, but especially in rural areas that would never have been able to afford it on their own. This base level of infrastructure enabled the economy to grow. In the 1920s, for instance, the United States set two percent interest rates and delayed payment plans for borrowing money for rural electrification.

But other governments around the world still lack the will or the money to do the same. And private companies such as Development Alternatives cannot raise enough cheap capital to fill in the gaps. "The global system wants to charge us 15 to 18 percent."

Apart from government funding, our participants expressed strong support for researching other avenues for raising capital to support invention and innovation. Those avenues include the establishment of awards and prizes. "We need to give out awards," said Khosla, himself the recipient of the United Nations Sasakawa Environmental Prize

for 2002. “They get people’s attention, and help to legitimize and raise the value of the profession in the eyes of society.”

There was also strong support to find ways to change how U.N. agencies, non-governmental organizations, foundations, and corporations go about providing finance, by encouraging those organizations to spend more time listening to needs and success stories on the local level, with the goal of innovating new business models that supporting sustainable livelihoods.¹⁰

The venture capital model for funding innovation and social entrepreneurship has shown immense promise, but more study needs to be done on the impact of efforts such as the World Bank’s Development Marketplace, which since 1988 has awarded more than \$16 million to about 330 development projects through national and global competitions. A *New York Times* editorial recently noted that the effort, which was inspired in part by Silicon Valley’s system of venture capital, has led to novel solutions such as farmers in Zimbabwe surrounding their crops with chili peppers to keep elephants from trampling their fields, and a project in Tanzania in which researchers are training rats to detect tuberculosis.¹¹

#4 – Developing a social competitiveness index:

There is substantial variation in social entrepreneurship and public-sector innovation across different countries, and we need a systematic way to measure those variations in order to see how certain efforts may or may not be working. “Social innovation works but we have no empirical research,” said Pamela Hartigan. “We are falling in love with these heroic personalities. But we don’t have data to support these claims.”

Determining factors for social competitiveness include government policies, sources of capital, cultural and social norms, education and training, using failure as building blocks of success, as well as peer knowledge, as an individual is much more likely to take a risk if they know someone else who has done it. If we had a global index that measured various factors that contribute and result from social entrepreneurship, we’d be better able to answer key questions such as: How do social entrepreneurs innovate?

Hartigan compares this index to the “national innovation capacity index” done by Michael Porter at the Harvard Business School along with Scott Stern at the

Northwestern University's Kellogg School of Management. That study uses country-by-country patenting, the percent of the population working as scientists and engineers and other metrics to compare innovation capabilities of about 95 countries.¹²

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PARTICIPANT BIOGRAPHIES

Shereen El Feki

*Science and Business Correspondent
The Economist*

Shereen El Feki has been a science and business correspondent for *The Economist* since 1998. She writes about biomedical research, the pharmaceutical and biotechnology industries, international healthcare policy, biomedical ethics, intellectual property rights, and agribusiness. She also regularly comments on these issues for both radio and television. El Feki holds a B.Sc. from the University of Toronto, as well as an M.Phil. in biochemistry and a Ph.D. in molecular immunology from the University of Cambridge.

Merton C. Flemings

*Director, Lemelson-MIT Program
Massachusetts Institute of Technology*

Merton C. Flemings is Toyota Professor of Materials Processing emeritus at M.I.T., where he has been a member of the faculty since 1958. Flemings established the Materials Processing Center at M.I.T. in 1979 and was its first director. He served as Head of the Department of Materials Science and Engineering from 1982 to 1995, and from 1998 to 2001 as M.I.T. director of the Singapore-MIT Alliance, a major collaboration between M.I.T. and Singapore in distance engineering education and research. He is author or co-author of 300 papers, 26 patents and two books in the fields of solidification science and engineering, foundry technology, and materials processing. Flemings has received numerous awards and honors, including election to the National Academy of Engineering and to the American Academy of Arts and Sciences. He has worked closely with industry and industrial problems throughout his professional career. Flemings is Chairman of the Silk Road Project, a not-for-profit corporation devoted to fostering creativity and celebrating local cultures and global connections.

David Grimshaw

*International Team Leader, New Technologies
Intermediate Technology Development Group*

David Grimshaw currently leads a team whose mission is to enable poor women and men to assess and respond to the challenges of new technologies, and to adopt applications that improve their livelihoods. Recently funded research projects include the use of geographical knowledge by business, knowledge exploitation and the business benefits of e-business (sponsored by Microsoft). Grimshaw is currently working with ITDG on a DTI funded project to develop a knowledge sharing strategy. He is the author of *Bringing Geographical Information Systems into Business, second edition* (John Wiley Inc., 2000) and joint editor of *IT in Business: A Manager's Casebook* (1999).

Currently, a visiting fellow at Cranfield School of Management, Grimshaw launched an e-commerce elective in the Cranfield MBA in 1998, and ran an executive program on e-

business strategies. He also has been a visiting fellow at Curtin University, Australia; the National Center for Geographic Information and Analysis, New York State University at Buffalo; the International Management School, St. Petersburg; and the Graduate School, Universiti Utara Malaysia. He is currently a visiting professor at the Universiti Teknologi Malaysia.

Grimshaw served as chair of the Education Committee on the Council of the Association for Geographic Information from 1999 to 2002. He was on the judging panel for the Digital Britain 2000 Awards and the e-Business Excellence Awards in 2000 and 2001, and has served as external examiner at University of Bath and University College Dublin. Grimshaw has also advised many companies on strategic information systems planning, geographical information systems, and e-business strategies.

Pamela Hartigan

Managing Director

Schwab Foundation for Social Entrepreneurship

Pamela Hartigan has held positions with academic, community-based, and multilateral organizations. Before joining the Schwab Foundation, Hartigan was executive director of the Department of Health Promotion at World Health Organization. In July 2000, Klaus Schwab, Founder and President of the World Economic Forum, invited her to spearhead the Schwab Foundation for Social Entrepreneurship. The Foundation is dedicated to globally advancing the field of social entrepreneurship, through building and supporting its practitioners whose efforts have achieved transformational social change. In addition to her leadership position at the foundation, she teaches a graduate course in social entrepreneurship at the School of Business and Social Science of the University of Geneva. She earned a Masters in economics and education, plus a Ph.D. in cognitive psychology.

Ashok Khosla

President

Development Alternatives

In addition to his role at Development Alternatives, Khosla is also president of Technology and Action for Rural Advancement (TARA); TARAhaat and Managing Trustee; and People First. He is chairman of DESI Power Pvt Ltd. and secretary general of the People's Commission on Environment and Development.

Khosla was previously director of the Office of Environment for the Government of India, where he set up the first national environmental agency in the developing world. Subsequently, he was director of INFOTERRA in the United Nations Environment Program, and was in charge of the design and implementation of the global environment information system.

Khosla has been a consultant to various organizations such as the World Bank, United Nations, GEF, the MacArthur Foundation, IDRC, and the Royal Swedish Academy of Sciences. He was also special advisor to the Brundtland Commission, vice president of the Club of Rome, chairman of WETV (the global access TV network), and cofounder of the Factor 10 Club. He has served on several international agency boards, including the Worldwide Fund for Nature, World Conservation Union, International Institute for Sustainable Development, Stockholm Environment Institute, and the Earth Council. He was chairman of the '92 Global Forum, in Rio de Janeiro, and he has served as a board member of several government, industry and NGO bodies in India, including the National Environment Council and the Science Advisory Committee to the Cabinet.

Khosla has authored more than 350 papers and articles and is editor of the monthly journal, *Development Alternatives*. He received the 2002 United Nations Sasakawa Environment Prize, the Karl Schwab Outstanding Social Entrepreneur Award, UN Global 500 Award, Stockholm Challenge Award, and others.

A graduate of Cambridge University, he received his doctorate in experimental physics from Harvard University, where he has lectured on physics, astronomy and environment.

Julia Marton-Lefèvre

Executive Director

Leadership for Environment and Development International (LEAD)

Julia Marton-Lefèvre is vice chair of the World Resources Institute and a member of several boards and commissions, such as the International Institute for Environment and Development (IIED); the InterAcademy Council's Panel on Promoting Worldwide Science and Technology Capacities for the 21st Century; the Dow Chemical Company's Corporate Environmental Advisory Council; and the Environmental Advisory Board of the Coca-Cola Company. She is also a trustee of the St. Andrew's Prize and a member of the Editorial Board of the *New Academy Review*. From 1992 to 2002, Marton-Lefèvre was a member of the China Council for International Cooperation in Environment and Development. She has also served on the Oxford Commission on Sustainable Consumption and the Committee on Science and Technology in Developing Countries.

Before joining LEAD in September 1997, Marton-Lefèvre was executive director of the International Council for Science, based in Paris. Other prior positions include program specialist in environmental education under a joint UNESCO-UNEP Program, university teacher in Thailand as a Peace Corps volunteer, and a staff member of the Fund for Education and Peace in New York. Marton-Lefèvre has studied history, ecology and environmental planning in the United States and France, plus co-authored numerous books and papers. In 1999, she received the AAAS Award for International Cooperation in Science. She is a Fellow of the Royal Geographical Society of the United Kingdom.

Ehsan Masood

Journalist

Ehsan Masood is a London-based journalist specializing in science and international development. His work mostly appears in *Nature*, *New Scientist* and Science and Development Network (www.scidev.net)—a news web site reporting on science, technology, and the developing world. He has also written for *The Guardian*, *Le Monde* and *El Pais*.

Masood is a consultant to Leadership for Environment and Development (LEAD); he was previously director of communications at LEAD from 2001 to 2003.

Prior to LEAD, Masood was the opinion editor at *New Scientist*. He also worked as a science reporter for *Nature*, covering environmental sciences, UN environment conventions and international science and technology policy. In the early nineties, Masood was a freelance writer. Masood studied physics at Portsmouth Polytechnic and science communication at Birkbeck College, London. He speaks passable Urdu and less-passable Arabic.

Penelope Mawson

Director of Communications

Leadership for Environment and Development International

Penelope Mawson's responsibilities as director of Communications include designing and producing communication projects to promote sustainable development, and managing internal and external communications by the LEAD Network.

Mawson has a 12-year career as a green communications specialist in both the private sector and the non-profit world. She manages her own communications consultancy, Future Attractions. Her clients have included the British Council, the Commonwealth Institute, UK; the Eden Project, UK; Grameen Bank, Bangladesh; and the Australian Museum, Sydney. She currently has an exhibition, which promotes a poverty-free world around the UK.

Mawson was Interpretation and Communications manager at the Earth Centre in England from 1995 to 1999—the world's largest visitor attraction for sustainable futures. She started her career as a graduate trainee in the communications department for Friends of the Earth. Mawson has an Honors degree in English from the University of Leeds and a Master's degree in environmental and developmental education from South Bank University.

Nick Moon

Co-founder, Managing Director

Appropriate Technologies for Enterprise Creation

Nick Moon co-founded Appropriate Technologies for Enterprise Creation (ApproTEC), a not-for-profit agency that specializes in the development and promotion of technologies and related business development services for Micro & Small Enterprise Growth in sub-Saharan Africa. He recently obtained a MBA degree from University of Durham, UK.

Prior to ApproTEC, Moon was head of the Appropriate Technology Unit at ACTIONAID-Kenya, which is part of ACTIONAID—a British International NGO that works with disadvantaged communities in developing countries. Moon has also spent time working with Voluntary Service Overseas (VSO), in Kakamega, Kenya as deputy manager/technical instructor of the Shamberere Rural Education Program. VSO is a British International NGO that places specialist/professional volunteers at community development and education projects in developing countries.

Moon also co-founded and was managing partner of Buckingham Moon in London, which specialized in woodwork and construction, engaged in high-class joinery and cabinetwork, and restored housing/listed buildings of the Georgian period.

Moon (with ApproTEC co-founder Martin Fisher) won the 2003 AGFUND International Prize for Innovative Initiatives in the Field of Poverty Alleviation, the 2003 Beacon Fellowship Prize for Creative Giving—in recognition of his achievements in social enterprise, the 2003 Schwab Outstanding Social Entrepreneurs Award and the 2003 TIME Europe's: European Hero award. ApproTEC's technologies have won the San Jose Tech Museum Award for Technologies Benefiting Humanity (2002), the Irrigation Association Award (2002), the IDESA (Innovative Designs for East and Southern Africa) award 2003, and ApproTEC micro-irrigation pumps were cited by Newsweek (April 2003) as one of 10 inventions to change the world. ApproTEC's business model has been taught at Harvard and Stanford business schools as an example of best practice in Social Enterprise

Adil Najam

*Associate Professor of International Negotiation and Diplomacy
Fletcher School of Law and Diplomacy, Tufts University*

Adil Najam has a Ph.D., two Masters degrees from Massachusetts Institute of Technology, and a specialization in negotiation from the Program on Negotiation at Harvard Law School. His research focuses on sustainable development, environment and development policy, nongovernmental organizations, and negotiation—all with a particular focus on developing countries.

Najam's recent books include *Civic Entrepreneurship: Civil Society Perspectives on Sustainable Development* (co-authored) and *Environment, Development and Human Security* (editor). He serves on the boards of the Pakistan Institute of Environment-Development Action Research, the Pardee Center for the Study of the Longer-Range Future (Boston University), and the Center for Global Studies (University of Victoria).

Najam is a visiting fellow at the Sustainable Development Policy Institute (Pakistan) and an associate at the International Institute for Sustainable Development (Canada). He also serves on the editorial boards of *Ecological Economics*, *Nonprofit and Voluntary Sector Quarterly*, *Yearbook of Environment and Development Cooperation*, and *Annual Editions: Environment*.

Najam was awarded the Emerging Scholars Award of the Association for Research on Nonprofit and Voluntary Association, the Stein Rokan Award of the International Political Science Association, and the MIT Goodwin Medal for Excellence in Teaching.

Julia Novy-Hildesley

Executive Director

The Lemelson Foundation

Julia Novy-Hildesley is executive director of The Lemelson Foundation, a private family philanthropy founded by Jerome Lemelson, one of the most prolific inventors in U.S. history, and his family. The foundation cultivates and promotes invention and innovation to strengthen and sustain social and economic life in the U.S. and developing countries. Novy-Hildesley was formerly the director of the World Wildlife Fund's California office. She has consulted to the World Bank, USAID and the UK Department for International Development. Additionally, she has conducted research in Tanzania, Bolivia, French Polynesia and Madagascar—as a Fulbright Scholar. She earned a Master's of philosophy degree in international development from Sussex University—funded by a Marshall Scholarship, and graduated Phi Beta Kappa from Stanford University with a Bachelor's degree in human biology and a Minor in African studies. She speaks French, Spanish and Kiswahili.

Anna Richell

Designer and strategist

Design Council

Anna Richell is a designer and strategist who joined the Design Council in April 2003 as a design and innovation manager. The two projects she works on are: Integrating and embedding sustainable thinking in the Design Council, their learning, their projects, and the messages they communicate; also, raising the profile and encouraging the effective use of design in SME's in the UK in order to improve and sustain their business successes. Prior to this Anna worked for Businesslink Wessex as an innovation and technology advisor. She worked closely with inventors and innovators to help them secure funding and commercially exploit ideas in response to market needs. She was also helped to establish a voice for inventors by setting up inventors clubs, and helping plan a National Invention strategy that looked at a process for successfully taking ideas to market. Richell has worked as a product designer on projects for the NHS, the Police, and Dyson. Her degrees are in product design and sustainable design.

Ammon Salter

*Research Fellow, Innovation Studies Centre
The Business School, Imperial College London*

Ammon Salter is a Research Fellow in the Innovation Studies Centre of The Business School, Imperial College London. He completed his doctorate in science and technology policy research (SPRU) at the University of Sussex in 1998. From 1998 to 2002, he worked at SPRU on several government science and technology policy studies, including a review of the economic benefits of basic research for the UK Treasury. He joined Imperial College London in 2003, where he is currently working on a project exploring the management of dispersed project teams in multinational organizations. His research interests include the management of innovation, science and technology policy, and university-industry interaction. He has acted as a consultant for a number of leading industrial organizations such as the European Commission, Universities UK, and the Department of Trade and Industry. He was co-editor of *Science and Innovation*, published by Edward Elgar in 2003, and he has published a number of articles in academic journals, including *Research Policy*, *Cambridge Journal of Economics* and *International Journal of Innovation Management*.

Evan I. Schwartz

Author and Independent Journalist

Evan I. Schwartz received his B.S. in computer science from Union College in 1986. He is an author and journalist who writes about innovation and the impact of technology on business and society. He is currently a contributing writer for MIT's *Technology Review*. A former editor at *Business Week*, he covered software and digital media for the magazine and was part of teams that produced 12 cover stories and won a National Magazine Award and a Computer Press Award. He has also published articles in *The New York Times* and *Wired*.

His forthcoming book, *Juice: The Creative Fuel Driving Today's World-Class Inventors*, is set to be published in the fall of 2004 by the Harvard Business School Press. It juxtaposes stories of classic inventors with those of a new breed of innovators and reveals their critical thinking strategies.

Schwartz' previous book, *The Last Lone Inventor: A Tale of Genius, Deceit, and the Birth of Television* (HarperCollins, 2002) tells the story of television inventor Philo T. Farnsworth and his epic battle against RCA tycoon and NBC founder David Sarnoff. His first book, *Webonomics* (Broadway Books, 1997), anticipated the emergence of the Internet economy. His second book, *Digital Darwinism* (Broadway Books, 1999), anticipated the Darwinian shakeout among the dotcom species. Each was translated into nine languages and named as a finalist for a Computer Press Award for non-fiction book

of the year. He has recently served as an adjunct lecturer at Boston University's College of Communication.

Eugenio Singer

President

ERM Brasil

Eugenio Singer is a board member of ERM Brasil, a world leading environmental consulting company, where he has been the president for more than 10 yrs. Singer is a member of the Semco Group, where he is engaged in the development of new ventures with his partner Ricardo Semler.

A graduate of the UNICAMP School of Civil Engineering, Singer later became an assistant professor there. He is an international consultant on environmental management for the PAHO, CEPAL, and IDB. He has taught courses on environmental assessment in over 20 countries in Latin America and the Caribbean. Singer is also a LEAD Fellow and scientific advisor of FAPESP, FAPEAL, and FINEP. He received his Ph.D. in environmental and water resources engineering from Vanderbilt University, U.S., and his M.Sc. in nuclear engineering from the University of Sao Paulo, Brazil.

Singer founded the Pharos Institute, a non-governmental organization that protects Brazil's coastal region and promotes human development there.

Rory Stear

Founder and Chief Executive Officer

Freeplay Energy Group

Rory Stear began forming his own businesses at 18 years old. Early in his entrepreneurial career, he founded and was managing director of Seeff Corporate Finance, which specialized in mergers and acquisitions in his native South Africa.

In collaboration with Chris Staines, Stear gained control of a wind-up radio technology and founded the international company, Freeplay Energy Group to develop, market and distribute self-sufficient technology products.

Stear was one of the first South Africans invited to join the African Business Roundtable in 1995. In 1996, he was a member of President Nelson Mandela's business delegation to the UK and also traveled with the president during his 1998 visit to the United States.

Stear was a delegate for the Birthing of Giants program for the ongoing development of chief executives, sponsored by Massachusetts Institute of Technology and the Young Entrepreneurs Organization, which he completed in 2000. He is also a member of the Young Presidents Organization's London chapter; the London branch of the Institute of

Directors; and the RAC Club in London. Stear sits on the London board of South Africa's National Business Initiative and is a patron of Emmaus, an organization that provides shelter to the homeless.

In 2000, *Business Week* named him one of the global "Top Entrepreneurs." In August 2000, Stear received the Theodor Herzl award in Jerusalem in recognition of his "impressive vision and tremendous accomplishments." In 2002, he was elected a fellow of the Schwab Foundation for Social Entrepreneurs.

Zhang Lubiao

Professor and Deputy Director-General

Institute of Agricultural Economics of CAAS, China

Lubiao's interests include water policy and institutions; environment and trade; sustainable agriculture; and poverty alleviation. From 1994 to 1999, Lubiao served as visiting professor at the Resource For the Future of USA and Wageningen University of the Netherlands. Lubiao is a consultant of the World Bank, FAO, UNDP, UNEP, WFP, IFAD, WWF, and AFDB. He is an advisor for the MOA and the Ministry of Science & Technology. Concurrently, Lubiao is a consultant and coordinator of the World Bank for the Shanghai Conference on Scaling up Poverty Reduction May 25-27 2004.

Lubiao won the Robert S. McNamara Fellowship of the World Bank Institute and the Walter O. Spofford Jr. Internship of RFF (1999-2001). To date, he has published more than 100 papers and reports, plus four books on water policy, institutions, and sustainable rural development in China. Lubiao received his Ph.D. in agricultural and resource economics at Nanjing Agricultural University, and received extensive overseas trainings by the World Bank Institute, EEPSEA, and Winrock International. Lubiao is a LEAD Fellow.
