

bridging the gender divide*



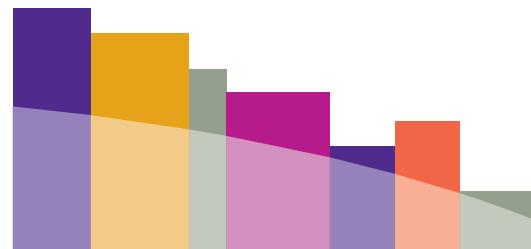
HOW TECHNOLOGY CAN ADVANCE WOMEN ECONOMICALLY

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THE INTERNATIONAL CENTER
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acknowledgments

ICRW gratefully acknowledges the ExxonMobil Foundation for its generous support of this research. The authors would like to thank internal advisors at ICRW—Anju Malhotra, Rekha Mehra, Jennifer Schulte, Sandy Won, and Jeannie Bunton—for their efforts to inform our thinking on economic advancement and women. We also appreciate the input of our partners in the Women’s Economic Opportunity Initiative—Lorie Jackson of ExxonMobil, Jennifer Silberman of APCO Worldwide, Yolonda Richardson of Richardson Consulting, and Karin Hillhouse of Ashoka’s Changemakers—in helping to shape the vision for this paper throughout its development. Our external advisors from the development research community who regularly work on the issues of women and technology—including Joy Clancy, Sonia Jorge, and Gail Karlsson—were also extremely helpful, providing insights about realities on the ground. We would also like to thank several development organizations that provided us with information about their technology interventions for women including KickStart, the United Nations Development Programme, and International Development Enterprises (India). Lastly, we thank our editor, Bruce Ross-Larson and our graphic designer, Carole Goodman, for their help in streamlining the paper and making its content so appealing.

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Technology defines our era. In the past few decades, numerous innovations—including ever-shrinking computers, mobile phones, and alternative energies—have been introduced in homes and workplaces, changing the way we live, how we work, and what we're able to do. *Bridging the Gender Divide: How Technology Can Advance Women Economically* examines why technology is essential to women's economic advancement and clarifies how it puts the process in motion by showcasing technologies that have helped women in developing countries to increase their productivity, create new entrepreneurial ventures, or otherwise access new income-generating pursuits.

This paper builds on ICRW's long-standing research and program work on the realities of what it takes to enable women to increase their resources and economic opportunities, and strengthen their ability to compete in market economies. Most important, it speaks to the growing number of actors driving innovation from the public, private, and social sectors with practical recommendations on how to improve the way technologies are developed and deployed so they benefit women and enable them to be more successful economic actors, stronger leaders, and greater contributors to their families, communities, and domestic economies.

WHY WOMEN'S ECONOMIC ADVANCEMENT MATTERS

The potential to advance women economically may be the most exciting transformative feature of technology. Empowering women and improving the efficiency of their work is critical for reducing poverty. Mounting evidence confirms that women's improved economic status produces many positive economic and welfare outcomes for children, families, and societies:

- Countries with less inequality in men's and women's employment and education benefit from lower child mortality, as well as more transparent businesses and faster economic growth.¹
- Women's ability to access income, technology, and paid work improves their children's welfare more than men's access to similar resources.²
- A mother's social and economic status is considered one of the best indicators of whether her children will complete their education and enjoy healthy, poverty-free adulthoods.³

- Increases in household income, particularly income controlled by women, correlate with a boost in children's nutrition and survival.⁴
- Women with higher earning potential and education tend to vaccinate their children at roughly twice the rate of women with lower education and earning potential.⁵
- Globally, children whose mothers enjoy higher earning potential and education go on to complete more education than children whose mothers have less schooling.⁶

Women's economic advancement also promotes overall economic growth. Studies from Burkina Faso, Cameroon, and Kenya demonstrate that increasing women's control over household inputs and farm income could boost farm yields by up to 20 percent.⁷ Simulations from Latin America suggest that eliminating occupational and wage discrimination against women could lead to a 9 percent increase in gross domestic product (GDP).⁸ And a recent World Bank study of India's rapid growth found that states with higher female labor market participation rates enjoyed greater poverty reduction.⁹

The implication of this evidence is simple: Investing in women can transform the trajectory for children and families and can lead to widespread economic growth.

WHY TECHNOLOGY MATTERS

Technology also is an engine for economic growth. Technological capability is one of the five categories for the Growth Environment Scores (GES), Goldman Sachs' composite indicator of the economic growth environment in 181 countries. A GES study of countries in the Persian Gulf shows that technology is so critical to growth and economic well-being, that if lags in technology use were addressed, along with low levels of investment and human resource development, the region could effectively close its income gap with the G-7 countries by 2050.¹⁰

Strong links also have been made between use of specific technologies and growth. For example, evidence indicates that economic growth in Malaysia and Thailand between 1995 and 2000 would have been negative without investments in information and communication technology (ICT).¹¹ It is also estimated that an increase of 10 mobile phones per 100 people boosts GDP growth by 0.6 percent.¹²

THE GENDER AND TECHNOLOGY DIVIDE

Improving women's access to technology has the potential to spur their economic advancement and stimulate broader economic growth. Regrettably, technology has been underused in unlocking women's economic opportunities. The gender divide is evident in both traditional and modern technologies. Despite the fact that most low-income women in developing countries are primarily employed in agriculture,¹³ a large literature shows that men have been the primary adopters and shapers of agricultural technologies in developing countries, and agricultural innovations have been designed specifically for men's use.¹⁴ Animal-drawn ploughs, for instance, were developed to pursue men's work in clearing farmland, and are too heavy for women to push or have handles that women can't reach.¹⁵ As a result, women continue to use traditional, more labor-intensive methods, undermining their agricultural productivity.¹⁶

For modern technology the divide is just as significant but is poorly documented. Sex-disaggregated statistics on technology use are generally not available since the private companies that provide technology services do not make their data public, and many governments do not routinely collect national statistics on technology, if at all. Nevertheless, the existing fact base paints a consistent picture. Generally, the gender divide in digital technology is larger in low- and middle-income countries, though it exists in both developed and developing countries.¹⁷ For example, in OECD countries, there is a gap of 40–60 percent between men and women's presence in ICT-using occupations.¹⁸ In most developing countries, women lag behind men in using the Internet, mobile phones, and radios.¹⁹ For example, women are estimated to be just 25 percent or less of Internet users in Africa,²⁰ 22 percent in Asia, 38 percent in Latin America, and a mere 6 percent in the Middle East.²¹ Even in rapidly developing countries, women still trail men in access to mobile phones, as in the Czech Republic, where only 60 percent of women had access to mobile phones in 2003, compared with 72 percent of men.²² Radio—a basic source of information for most families in developing countries—also disproportionately benefits men. In Ethiopia, for example, 11 percent of women listen to radio at least once a week, slightly less than half of the 24 percent of men who do so.²³ Globally, while many women use computers—mainly for data entry purposes—far fewer work in computer programming, or in designing computer software and hardware.²⁴ The limited data available on women's participation in computer science and engineering jobs around the world indicate that women are sorely under-represented in higher-skilled and higher-prestige positions.²⁵ Lacking access to critical information and professional opportunities, women miss out on possibilities to increase their productivity and strengthen their economic participation.

Women in developing countries also are deprived of the basic benefits of technology, such as efficient household energy for cooking, heating, and lighting, as well as for home-based agricultural and industrial activities. The rural poor, the majority of whom are women, largely only have access to fuels that are inefficient in converting to energy.²⁶ Thus, poor rural women disproportionately lack access to clean, efficient, reliable, safe, and affordable energy service options.²⁷

Disparities notwithstanding, the global economy and its accompanying rapid technological innovations create a tremendous opportunity to bridge the gender and technology divide and leverage the benefits of technology to propel the economic advancement of lower and middle income women in developing countries.

BRIDGING THE DIVIDE

Bridging the gender and technology divide requires two main shifts:

- First, we need to focus our innovation efforts on sectors, such as energy and information and communication technologies (ICTs), which can convey rapid and significant benefits to women in developing countries. Like education, health, water, and agriculture—sectors that are widely recognized for their positive impacts on women and their families—energy and ICTs are particularly promising because they have the potential to benefit all women, regardless of their primary occupation, while often profiting their families and communities. For example,

an alternative household power source (the multifunctional platform) provides energy that lengthens the productive work day for women and other members of the home where it is installed. ICTs, including mobile phones and computers with Internet connections, have allowed women to develop new careers as village phone owners while also giving communities access to these services. Focusing on these two sectors would concentrate technology development efforts in a way that could be particularly beneficial for women in developing countries.

- Second, we need to radically rethink the lifecycle for developing and deploying new and existing technologies. Rather than allow enthusiasm for a given technology to drive how it is designed, marketed, and distributed in the field, developers need to put female users at the center of their thinking, consulting and involving women at critical design and deployment phases. Rather than creating a technology and only then figuring out how to entice women in developing countries to adopt it, developers must first ask: “What technologies do women need to increase their economic opportunities?” And then they must involve women—as technology innovators, developers, and drivers of the process—to design something that women can’t afford *not* to use.

An in-depth look at successful cases of technology interventions for women’s economic advancement reveals one common strategy: Each involved women in at least one phase in the technology lifecycle. Including women and their needs and perspectives increased the likelihood that women would have greater access to the technology and actually use it (figure 1). The eight phases in the technology lifecycle include:

- Identifying the problem the technology will help solve.
- Designing the technology to meet the needs of potential users.
- Researching the market to test and increase use by target populations.
- Introducing mechanisms to address barriers to access.
- Training users to operate, repair, and maintain the technology.
- Supplying and distributing the technology to ensure access.
- Creating and maintaining market linkages for women’s technology-generated goods and services.
- Assessing and evaluating the entire process to gauge and strengthen each phase of technology development.

Focusing on the lifecycle alone will not necessarily improve women’s ability to access technology. Attention must also be paid to the barriers that have traditionally contributed to the technology and gender divide:

- Women in developing countries do not receive the basic education and training needed to be ready technology adopters and are often seen only as “users” or “receivers” of technology, rather than as innovators involved in technology design and development.
- Their domestic chores and multiple roles as caregivers as well as economic actors mean they have little free time to explore and experiment with new technologies.
- They are constrained by social norms that confer control over much technology to men.
- Because of financial and institutional barriers, they lack the means to use, rent, or purchase established and new technologies that could help them advance economically.

FIGURE 1: Technology lifecycle

These barriers are surmountable. Indeed, our research shows that technologies supporting women's economic advancement often do so by addressing (directly or indirectly) one or more of these barriers in a way that creates an enabling environment for women to access and use technology.

Involving women in the technology development lifecycle can set off a positive chain reaction that enables women to use the technology to enhance their economic activity—by improving their productivity in current activities or allowing them to take advantage of other income-generating opportunities. They then have more access to income and other resources, as well as the skills and self-confidence to advocate for themselves. They use their newfound resources and abilities in ways that confer broad social benefits—such as better health and education for their children—by improving the economic conditions of their families and communities.

OVERVIEW OF THE PAPER

This paper looks at ways technology has facilitated the economic advancement of poorer women in developing countries and explores what needs to happen to trigger wider economic advancement. The paper begins by introducing a conceptual framework that shows how integrating the needs of women to the technology development lifecycle can trigger a chain

of events that leads to economic advancement and, eventually, to wider social and economic benefits. Next, it uses data from a literature review, in-depth case studies, and interviews with experts in the field to examine the lessons of technologies introduced in the past and discusses the common characteristics and effective strategies of successful initiatives. It closes with specific recommendations on better ways to develop, introduce, and disseminate technologies—both new and already existing—that could help low- and middle-income women worldwide, particularly in developing countries, to advance economically. While the paper and the recommendations focus on the level of technology initiatives, the conclusion also includes an overview of complementary policy-level recommendations.

Women's **ECONOMIC ADVANCEMENT** has three components:

- **Economic decision-making:** women have the power to make and act on economic decisions.
- **Economic efficacy and self-confidence:** women have a personal sense of worth and the ability to perform in the economic sphere.
- **Access to economic resources,** which include:
 - **Assets:** women have income, property, savings, and financial capital to work productively and foster well-being.
 - **Capacity:** women have the education and skills to get jobs or prosper in business.
 - **Opportunity:** women have access to credit, property, financial, labor, and commercial markets.
 - **Environment:** women have legal and social environments that support their economic participation and success.

TECHNOLOGIES are human-made artifacts and processes for enhancing human capabilities. This paper focuses on:

- **"Hard" technologies:** tangible machines, hardware, or utensils that can be touched.
- **"Soft" technologies:** Internet access and telecommunication devices that facilitate the flow of information and knowledge.

Because of limited space, this paper focuses on technologies most directly related to the economic and business sphere and does not include biotechnologies and medical devices.

The women we focus on include **LOWER- AND MIDDLE-INCOME WOMEN IN DEVELOPING COUNTRIES, PARTICULARLY THOSE IN RURAL AREAS.** These women tend to be:

- The main suppliers of agricultural labor.
- More likely than men to be engaged in informal employment with little job security or benefits.
- Disproportionately responsible for unpaid labor benefitting the household, including caretaking of elders, children, and others.
- Far less literate than men.



1. BARRIERS AND WAYS TO OVERCOME THEM

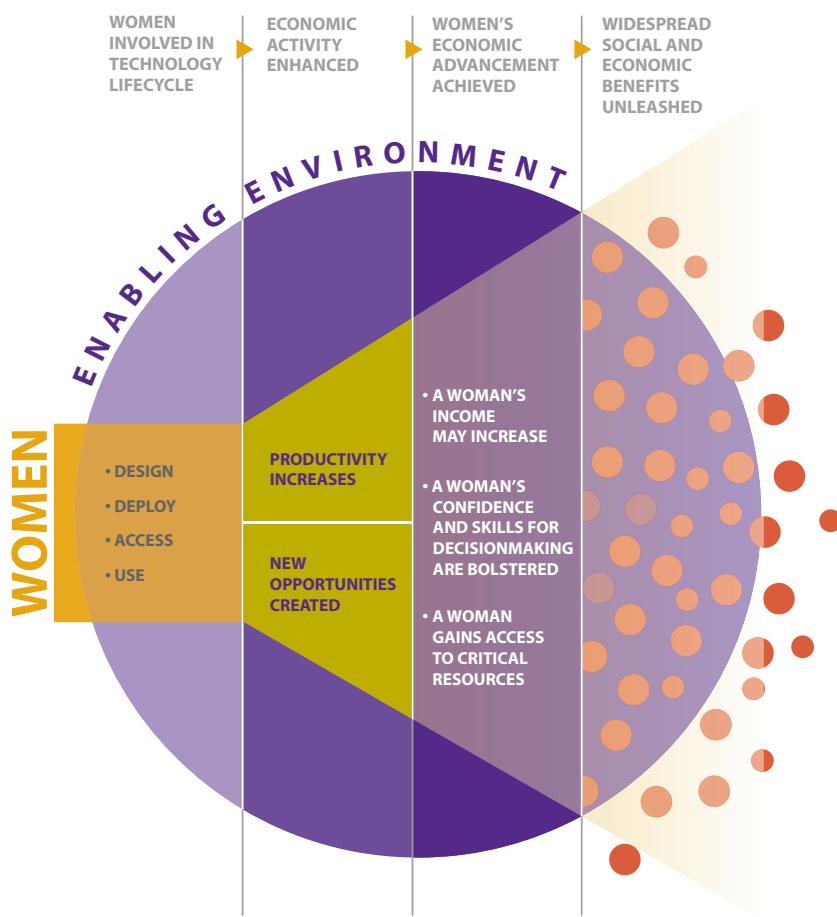
Four barriers can hinder women's access to and use of technologies:

- **Exclusion from technology education and design.** Not only do men overwhelmingly constitute the users of diverse types of technologies worldwide, but they also dominate the innovation process as developers, creators, and designers.²⁸ Women are often seen only as "users" or "receivers" of technology, not as innovators,²⁹ and are underrepresented in higher education programs in science, technology, and engineering.³⁰ This is partly because women don't have the basic educational foundation for a successful scientific career. Although global gender inequalities in primary and secondary education attendance as a whole have shrunk in recent years, women still make up the majority of the illiterate worldwide.³¹ And many women in developing countries lack the education and skills to access and effectively use technologies, much less build a career around them.³²
- **Little free time.** Across developing countries, women bear a disproportionate burden of household and family responsibilities, such as cooking, cleaning, and fetching fuel or water, as well as child and elder care. These tasks are time- and labor-intensive, leading rural women in some areas to spend from 1 to 5 hours a day gathering biomass for fuel³³ and about 1.6 hours a day just collecting water in the dry season.³⁴ This heavy burden of unpaid household responsibilities often leads to "time poverty," the absence of discretionary time women can dedicate to personal interests, paid labor, education, or other endeavors. Among those endeavors is learning skills that would allow them to adopt new technologies to improve their productivity or start a small business.³⁵
- **Social norms favoring men.** Throughout the world, technologies are often considered to be within the purview of men.³⁶ Gender norms about men's control of technology, information, and knowledge limit women's opportunities to learn, use, and benefit from technologies.³⁷ At home, husbands might regulate the family radio, mobile phone, or television, controlling when and how other family members use them. At work, men may determine that operating a plow or a computer is not something women should be allowed to learn. Even technology programs that target women can be co-opted by men once their utility and profitability are established—so women who do gain access to a technology do not see the economic benefits associated with it.³⁸
- **Financial and institutional constraints.** Women tend to lack the financial resources to use, rent, or purchase established and new technologies.³⁹ For example, telecenters often provide the only Internet or computer access available in a community but charge a fee that few lower income women can afford.⁴⁰ One of the main reasons women lack access to capital is that laws, policies, and social customs often favor men's ownership of assets. Inheritance laws and social customs in many developing countries prohibit women from owning property, limiting their ability to take out loans that require collateral for large technology purchases.⁴¹ So, would-be women entrepreneurs cannot set up their small businesses. Nor can they buy computers or mechanical equipment that would aid in their work or allow them to train others. This inability to borrow leads to a vicious circle: women cannot develop their skills, which prevents them from earning higher incomes, so they cannot afford the technologies that might boost them to the next rung on the economic ladder.

These barriers, though formidable, are surmountable. Indeed, our research shows that technologies supporting women's economic advancement often do so by addressing (directly or indirectly) one or more barriers in a way that creates an enabling environment for women to access and use technology.

How does technology help women advance economically? The conceptual framework in figure 2 shows the major pathways for technology to increase women's ability to participate in economic activity, facilitate their economic advancement, and in time bestow significant social and economic benefits. Based on findings from literature on women's advancement and technological innovations affecting women, this framework provides a theoretical grounding for why and how technology might be connected to women's economic advancement. The examples of technologies and their impacts on women, discussed in the rest of the paper, test these theoretical connections.

FIGURE 2: How technology can facilitate the economic advancement of women



When women are involved in the development and deployment lifecycle of a particular technology, a positive chain reaction is initiated. Women are considered and directly consulted at critical milestones marking the path from conception to deployment in the field. Women's needs are taken into account at the design phase, and the product is customized accordingly. Special efforts provide women with access to the technology, such as distributing it in the home rather than at a marketplace to which some women may have difficulty traveling. Microloans make it easier for women to buy the technology. And training programs show women how to use and repair the technology to sustain its use.

Assuming this involvement takes place, women are able to use a given piece of technology in a way that enhances their economic activity—either improving their productivity in a position already held or creating new positions and entrepreneurial opportunities. These developments trigger the hallmarks of women's economic advancement: more income is directed to women; their economic decision-making and efficacy at home and in the workplace improves; and they gain access to other assets and financial resources that increase their ability to care for themselves. Having advanced economically, women then use their newfound resources to confer broad social benefits—such as better health and education for their children—by improving the economic conditions for a community.

Put simply, two symbiotic processes define the link between technology and women's economic advancement. First, incorporating women into the technology development lifecycle ensures that they get *access* to the technology. Second, women advance economically when they *use* the technology and leverage its advantages in their everyday lives.

In the next section, we profile several technologies, demonstrating how they successfully facilitated the paths to economic advancement outlined in the conceptual framework. The profiles examine the social and institutional barriers each technology had to overcome to create the enabling environment for women's economic advancement, laying the ground for the chain reaction.

2. WHAT MAKES A TECHNOLOGY HELP WOMEN ADVANCE ECONOMICALLY?

A review of the literature on technologies used by women in the developing world yielded two critical findings. First, fact-based information about the impact of technology on women is scarce. But second, some promising success stories can be assembled and analyzed to draw broad observations about what enables some technologies to be embraced and applied by women in a manner that advances them economically.

Nine technologies captured our attention. The process to develop and deploy them integrated women in ways that recognized them as more than end users. And the results available indicated that applying the technology enabled female users to increase productivity, pursue new entrepreneurial opportunities or skills, or otherwise improve their economic opportunities. Successful technology examples clustered in the energy and ICT sectors, reflecting recent trends in innovation and the great need for energy and information in developing countries. Modest innovations in these sectors make significant contributions to women's economic advancement because they have the potential to benefit all women and often have advantages for their families and communities as well:

- **Improved fuel-efficient cookstoves**, such as the Upesi stove in Kenya, reduced the time rural women spend on household cooking tasks.
- **Motorized scooters** provided large numbers of urban women in countries such as China, India, Malaysia, and Thailand with a safer and more reliable mode of transportation, making it easier for them to access employment and educational opportunities.
- **Alternative household power (aka multifunctional platforms)**, which uses diesel engines to power food processing and carpentry tools, increased the productivity of women's domestic and income-generating activity.
- **ICT educational academies**, such as those promoted by Cisco Systems and UNIFEM in the Middle East, trained women in technical and career skills to enter and compete in the high-skilled ICT labor force.
- **Treadle water pumps** enabled women farmers to irrigate small plots from underground or surface water sources and, in turn, to increase their harvests and incomes.
- **Solar dryers to process fruits and vegetables**, such as those used by rural women's groups in Uganda, increased the efficiency of processing dried fruits for export.
- **Village mobile phones** facilitated women's roles as entrepreneurs who operate businesses that require communications services or who even own the pay phone center serving a community.
- **Outsourced ICT services** in Asian countries such as India, China, and the Philippines generated many new employment opportunities for women.
- **ICT telecenters and kiosks** provided relatively affordable means of accessing vital business skills and market information relevant to women's income-generating activity, so that women could start small businesses.

Although these nine successful technologies affected women's lives in different ways, they shared common features:

- They promoted women's economic advancement through one or more pathways, meaning that they may have helped to both increase productivity and provide a new employment opportunity, rather than one or the other.
- They were introduced in a way that addressed the barriers to women's involvement—working around social norms, providing access to capital, accommodating time constraints, or including women in the technology development or deployment process.
- They reached women through effective distribution channels, such as grassroots women's cooperatives, where women were prepared to receive new information and could often apply it immediately.
- The more successful technologies could also be scaled up to reach large numbers of women through affordable and feasible channels to facilitate broad distribution.

Figure 3 shows how the nine successful technologies performed against the barriers and pathways identified in the conceptual framework. Each enabled women to move along the pathways identified in our conceptual framework, overcoming at least one barrier to women's access and use of technologies. Many technologies helped women increase their productivity. And all increased women's employment and entrepreneurship opportunities.

While several technologies overcame the barrier of time and involved women in the design process, more improved women's enabling environment by addressing economic and institutional constraints. All addressed social norms. These findings suggest that improving women's productivity and increasing opportunities for women may be important components of technology initiatives that successfully put women in developing countries on a higher trajectory toward economic advancement.

It is worth noting that the technologies we examine here are almost all project-based interventions carried out by nonprofit organizations or development agencies, rather than market-based interventions by private sector actors. This focus is likely to result from more documentation of project-based interventions in the development literature. Despite this skewed sample, since many project-based interventions have links to the market and private sector partnerships, market-based interventions aren't entirely excluded. In fact, the lessons we focus on here relate to both market-based and project-based interventions and are intended for both nonprofit and for-profit audiences. Indeed, because their approaches can be complementary, both are needed to bring technologies to lower- and middle-income women. Project-based interventions are often designed to reach marginal groups that might otherwise be neglected by the market—and are thus particularly effective for reaching women in lower economic strata. Market-based interventions, by contrast, are usually targeted at the large middle class and are particularly effective in increasing the reach and scale of interventions.

There also can be synergies between market-based and project-based approaches for the same intervention. For example, the Grameen Village Phone program brought a market-driven technology to rural women using a project-based intervention. And cookstoves, multifunctional platforms, and water pumps, while initiated by nonprofit organizations or development agencies, all aimed to create market-driven supply chains to deploy technologies to low-income women.

The next section of this paper examines in-depth case studies of these technology interventions to understand the strategies they used, the synergies between various actors, and the lessons future technology developers can apply from their efforts.

FIGURE 3: Technologies that successfully advanced women economically

		TECHNOLOGY	HOW DOES IT WORK?	PATHWAYS TO ECONOMIC EMPOWERMENT				BARRIERS ADDRESSED	
				PRODUCTIVITY	MARKET OPPORTUNITY	TIME	NORMS	ECONOMIC CONSTRAINTS	TECH DESIGN
ENERGY	Upesi Cookstoves	Energy-efficient stove with lower smoke emissions	✓ ✓ ✓ ✓ ✓ ✓						
	Solar Dryers	Dryer chamber to dry fruits and vegetables	✓ ✓ ✓ ✓ ✓ ✓						
	Multifunctional Platforms	Diesel engine plus tool attachments, like battery charger, grinding mill, etc.	✓ ✓ ✓ ✓ ✓ ✓						
	Treadle Water Pumps	Foot-pedaled water pumps to irrigate small land plots	✓ ✓ ✓ ✓ ✓ ✓						
TRANSPORTATION	Motor Scooters	Simple two-wheeler that urban women use to travel to work and school	✓ ✓ ✓ ✓ ✓ ✓						
INFORMATION AND COMMUNICATION	Village Mobile Phones	Women entrepreneurs sell mobile phone usage to other women and men	✓ ✓ ✓ ✓ ✓ ✓						
	Outsourced ICT Services	Outsourced IT jobs, such as medical transcription and software support	✓ ✓ ✓ ✓ ✓ ✓						
	ICT Telecenters	Fee-based ICT products and services at community center	✓ ✓ ✓ ✓ ✓ ✓						
	ICT Academies	High-skilled IT training for women in national universities	✓ ✓ ✓ ✓ ✓ ✓						

3. LIFECYCLE OF SUCCESSFUL TECHNOLOGIES

An in-depth look at successful cases of technology intervention for women's economic advancement reveals one common strategy employed: Each involved women in at least one (and often *more*) of the eight phases in the technology development and deployment lifecycle—thereby ensuring women's greater access to and use of the technology (figure 1). Besides considering women's needs at a particular phase in the technology lifecycle, in most cases these initiatives actively engaged women in the process, resolving the specific issues related to that phase. They thus helped create the conditions for women to become part of the solution to their problems.

The phases of the technology lifecycle⁴² include:

- Identifying the problem the technology will help solve.
- Designing the technology to meet the needs of potential users.
- Researching the market to test and increase use by target populations.
- Introducing mechanisms to address barriers to access.
- Training users to operate, repair, and maintain the technology.
- Supplying and distributing the technology to ensure access.
- Creating and maintaining market linkages for women's technology-generated goods and services.
- Assessing and evaluating the entire process to gauge and strengthen each phase of technology development.

FIGURE 1: Technology lifecycle



PHASES 1 AND 2: PROBLEM IDENTIFICATION AND TECHNOLOGY DESIGN

UPESI RURAL COOKSTOVES

All too often, women in developing countries have not benefited from technologies as much as men because they were not part of the design process. Nowhere is this more evident than for cookstoves.

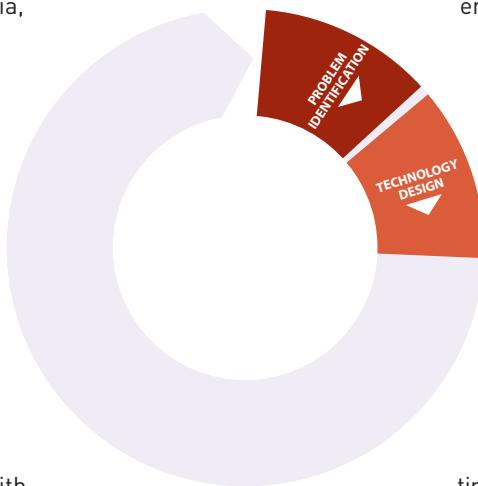
Beginning in the 1950s development and environmental policymakers became increasingly concerned with forest depletion and the fuelwood consumed for cooking by rural households in Asia, Latin America, and Sub-Saharan Africa. To address this problem, governments and international agencies established design teams—almost entirely male—to develop stove technologies to reduce fuelwood consumption and increase the energy efficiency of household cooking. They promoted these stoves widely for more than five decades. But most women and their husbands saw few benefits beyond saving fuelwood and did not purchase them.⁴³ Years later, consultations with women revealed that they preferred stoves that saved cooking time, still provided household space heating, were durable, matched local cooking styles, preserved traditional food taste and quality, and were sized so they could cook without standing for hours.⁴⁴ The early fuel-efficient stoves met few of these criteria and so were not adopted by many rural households.

In the late 1980s the Kenya Ministry of Energy and the German Agency for Technical Cooperation identified the need to address ongoing fuelwood shortages, as well as the negative health impacts of wood-burning stoves on

rural women and their families. In contrast to most early improved-stove interventions, these agencies worked with rural women to help design the clay and ceramic Upesi cookstove.

A few years later, an international nongovernmental organization (NGO), the Intermediate Technology Development Group, worked with a Kenyan environmental NGO to creatively scale up the production and distribution of the Upesi stove by engaging with rural women's groups that worked in agriculture and pottery-making. The project implementers consulted with the women about their needs, field-tested prototype stoves (including the Upesi) with them, and integrated them not only as users but also as producers of the stoves. That made it possible to scale up the Upesi stove, which reduced fuelwood consumption while also saving women's time and minimizing indoor smoke.

The Upesi stove has now been introduced throughout Kenya, with more than 16,000 units sold. Women consumers saved time in performing cooking-related tasks, giving them the opportunity to increase their productivity and take on additional income-generating activity.⁴⁵ Female producers and retailers of the stove have benefited directly from this income-generating activity and enjoy larger and more diversified incomes. For both groups of women, the increased productivity and entrepreneurial opportunities have increased their confidence, social status, economic agency, and access to resources.⁴⁶



LESSONS: The Upesi cookstove could have followed the trajectory of earlier stove development projects, but with women's involvement in the design and explicit attention to women's needs, the four partner organizations created a technology that simultaneously reduced fuelwood consumption and appealed to women. They show how important it is to engage with women before developing a technology to truly understand their needs and then incorporate those needs into the design process. Without such customization, new technologies risk not being adopted by women.

PHASE 3: MARKET RESEARCH

MOTORIZED SCOOTERS

After technologies have been piloted and sold to an early set of women users, technology developers and marketers may later realize that additional modifications are needed to ensure that the technologies better meet women's preferences and needs or are deployed in ways that more effectively reach women.

Over the past decade or so, middle income urban women in several Asian countries, such as China, India, Malaysia, and Thailand, have been using two-wheeled motorized scooters for personal transportation. Private automobile companies had earlier realized that, by modifying traditional motorcycles to make light-weight, easy-to-use and more affordable scooters, they could target a large consumer group that included young people, the elderly, and women.

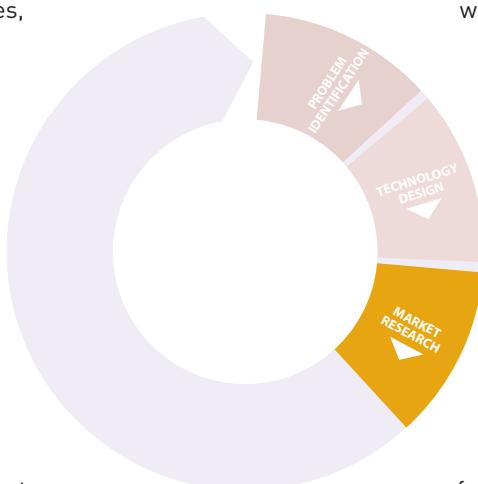
In India, automobile companies manufacturing scooters conducted market research tracking their sales figures to different demographics of customers. They found that in recent years women in India purchased approximately 480,000 scooters annually and were 60 percent of scooter customers.⁴⁷ Such market research led several scooter companies, including Hero Honda and Kinetic

Motors, to invest further in designing scooters and targeting strategies to attract larger numbers of urban, middle income female customers.⁴⁸

For example, in recent years these companies have designed newer scooter models in bright, vibrant colors believed to be more appealing to younger women.

They now have scooter sales showrooms for women in major cities across India. Staffed only by female salespersons, the showrooms create a comfortable environment for women to seek more information about scooters and to purchase them.

Since the mid-1990s women's use of scooters in India has facilitated the entry of urban, educated women into the expanding information technology occupations by providing them with a reliable, faster, and safer way to commute.⁴⁹ It has also made it easier for young women to travel to more distant areas to pursue university education and access other formal employment opportunities. Similarly, in other East Asian countries women's scooter use saves time in both household and market work, thus increasing their productivity and their ability to seek broader and more gainful employment opportunities.



LESSONS: By conducting market research of women's recent purchase and use of scooters, Indian automobile companies have been able to not only take advantage of a growing market segment for their product but also design a more appealing and affordable transport technology tailored to the preferences of middle income urban women. They have also determined that it is profitable to invest in pursuing more effective deployment strategies to reach this set of women.

PHASE 4: TECHNOLOGY INTRODUCTION

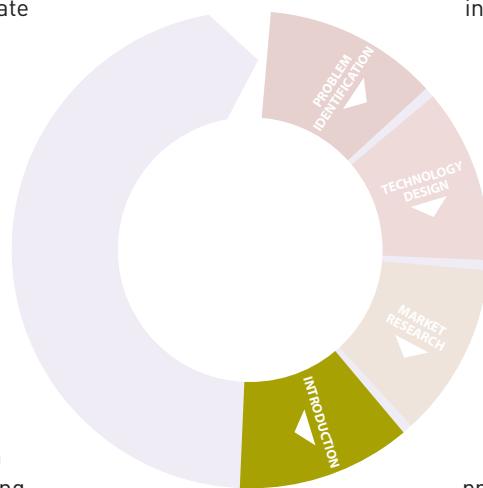
ALTERNATIVE HOUSEHOLD POWER (AKA “MULTIFUNCTIONAL PLATFORMS”)

Women’s limited financial resources often constrain their ability to access technologies that can contribute to strengthening their economic activities.

To improve women’s access to energy services in Mali, the United Nations Development Programme (UNDP) and the United Nations Industrial Organization (UNIDO) worked with the Malian Ministry of Women and Children, and local NGOs in the late 1990s to introduce an energy technology called the multifunctional platform (MFP) in rural areas. The MFP is based on a stationary diesel engine designed by an Indian manufacturer, which runs on diesel, bio-diesel or vegetable oil, and powers mechanized tools such as cereal grinding mills, oil presses, and carpentry equipment. It can also provide electricity for water pumps or a small lighting grid—dramatically increasing the energy available in a home. The simple addition of lighting, for example, allows households to be productive at night.

The project implementers first identified rural women’s associations in Mali that were interested in acquiring the MFPs and then ensured that these women became the owners of the technology. Most important, UNDP made the platform affordable by subsidizing about 50–60 percent of the up-front cost, while women users pooled their capital to finance the remainder.⁵⁰ While the project also aimed to promote the sustainability of the platform’s manufacture and distribution by cultivating a local demand-driven supply chain, the initial financial subsidy ensured that women’s groups could access and own the energy

technology early on. Also critical to women’s success in accessing, owning, and using the platforms was how the project overcame traditional social norms by gaining the support of male village leaders, who then advocated for women’s control over and use of the technology to strengthen their economic activities.⁵¹



In the first year 149 platforms were installed in Mali, with 500 to 1,000 clients, mainly women, paying to use them.⁵² As of early 2009 approximately 750 MFPs were operating in Mali, and several hundred more had been introduced in other West African countries, including Burkina Faso, Ghana, Guinea, and Senegal.⁵³

Evaluations indicate that women using the technology substantially increased their productivity in performing labor-intensive household chores and economic work, enabling them to increase their production of shea butter and other market products.⁵⁴ Some women also marketed the MFP energy services to other community members.⁵⁵ As a result, women users of the technology increased their incomes, sometimes by as much as 300 percent.⁵⁶

Women’s economic gains enabled them to play a greater role in community decision making processes, and also contributed to improving their families’ livelihoods. And their sale of energy services helped to increase the productivity of other village microenterprises, as well as broadly promote the diversification of economic activities within their communities.⁵⁷ Over time, many women users of the platforms came to be regarded in a new light: as effective technology users and owners for enterprise work.⁵⁸

LESSONS: By helping women’s groups to overcome the initial financial barrier impeding their ability to access technology, the UNDP-led project enabled women to benefit from a critical energy service to catalyze their own economic activity, as well as that of their communities. This example shows that, in addition to making the technology, developers have to think about overcoming the barriers to women’s access to and use of it—in this case, making it affordable. Partnerships between agencies with differing abilities to reach women, cultivate demand, or provide wraparound services may be one way to enhance sustainability.

PHASE 5: TRAINING

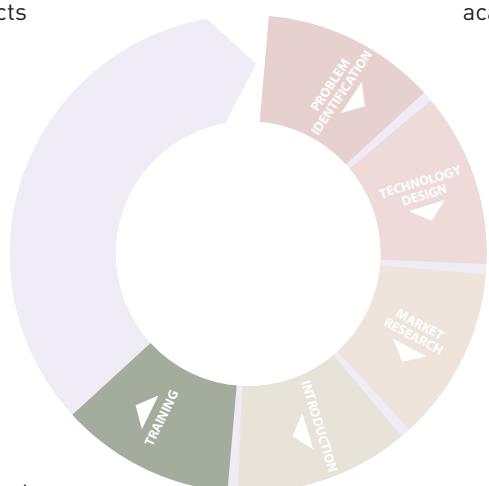
INFORMATION AND COMMUNICATION TECHNOLOGY (ICT) ACADEMIES

Technologies, particularly those in the global ICT revolution, give women many opportunities for economic advancement. But without the skills to use the technologies, women can remain on the lowest levels of the economic ladder. Even in Bangalore, India, where the ICT sector has transformed economic conditions, women continue to work in menial rather than career-enhancing jobs.

Women's overrepresentation in low-paying, low-opportunity jobs not only detracts from their economic advancement, it also constrains the productivity of businesses and slows economic growth—because markets cannot efficiently elevate talent to positions of higher responsibility, whether male or female.

To address women's underrepresentation in high-skilled ICT occupations, Cisco Systems launched a training initiative to provide women with the skills to use ICTs. In partnership with the Cisco Foundation, United Nations Development

Fund for Women, and national governments throughout the Middle East, the *Achieving E-Quality in the IT Sector* initiative trained women at universities in Egypt, Jordan, and Lebanon to design, build, and maintain computer networks and other ICT applications. Coupled with training for women in networking, interpersonal skills, and career planning, as well as job placement programs that linked graduates with ICT employers, the academies give women a competitive edge in the high-skilled ICT labor force.⁶⁰



Achieving E-Quality in the IT Sector has trained more than 2,500 students, 55 percent of them female, in three countries. Hundreds of female graduates have entered new formal employment in their national ICT workforce.⁶¹ Through their formal employment, women have new opportunities to earn greater incomes and enjoy higher trajectory careers, contributing to their families and communities.

LESSONS: By engaging women in a creative training process to build their skills in ICT operation, installation, and maintenance, Cisco Systems and its partners helped women to enter the ICT workforce on more equal footing with men, not only for women's own benefit but also to promote positive economic growth among businesses and national economies in the long term. This example illustrates the importance of ensuring that women receive training that is accessible, both in cost and in the time of day or season when it is offered. For a new technology to proliferate, women and men must learn how to use it—and how to apply that knowledge to increase economic opportunity.

PHASE 6: SUPPLY AND DISTRIBUTION

TREADLE WATER PUMPS

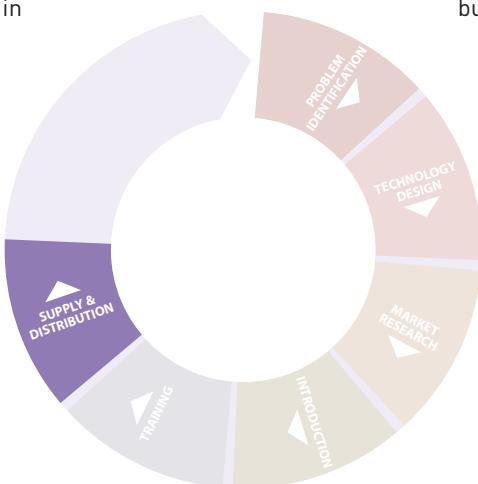
Technologies can be powerful tools for women's economic advancement. But only if they reach scale will they be able to promote wider benefits such as higher economic growth and poverty reduction.

To help poor farmers in developing countries improve their crop production through irrigation technology, an American engineer in Bangladesh designed a treadle micro-irrigation water pump in 1985. In subsequent years, the non-profit organization International Development Enterprises (IDE) designed various other models of the foot-pedaled pump, and established their commercial viability by introducing a market-based approach for their supply and distribution in South Asia, enabling the technology to reach larger numbers of farmers. To do so, IDE forged partnerships with local manufacturers and village-based distributors to create a sustainable supply chain for the pumps in South Asia.

By training local manufacturers, retailers, and technicians to use, produce, sell, and repair the treadle pumps, IDE

created a market-driven mechanism to distribute them. In the late 1990s, another NGO, KickStart, adapted the design of the pumps to suit conditions in East Africa and followed a similar process to supply and distribute them using sustainable, market-based principles.

IDE and KickStart have in total sold more than 2 million pumps.⁶² Most pump buyers are men, but women make up about 60 percent of KickStart users and managers⁶³ and a significant number of IDE pump users.⁶⁴ Women customers report that the pumps increased their agricultural productivity, allowed them to grow high-value crops, and increased their families' average annual net income by \$50 to \$500 for IDE pumps and \$1,000 for KickStart pumps.⁶⁵ Through their higher productivity and incomes, women have contributed to their families' well-being and to changing norms about women's work in their communities. In South Asia, for example, after using the water pump women began to move into new segments of agricultural work traditionally performed by men, including irrigation.⁶⁶



LESSONS: IDE and KickStart secured the commercial viability of their product and established a market-oriented supply chain to manufacture and distribute the technology.⁶⁷ By doing so, they created a sustainable market mechanism for women and men throughout South Asia and Sub-Saharan Africa to purchase the water pump technology and dramatically improve their agricultural production and economic livelihoods. Investing early in efforts to ensure that a supply chain exists to scale up the technology and that women can access it goes a long way toward strengthening sustainability.

PHASE 7: MARKET LINKAGES

SOLAR DRYERS

Women's enhanced economic activity will lead to higher incomes or greater empowerment only if adequate demand and markets for their goods and services exist.

A successful technology introduction project in rural Uganda initiated by a national private sector company, Fruits of the Nile, promoted solar dryers among women farmers for processing their harvested agricultural produce.

One of the intervention's objectives was to connect women's food processing activities to a new economic opportunity and a growing international niche market for value-added dried fruit products.

Fruits of the Nile partnered with national agricultural institutions to develop the technology, and with government agencies and NGOs to identify and organize the participating women's farmer groups. These project implementers helped to establish women's groups' ownership of the dryers

by providing some of them with credit to support their collective purchase of the technology.

Most important, the intervention created a new viable, export-oriented market for the dried fruits produced by the women's groups. Fruits of the Nile purchased the value-added goods from women at fair trade prices and subsequently exported them to international markets through another commercial intermediary. To strengthen the economic viability of the women's new market linkages, the project also provided them with critical training in product quality control and enterprise management.

Women farmers who operated the dryers to process fruit for export improved the productivity and quality of their food processing work, enabling them to produce high-quality dried fruits suitable for sale in international markets. As a result, they earned higher incomes during the early years of the project,⁶⁸ as well as more than 10 years later.⁶⁹



LESSONS: Women's use of the solar dryers helped to create a new economic opportunity through which they were able to move into higher value agricultural production activities. A partnership between private intermediary companies and national agricultural agencies created a new economic opportunity for rural women not only by providing them with a renewable energy technology but also by equipping them with relevant business skills and establishing new, sustainable market linkages for their products. Though the women did not create the market linkages themselves, they were able to benefit from them because project implementers recognized the need and made creating these linkages a driving force of the project.

PHASE 8: ASSESSMENT AND EVALUATION

VILLAGE MOBILE PHONES

The positive impacts of technology interventions on promoting women's market activity and economic advancement can be fully understood only if implementing actors conduct assessments and evaluations. Unfortunately, many technology-introduction projects have not systematically evaluated their impact on women.

An exception is an ICT technology intervention implemented in the late 1990s in rural Bangladesh that provided women with a new entrepreneurial opportunity. The Grameen Bank, a leading global microfinance institution, created the for-profit GrameenPhone entity and partnered with two international telecommunications companies to create the Village Phone program. The program has provided more than 220,000 rural women with financing and training to purchase mobile phones and start their own phone booth businesses, by selling phone use to other village residents.⁷⁰

In the several years following the start of the program, both Grameen staff and external researchers conducted assessments to determine the impact of the intervention on women phone booth owners and customers. These

studies revealed that most women village phone microentrepreneurs increased their earnings and savings as a result of their new enterprise activity, earning about 30–40 percent of their total household income.⁷¹ As a result, these women gained more confidence and social standing within their communities as successful economic actors.⁷²



Women who purchased mobile phone use from the microentrepreneurs also benefited from time savings in performing household and market work.⁷³ For some women who sold their goods in local markets, enhanced access to market information via mobile phones helped them set better prices for their products.⁷⁴ Further, by helping clients improve their market earnings through faster access to information, the phone operators' services facilitated other local economic activity.

More recent studies have indicated that, as mobile phone access has spread across rural Bangladesh, the earnings of the pay phone operators have declined.⁷⁵ This trend calls into question the long-term sustainability of the business model and underlines the importance of ongoing evaluation.

LESSONS: Assessments of projects and programs specifically examining how women benefit from them are essential to understanding the pathways and processes through which technologies can spur women's economic empowerment. Such insights are useful not only because they enable the intervention's implementers to make necessary modifications to improve future effectiveness and positive impact on women. They also provide the larger community of international donors, the private sector, governments, and nonprofit organizations with stronger evidence of what particular features of technology interventions have been most effective in promoting women's access to and use of technologies in different contexts and over time.

4. RECOMMENDATIONS FOR ACTION

Technologies can promote women's economic advancement by improving the productivity and quality of women's work and generating new employment opportunities. But the countries that most need the benefits of technology often lack the financial and human resources to create the environments needed to foster new technologies. Furthermore, the development of a new technology is only the first in a series of steps that must be fine-tuned if a given technology is to be the key that unlocks the economic potential of women.

Many existing technologies had the potential to benefit women but, for a host of reasons, were never embraced or adopted. Thus, developing and distributing technologies that meet women's needs must focus on key steps of the process that carry the technology from conception through use and widespread adoption in the field. Particular attention should also be paid to existing technologies that haven't been adapted or distributed to the full benefit of women. Later phases of the lifecycle can help guide the revamping, reintroduction, and deployment of an existing technology. But to avoid such problems, innovators should first ask critical questions about needs, barriers, markets, training, and assessment at the earliest phases of research and development to ensure a technology will aid women in developing countries.

Key Questions

QUESTIONS TO CONSIDER PRIOR TO DEVELOPING A TECHNOLOGY:

- What problems do women face that could be solved by a technology?
- How can women be involved in technology design to ensure their needs are met?
- What market research is needed to increase women's use of the technology?
- What barriers—including social norms—have prevented women from previously accessing technology solutions, and how might those barriers be addressed?
- What will it take to bring the product to market and make it economically sustainable (such cost-sharing measures), and which partners will be essential to ensure its distribution to women?
- What kind of knowledge and training will users and other community members (such as technicians) need to sustain use of the technology?
- What linkages are needed to support a market for the goods and services women produce via the technology?
- Can a feedback mechanism be put in place to monitor experience in the field and refine delivery methods for the technology as it unfolds?



External stakeholders—the private sector, multilaterals, bilaterals, and NGOs—that partner with innovators to develop a technology can create the environment where these questions are asked and ideas are tested in a way that changes how technologies are brought to market. With a series of “To Dos” and “Not To Dos,” we provide targeted guidance for innovators, funders, private sector entities and program implementers (both NGO and governmental), working to connect women in the developing world with technologies that could improve their economic opportunities. These recommendations focus on what can be done within the context of a technology initiative and are based on the lessons discussed in section 3, the authors’ field experience, or the knowledge of other implementers consulted for this report.

TECHNOLOGY INITIATIVES

WHAT TO DO

- **ENGAGE WOMEN THROUGHOUT THE DESIGN AND DEPLOYMENT PROCESS.** Too often, women are taken into account only when marketers want to sell to them. Early engagement in focus groups can often help innovators identify the broad problems that technology can solve and the best ways to customize it for women’s use. Once a technology is developed, women can be critical voices about how to position and distribute a product as well as essential endorsers in a community grappling with whether to embrace or reject something new. Because women are particularly well-placed to identify solutions for their own problems, engaging them at key points throughout the design and implementation process ensures the technology will be used and will create results meaningful to businesses as well as to individual women. And for the most effective results, wherever possible women should be actively leading the effort to design and deploy technologies to meet their needs—as technology innovators, designers, developers, and distributors, as well as advisers.
- **FOCUS ON SECTORS LIKELY TO CONVEY RAPID AND SIGNIFICANT BENEFITS.** Most of the successful examples cited in this paper relate to technologies in the energy and ICT sectors because—similar to education, health, agriculture, and water and sanitation, which are widely recognized for their positive impact on women and their families—these sectors have the potential to benefit all women regardless of their primary occupation, as well as their families and communities. ICT and energy technologies can address immediate issues affecting women and communities, making it easier for women to gain support for accessing them. For example, an alternative household power source (the multifunctional platform) provides energy that lengthens the productive day for all members of the home where it is installed, not just the women who live there. ICTs, including mobile phones and computers with Internet connections, have allowed women to develop new careers as village phone owners while also giving communities access to these services. Focusing on these two sectors—while also listening for great ideas in sectors with innovative potential or already renowned for their gender impact—would direct technology development efforts in a way that could be particularly beneficial for women in developing countries. We never know where the next groundbreaking idea will come from, but rather than diffusing investments across many sectors, concentrating in a few sectors may produce synergies and collaborations that otherwise would not occur.

- **REACH FOR PARTNERS WITH COMPLEMENTARY CAPABILITIES.** Different sectors have different strengths and weaknesses. Many NGOs have access to lower- and middle-income women that the private sector lacks, whereas the private sector has the experience of creating markets for products that might be necessary for a technology solution to become sustainable. By building partnerships across organizations with complementary skills, innovators and implementers of technology initiatives can strengthen the viability of a technology.
- **INVEST IN TRAINING THAT IS OBVIOUSLY NEEDED.** It is not enough to introduce a technology and expect women to use it—they need to be trained in how to use it and reap its many benefits. When developing training programs, a number of practical factors need to be considered: Could it be conducted at home or during “off hours” when women might be most able to attend? If a training center is involved, is it in a neighborhood women will feel comfortable traveling to? There also are downstream training needs to consider. For example, like the Village Phone model, if a technology will give women the ability to create a business, then consider the skills they will need to develop a successful one. Although an accounting class might seem to have nothing to do with pay phones, it might very well be the critical skill a woman needs to manage her business, strengthening her entrepreneurial capabilities.

WHAT NOT TO DO

- **DO NOT UNDERESTIMATE THE COMPLEXITY OF ENSURING ACCESS TO AND SUSTAINED USE OF EXISTING AND NEW TECHNOLOGIES.** Many times enthusiasm over a technology is concentrated at the development stage and little thought is put into how to build support for it, explaining why many promising technologies never reached their potential. By focusing on the business problem of building support for the technology and making it sustainable—looking at how it will be taken to scale, distribution channels, marketing strategies, and the like—developers will have a greater chance of seeing the technology absorbed once launched.
- **DO NOT REDUCE WOMEN TO THEIR ROLE AS END USERS.** Too often, women are perceived only as potential users of a technology. In fact, they could be professionals charged with repairing or operating the technology, owners who buy large quantities and lease it (or a piece of it) to others, or even instructors who teach others how to operate the technology. A marketing plan that takes these many roles into account has a greater likelihood of success.
- **DO NOT FORGET TO DOCUMENT THE JOURNEY.** One of the key findings to emerge from this study is the lack of information about the extent of the gender and technology divide and what technologies work for women and why. There are surprisingly few documented examples of game-changing technologies for women. More research is needed to assess successes and failures and identify promising practices to inform other efforts to reach women with technologies. To better address the problems that do exist, sex-disaggregated data are needed on the access to and use of technologies in countries throughout the world. Because documentation and strong evidence are needed to guide decisions about future interventions, program implementers and donors should partner with research organizations to evaluate the processes and impacts of technologies on women’s economic advancement in and across different contexts.

TECHNOLOGY POLICY

Successfully seeing a technology through the full process of the lifecycle requires joint action by actors from multiple sectors and at various levels—the policy level as well as the initiative or project level. While this paper has focused on what can be done in a technology initiative, policies on technology formulated by national governments and international aid agencies can play a critical role in shaping the larger context in which a technology initiative can thrive or flounder—and in which technologies have the potential to reach and substantially benefit larger numbers of women.

Effective policies are needed to help create the enabling environment to reduce barriers to women's ability to access and use technologies, and to more effectively ensure that women are able to harness technologies for their economic advancement. Such policies are needed to systematically promote gender equality in the technology domain, thereby complementing and multiplying the impact of successful on-the-ground interventions that integrate women into the technology lifecycle. Determining what policies are needed to get more existing and new technologies into the hands of women in developing countries requires evidence-based strategies tailored to the particular needs and constraints faced by women in different parts of the world.

Nevertheless, some broad policy directions are relevant to promoting technologies for women across regions. Although the policy issues and recommendations related to women and technology are complex and merit an extensive, dedicated discussion, we briefly touch on some key examples here to provide a macro view of the policy foundation needed to complement and support the successful implementation of the initiative-level recommendations described earlier.

Policymakers in national governments and international agencies can promote the economic advancement of women through technologies by:

- **GIVING EQUITABLE OPPORTUNITIES TO WOMEN AND GIRLS TO RECEIVE EDUCATION AND TRAINING IN SCIENCE AND TECHNOLOGY**, including in technology design and development, management, and maintenance.⁷⁶
- **PROVIDING INCENTIVES FOR WOMEN AND GIRLS TO BUY TECHNOLOGIES AND PARTICIPATE IN SCIENCE AND TECHNOLOGY EDUCATION PROGRAMS.** Because many technologies have high initial investment costs, initial subsidies are required to increase access by poor women. Education fees can also be a barrier to poor women.
- **INVESTING IN THE INFRASTRUCTURE REQUIRED FOR THE USE OF MANY TECHNOLOGIES.** For example, many ICTs such as faxes and the Internet require telecommunications infrastructure and electricity, both of which are limited in rural areas of developing countries.⁷⁷
- **DEVELOPING POLICIES TO PROMOTE UNIVERSAL ACCESS TO KEY TECHNOLOGIES**, for example by ensuring affordable ICT services at community access points and telecenters⁷⁸ or by formulating pricing policies to better ensure women's access.⁷⁹
- **PROVIDING THE REGULATORY ENVIRONMENT TO ENCOURAGE BUSINESS PRACTICES** that facilitate women's access to and use of technologies through, for example, taxation policies. Efforts to encourage and incentivize public-private and multi-sector collaboration for the distribution of technologies to women are particularly needed.

- **INTEGRATING GENDER EQUALITY GOALS AND GENDER ANALYSIS INTO TECHNOLOGY-RELATED POLICIES AND PROGRAMS.** This can be achieved in part by increasing women's participation in policy and decision-making positions, allocating funding specifically for technologies for women, and providing training in gender issues to government officials.⁸⁰
- **SUPPORTING THE COLLECTION OF SEX-DISAGGREGATED STATISTICS AND INDICATORS** related to key technologies.⁸¹ Such data are lacking and can be complemented by research on the contextual and locally-specific factors that limit women's access, such as laws pertaining to property rights and women's ability to obtain credit when formulating policies.

A FINAL WORD

Past initiatives demonstrate that technologies, if effectively applied and distributed, can produce important economic gains for women, their families, communities, and societies. The cross-project lessons brought together in this paper can help new initiatives apply the wisdom of experience on a broad scale. By taking the time and effort to apply these ideas now, we have the opportunity to leverage technologies in a way that puts women in developing countries on a higher trajectory toward economic advancement while also benefiting the aims of programs and businesses. With progress, women can become the majority of inventors, funders, and collaborators who lead development of the very tools that change the game for them. Such a promising opportunity for women—and the world—must not be missed.

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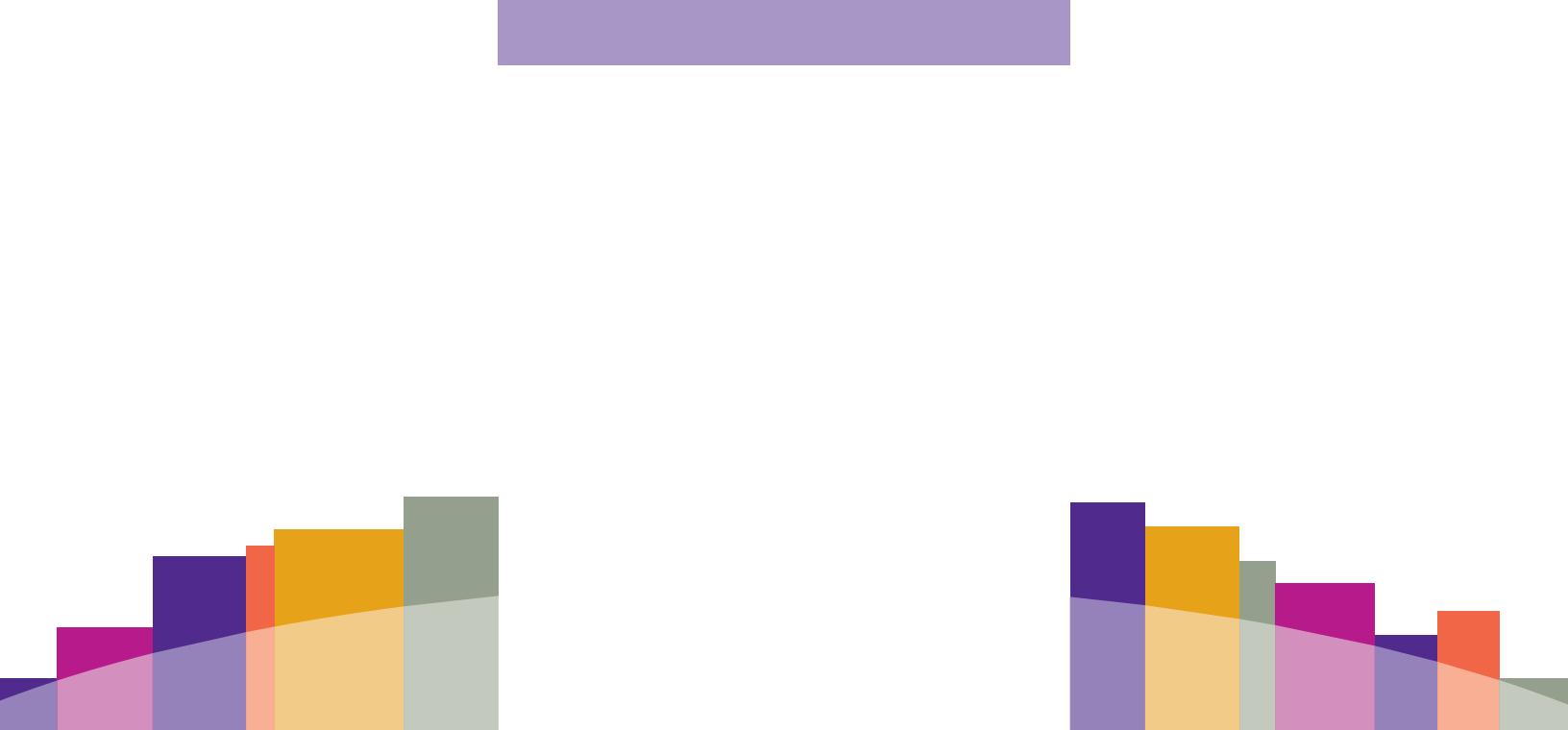
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