

Socioeconomic Impacts of Wireless Technology

A Review of Opportunities and Challenges in Health Care, Finance, Education and Community Empowerment



About This Report

The purpose of this report is to assess socioeconomic opportunities and challenges that arise from existing and emerging uses of wireless (licensed spectrum) technology, with a particular focus on the areas of health, finance, education, and empowerment. The report was commissioned by CTIA—The Wireless Association® and prepared by BSR.

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BSR's Information and Communications Technology (ICT) practice works closely with 38 ICT member companies and other stakeholders, ranging from telecommunications and internet firms to component and hardware manufacturers, several of which are also members of CTIA. BSR has a long history of working with companies in the ICT sector to integrate corporate responsibility into their business strategies.

ABOUT CTIA

CTIA—The Wireless Association® is an international nonprofit membership organization that has represented the wireless communications industry since 1984. Membership in the association includes wireless carriers and their suppliers, as well as providers and manufacturers of wireless data services and products.

The association advocates on behalf of its members at all levels of government. CTIA also coordinates the industry's voluntary efforts to provide consumers with a variety of choices and information regarding their wireless products and services. These efforts include the voluntary industry guidelines, programs that promote mobile device recycling and reuse, and wireless accessibility for individuals with disabilities.

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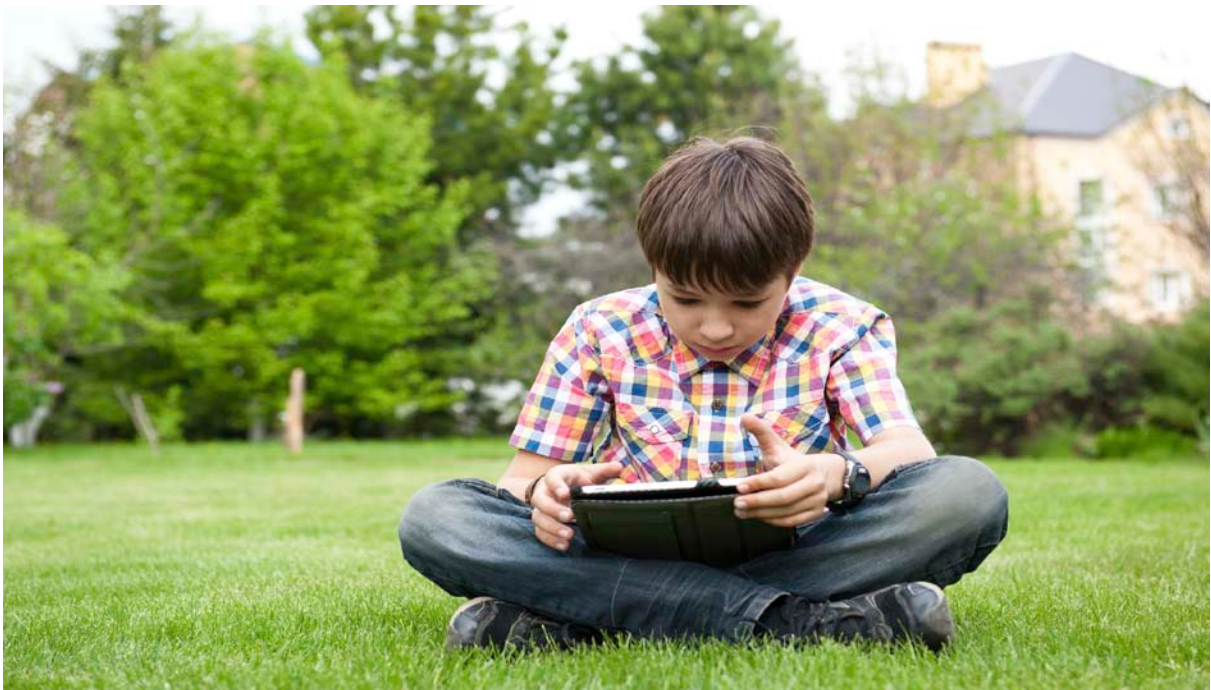
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Executive Summary

Almost 40 years ago, the development of wireless technology changed the way we make a phone call. Today, wireless technology allows us to connect with people around the world, enables machines to “talk” to machines, and delivers life-changing services to global communities that heal, educate, empower, and delight. The wireless revolution is here, and it’s changing our world.



The effect of wireless technology on modern society has been profound. Wireless mobility enables instant communication anywhere, anytime, mobilizing the rapid transfer of information and services over immense distances, unbound by geographic barriers. New ways to connect, share, and innovate using wireless technology are invented every day around the world, and are shattering traditional walls that have divided societies for centuries.

This report is a companion to *Wireless and the Environment: A Review of Opportunities and Challenges*, and reviews and assesses the power and effect of wireless technology on society. In this report, we examine the social effects through four lenses:

- » Health Care
- » Finance
- » Education
- » Community Empowerment

Almost 6 billion mobile phone connections exist in the world. With the right infrastructure and applications, this unlocks a vast opportunity to connect, heal, teach, and empower billions of people around the world.

These four sections are united by several cross-cutting themes that highlight the power of wireless technology to be an agent of social change:

- » **Ubiquity:** Almost 6 billion mobile phone connections exist in the world. Hundreds of millions of machines are connected through the “Internet of Things.” Wireless technology is everywhere, and that fact alone makes it a powerful tool. Health care workers can reach new patients because they all have mobile phones. The financially underserved can open a bank account through a mobile platform. Migrant workers can connect to each other over vast geographic distances through a common mobile application. The ubiquity of wireless helps to enable these outcomes.
- » **Remote capability:** The remote capability of wireless technology enables socially beneficial tools, applications, and services to reach people and places that were extremely difficult—if not impossible—to reach before. The ability to go anywhere anytime means that people can connect more frequently and more conveniently, and that they interact with each other while living in the real world—not stuck behind a desk relying on a monitor and a keyboard to connect. Generally speaking, the more convenient the technology, the more widely users will adopt it. More people using wireless technology means the services become more robust, and thus more socially impactful.
- » **Closing information gaps:** The ability of wireless to go anywhere anytime means that the technology can collect and provide information that could not have been gathered before. Workers can communicate with each other through wireless platforms about working conditions in factories and on farms. Patients with diabetes can chart their health care progress over time and thereby improve their management of this chronic disease. Citizens can easily identify and track the status of bills introduced by their elected representative. Creating the space and capability for information to flow more easily fosters greater transparency and more social connections that leads to socially positive impacts.

The United States serves as a springboard for several of the advanced mobile applications reviewed in this report in large part because of the advanced wireless 4G infrastructure currently being deployed in the country. Already, 75% of the world’s 4G subscribers (combining LTE and mobile WiMAX) are in the U.S., making this a hotbed for developing and testing powerful new applications. While several applications can be delivered over feature phones or smaller wireless devices, many of the advanced applications and integrated services will be tailored to harness the power of smartphones or tablet computers. This advanced infrastructure unlocks an entirely new world of wireless possibilities—from applications that enable students to trace planets across the sky on a tablet, to inventions that turn a smartphone into a mobile medical device that enables delivery of critical health care services to rural communities. The better the infrastructure to deliver these services becomes, the greater the impact they will have on society. The United States is leading the development of the wireless revolution at home, as well as in societies around the world.

Examining each of the four sections more closely highlights the powerful benefits of wireless technology.

Health Care Applications and Services

Known as the “mHealth” field, wireless technology features exciting applications and services in health care that will help address the world’s most pressing health care needs. A shortage of health care workers around the world means that pressing needs are not met. People who must manage lifelong chronic diseases struggle on a daily basis to implement optimal health care solutions.

Many preventable diseases continue to take the lives of children around the world because of poorly coordinated delivery of health care services.



Figure 1: *mHealth applications connect doctors to patients in real-time and enhance e-health record keeping through live updates.*

Wireless technology has been deployed in every corner of the world to help solve many of these problems. In the United States, chronic disease management applications have been shown to improve health outcomes while making it much easier for patients and doctors to communicate regularly and sync electronic health

records. Elderly people can now wear wireless devices that immediately contact emergency care workers without needing to sit next to a phone all day, thereby enabling a more active daily life. Applications around the world help health care workers coordinate medicine delivery efforts in the field, predict disease outbreaks before they become unmanageable, and connect rural patients to urban doctors to improve rural health care.

The potential for impact is tremendous, and the industry is only in its infancy. Just some of the outcomes that various studies and experts anticipate include:

- » **Dramatic improvements in adherence to treatment**, for example expanding the population of people successfully managing type 2 diabetes beyond the current rate of 39%¹
- » **Growth in in-home wireless health care** services and applications to become a US\$4.4 billion industry by 2013²
- » **Savings resulting from mHealth technology** that may reach US\$21.1 billion per year³

The industry has received widespread support from the private sector and is beginning to receive important regulatory guidance from the government. The U.S. Food and Drug Administration (FDA) and Federal Communications Commission (FCC) recently published draft regulations for the industry that will guide application developers, and final regulations are expected this year. Challenges still remain, however. Overcoming privacy and security concerns, as

¹ Peyrot, M. et al, "Psychosocial problems and barriers to improved diabetes management," *Diabetic Medicine*, 2005, http://www.dawnyouth.com/documents/dawn%20materials/dawn_publications/10_psychosocial_problems_and_barriers.pdf.

² Dolan, Brian, "U.S. Home-based Wireless Healthcare Market: \$4.4B in 2013," *MobiHealthNews*, August 5, 2009, <http://mobihealthnews.com/3727/us-home-based-wireless-healthcare-market-44b-in-2013/>.

³ CSMG Global, *mHealth: Taking the Pulse*, March 2010, <http://www.tmng.com/knowledge-center/research-reports/mhealth-taking-the-pulse>.

well as the necessity of integrating technology solutions conveniently into daily life will require continued innovation.

Financial Information and Services

Researchers estimate that billions of people around the world—and millions in the United States—own mobile phones, but do not have a bank account. While this fact might sound surprising, it presents an opportunity for wireless technology to transform the lives of people who are unbanked or underbanked. The growth of mobile banking over the past five years testifies to these opportunities around the world.

Applications in mobile banking, and more broadly in mobile finance, range from sending daily reminders to customers on their mobile phone, to providing critical business tools for individuals and small business owners. Mobile payments are quickly becoming an important financial service with a global value that is expected to reach US\$670 billion by 2015. Tools for small businesses include innovative products such as mobile credit card readers connected to tablet computers now seen in corner stores and coffee shops around the country. Simple tools can send customers important messages, such as account balance reminders, bill pay reminders, and ATM locations. These tools make banking more convenient on a daily basis while alleviating the feeling of “not knowing where you stand financially” before making a purchase on the go.

Some specific benefits of wireless in the financial arena cited in the report include:

- » **Reductions in the numbers of unbanked and underbanked** in the U.S. from the current FDIC-estimated 60 million adults⁴
- » **Growth in the mobile payment market** to over US\$670 billion by 2015⁵

The industry's infancy may be its greatest challenge. A lack of data on current use and best practices makes it difficult to take advantage of opportunities and understand how to best meet customer's needs. Cultural, political, and social norms surrounding banking and finance will also challenge those companies who are expanding into less traditional banking markets. However, the opportunities are real, and businesses, government leaders, and civil society partners must collaborate to expand access to mobile finance.

Educational Opportunities

Educational institutions are widespread adopters of wireless technology, sometimes in surprising ways. While only a few years ago teachers asked students to power down wireless devices at school, educational institutions are now going so far as to integrate them into the curriculum. There were nearly 1.5 million tablet computers in educational environments as of January 2012, less than two years after Apple introduced the iPad, one of the first tablet computers on the market.

⁴ FDIC, “Survey of Unbanked and Underbanked Households,” December 2009, www.fdic.gov/householdsurvey/full_report.pdf. Given that these figures date to 2008, it is possible that the numbers of unbanked and underbanked have grown in the wake of national financial turmoil.

⁵ Juniper Research, *Mobile Money Goes Mainstream*, www.juniperresearch.com/shop/download_whitepaper.php?whitepaper=143.

In the Year of the Protestor, mobile phones have been instrumental in organizing as well as documenting human rights campaigns around the world.

Educational wireless applications offer a variety of learning tools that improve educational outcomes, provide a more inclusive learning environment, and in many cases make learning, well, a lot of fun. The Star Walk or Sky Safari applications allow the world's future astronauts and astronomers to gaze at the stars at night with a smartphone or tablet that identifies stars, planets, and constellations around the night sky. Other applications feature learning tools that help students learn and retain information better through improved analysis and evaluation of ideas and enhanced creative thinking. E-textbooks may very quickly replace paper books, as teachers notice the benefits of teaching and learning online and outside of the classroom.

The report cites several opportunities in wireless education, including:

- » **Providing broadband access** to some of the 25 percent of U.S. school-age children lacking it⁶
- » **Increasing test scores and student confidence** among students, as exemplified by the 85 percent of students participating in Project K-Nect that reported feeling more successful in math⁷
- » **Reduced learning times**, as technology-based instruction can reduce the time it takes students to reach learning objectives by 30 to 80 percent⁸

If these educational opportunities are to be fully realized over 3G and 4G networks, it is important to ensure good mobile phone and network access for traditionally underserved populations, such as those in rural areas.

Community Empowerment

Outside of traditional industries like health care and finance, mobile technology is working in subtle ways to empower the lives of individuals and groups. Empowerment occurs in many ways—making information accessible to people (perhaps for the first time), collecting and organizing new types of information, or connecting people from around the world in ways never thought possible. The ubiquity of mobile technology enables teaching, learning, and connecting, and ultimately empowering society anywhere and anytime.

Civic participation is a key area where mobile technology is enabling government transparency around the world and providing people with the tools to become more active and engaged citizens. In the Year of the Protestor, mobile phones have been instrumental in organizing as well as documenting human rights campaigns around the world. Mobile technology has also been used to provide support structures and systems for victims of domestic violence, factory workers in Asia, and victims of natural disasters.

In the big picture, mobile technology and the ubiquitous mobile “app” are still in the early stages of what many predict will be a mobile revolution. As long as people need to connect, mobile technology will help empower those groups over greater distances than ever before and to solve problems in ways never thought possible.

⁶ Prabhu, Maya, “FCC announces Children’s Agenda for broadband, eSchool News, March 15, 2010, www.eschoolnews.com/2010/03/15/fcc-announces-childrens-agenda-for-broadband.

⁷ Ibid.

⁸ Ibid.

Potential Social Risks of Wireless Technology

As discussed in *Wireless and the Environment: A Review of Opportunities and Challenges*, the increased deployment of wireless solutions is not without challenges. While that report explored the environmental costs of wireless technology, there are also potential human or social risks, mainly around supply chain, human rights, and privacy issues.

Activists and industry efforts such as the Electronics Industry Citizenship Coalition (EICC) have worked to address supply chain concerns like excessive working hours, poor labor conditions, and bonded labor in factories. Years of effort have helped raise awareness of these issues, but the problems are complex and continue to exist. Potential human rights risks can also arise from the use of wireless devices by governments that lack commitment to the international standards governing human rights. Users in various countries have been subjected to unlawful tracking, monitoring, or data interception that undermines their fundamental rights of privacy and freedom of expression.

However, the potential for wireless technology to help make the world healthier, more financially inclusive, better educated, and more empowered means that the industry cannot shy away from addressing these challenges. Business, governments, civil society, and consumers all have a role to play in minimizing these harms. The entire ICT industry will continue to work through these and other emerging challenges through efforts like the Global Network Initiative (GNI) and the EICC.

Looking Ahead

Wireless technology is leading a revolution in how people teach, learn, and interact with, connect to, and empower each other. New markets with exciting applications and services could fundamentally shift the way that we live, bringing about a host of opportunities and raising new challenges for business, government, and society. We are hopeful that the wireless industry, with the right commitment from government, will help us overcome these challenges in order to realize these opportunities.

Introduction

Anyone who has used the internet to reestablish ties with an old friend—or check up on an old rival—knows the incredible power of technology to help individuals make connections. Beyond diversion though, technology is enabling a wave of powerful social and economic connections. Nowhere is this more apparent than in mobile technology. Whether it's a small business using Square to take credit card orders, a patient using a mobile link to upload diagnostic data, or a protestor in the Arab Spring using a cell phone to organize and inform an activist movement, wireless technology is transforming social and economic factors worldwide.

As highlighted in the companion to this report, *Wireless and the Environment: A Review of Opportunities and Challenges*, remote access, broadband, and lower costs are driving a wireless revolution, enabling the availability of unprecedented amounts of information and allow people to communicate, access services, and make decisions in ways that were never before possible. While the previous report highlighted the effects this is having on the environment, the present report focuses on the relationship between wireless and social issues.

Over six billion people—84% of the global population—have access to mobile phones. Beyond these individual connections, the machine-to-machine (M2M) “Internet of Things” is using wireless technology to drive a wave of innovation in technology, business, and culture. *Wireless and the Environment* emphasized how wireless is enabling powerful and previously impossible connections centered on machines. These connections include technologies such as fleet management devices that allow central dispatch to communicate with drivers, and smart meters that communicate a customer's utilities use to the company.

Turning to wireless and society, much of the focus is on how wireless is enabling powerful and previously impossible connections centered on people. Wireless connects people with other people, services, and information. These human connections include remote access to physicians, links to bank accounts and mobile money, and links between students and educators to allow learning anytime and anyplace.

Wireless enables social and economic benefits through several mechanisms:

- » **Ubiquitous reach:** Mobile devices have become nearly ubiquitous by being relatively affordable, multipurpose, and popular. In particular, their ubiquity means that mobile devices can serve as conduits to reach traditionally underserved populations or places without traditional wired infrastructure.
- » **Technology tools:** Mobile devices deliver technology tools on the spot and via remote access. These tools range from medical testing tools to checking and savings accounts. Such tools may leverage smartphone technology, but it is not necessary; text messages can also deliver services and information.
- » **Connections anytime, anyplace:** Mobile devices are able to connect people on the go, wherever they are, whenever they need it. While many mobile connections leverage location-based services, these services can happen anywhere; mobile technology opens the doors to doctors' offices, bank branches, and classrooms.

All told, these features mean that wireless enables more people to connect in new ways whenever and wherever they are. As a consequence, wireless is playing new and important roles in many aspects of social and economic activity, including:

- » **Health applications and services:** In response to a shortage of health care workers, difficulties in patient-led chronic disease management, and the scourge of preventable diseases, wireless can provide solutions ranging from disseminating information to disease management tools to remote diagnosis.
- » **Financial services and information:** With millions in the United States and billions around the world unbanked or underbanked, mobile technology can enable improvements in financial capabilities, access to market information, and mobile payments to increase access to financial services and the impact of those services.
- » **Education:** Wireless applications and devices can make learning more inclusive, engaging, and tailored to the needs of individual students—not to mention fun.
- » **Empowering people:** Mobile devices can help reach, connect, and empower people throughout the world to improve education, increase citizen engagement, and create global communities among the marginalized and disenfranchised.

These applications are exciting and powerful opportunities to improve the country and the world. At the same time, it is important to keep in mind that the sharp increase in wireless use can bring negative consequences. Among these, the manufacture, use, and disposal of electronics can carry social and environmental effects, along with privacy concerns.

We welcome your feedback on this report. Please contact the representatives from BSR or CTIA, identified on page 2, with any comments or questions.

"We're helping patients follow what their doctors have already prescribed, and it's leading to incredible improvements in patient health."

Anand Iyer, President & COO,
WellDoc

Health Care Applications and Services

Consider how diabetes affects the life of a hypothetical adult patient—John Doe. John was diagnosed as an adult with type 2 diabetes, a disease without a cure that he will be managing for the rest of his life. John was not prepared for how much managing a chronic disease would intrude on his daily life. He must take several blood tests per day, track the results in a paper logbook or spreadsheet, and bring the data to each doctor's visit. He must track his weight, diet, exercise routine, body mass index, hemoglobin levels, cholesterol, and blood pressure. His doctor encourages him to exercise daily and to eat a low-fat diet on a regular schedule. John does everything he can to keep up with the daily regimen, but it's frustrating and he's constantly falling behind.

Here's how a simple Mobile Health, or mHealth, application on his mobile phone is helping John manage life with diabetes and improve his health. John has a new mobile application on his cell phone that tracks all of his daily readings and entries, health records, charts, and trends and allows his doctor to periodically monitor his health. On any given morning, he wakes up, takes his first blood-sugar test, and inputs the results into the application. His mobile phone replies with a message, "Good job! Be sure to keep to one slice of toast at breakfast, and have a productive day!" The application sends him reminders to take his medications so that he does not have to watch the clock and suggests diabetes-friendly lunch options so that he will have enough energy for a daily workout. John's doctor can add a new prescription, which automatically syncs with John's mobile phone and sends him an alert about the change. The mobile application then connects John to a whole library of information about his new medication, including videos of leading experts explaining its health benefits.

Chronic disease management, such as daily management of type 2 diabetes, is cumbersome and frustrating, and quite frankly a mobile application can only do so much to help. But to have an application that takes care of 90 percent of the legwork for John, fits seamlessly into his daily life, and wirelessly syncs in real time with his e-health records makes it feel like John's not fighting the battle alone. Even better, he is measurably improving his health outcomes. WellDoc, the maker of DiabetesManager®, an application similar to the one described above, has documented through clinical studies that patient's A1c levels have

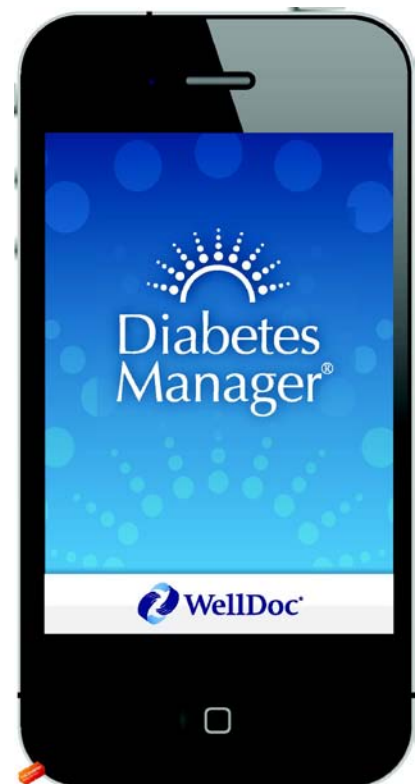


Figure 2: WellDoc's Diabetes Manager helps patients track vital health statistics and manage diet and exercise routines on a mobile device. (Source: WellDoc)

dropped by roughly two points.⁹ Keep in mind that a new drug is heralded for reducing levels by a half point. Additionally, doctors are four to five times more likely to recommend a medication with an mHealth application like DiabetesManager. Provider adoption has led to significant improvements in patient health as well.

“We are not giving doctors a new medicine that will cure diabetes,” explains Anand Iyer, President and Chief Operating Officer of WellDoc. “But we’re helping patients to more closely follow what their doctors have already prescribed, and it’s leading to incredible improvements in patient health.”

This is just one of many ways that wireless technology is significantly changing health care around the world. mHealth covers a broad range of health improvement applications and services deployed through mobile phones and other wireless devices. Hundreds of mHealth applications, projects, and products span the health care industry; they do everything from helping rural residents gain better access to health care to preventing disease outbreak through mobile surveillance tools. The rapid growth and creativity of mHealth applications has made it one of the most fascinating and dynamic developments in the health care industry.

This section explores the problems that mHealth services help to solve and profiles several applications that highlight these services. While advantageous in many respects, mHealth is by no means a panacea, and it will encounter several hurdles along the path to becoming a fully formed industry. However, the demand to solve global health problems has never been greater, and so the opportunity to refine and develop new, more powerful mHealth applications will continue apace.

Health Care Challenges and Wireless Solutions

The world faces critical problems in the administration of health care, from a shortage of health care workers around the world to high infant mortality rates from easily preventable diseases. mHealth applications are poised to improve the delivery and quality of health care in several ways:

- » **Shortage of health care workers prevents delivery of services.** The World Health Organization estimates a deficit of 4.3 million health care workers worldwide.¹⁰ In the United States, health care worker shortages are most acute in rural areas, where 20 percent of the population lives but only 9 percent of physicians practice.¹¹ High-quality health care cannot be delivered without sufficient numbers of health care professionals. Many mHealth applications help connect health care workers to patients in remote areas and help close the gap in health care services. Last year, the U.S. government supported these efforts through US\$6 million in mHealth grants to some of the most remote and poorest counties in the country for program and infrastructure development, including tele-ICUs, tele-visits from

⁹ Dolan, Brian, “Medicaid Patients Reduce hospitalizations with WellDoc,” MobiHealthNews, December 6, 2011, <http://mobihealthnews.com/15116/medicaid-patients-reduce-hospitalizations-with-welldoc/>.

¹⁰ World Health Organization, “International Action Needed to Increase Health Workforce,” March 13, 2007, www.who.int/mediacentre/news/releases/2007/pr05/en/index.html.

¹¹ U.S. Department of Health and Human Services, Agency for Healthcare Research and Quality. “Innovations Exchange: Field-Based Outreach Workers Facilitate Access to Health Care and Social Services for Underserved Individuals in Rural Areas,” www.innovations.ahrq.gov/content.aspx?id=1873.

The United States is scheduled to provide more than US\$30 billion to encourage deployment and adoption of mHealth applications in hospitals throughout the country.

physicians to patients in rural areas, and upgrades to e-Health equipment in hospitals.¹²

- » **Patient-led chronic disease management can be ineffective and expensive.** Patients suffering from chronic diseases must adhere to rigorous daily schedules and often make substantial changes in their lifestyles to manage the disease effectively over their lifetime. Treatment for chronic diseases is estimated to cost about US\$1.4 trillion per year, almost half of U.S. spending on health care. As described above, mHealth applications help patients by scheduling daily reminders, monitoring patient health conditions in real time, and connecting patients to physicians for immediate assessment and assistance. Experts estimate that savings from mHealth technology could reach US\$21.1 billion per year.¹³
- » **Preventable diseases still cause unnecessary deaths.** A child born in a developing country is more than 33 times more likely to die from preventable diseases than a child born in a developed country.¹⁴ Innovative mHealth applications are connecting in-field rural health care workers to patients and other workers to enable them to effectively coordinate and deliver vaccines and antibiotics and to improve education about basic disease prevention in rural communities.

Fortunately, great challenges bring great opportunities. The potential of mHealth applications has led to explosive growth and investment in the field, providing a solid foundation for further innovation and development. In July 2011, the FDA and FCC jointly published draft guidelines to provide developers of mHealth smartphone applications with standards and regulatory guidance. In addition, the federal government is scheduled to dispense more than US\$30 billion in subsidies to doctors and hospitals to encourage them to adopt electronic medical records, which will play a key role in the delivery of mHealth services by increasing the wireless accessibility of this information.¹⁵ A 2009 report estimates that by 2013, wireless health care services and applications designed for in-home use alone will grow by 180 percent and become a US\$4.4 billion industry.¹⁶

The private sector, particularly telecoms players, is also expanding efforts to develop mHealth products, platforms, and solutions. AT&T already generates revenues of about US\$4 billion a year from various health care applications. The company recently created an entire division dedicated to pursuing mHealth solutions through cloud computing solutions.¹⁷ Qualcomm announced a US\$100 million fund in late 2011 to invest in wireless technology and help accelerate the development and deployment of mHealth services.¹⁸

¹² Jackson, Sara, "\$6M in Grants Helps States Bring Telemedicine to Poor, Rural Patients," Fierce Mobile Healthcare, November 28, 2011, www.fiercemobilehealthcare.com/story/6m-grants-helps-states-bring-telemedicine-poor-rural-patients/2011-11-28.

¹³ CSMG Global, *mHealth: Taking the Pulse*, March 2010, <http://www.tmng.com/knowledge-center/research-reports/mhealth-taking-the-pulse>.

¹⁴ Vital Wave Consulting, "mHealth for Development: The Opportunity of Mobile Technology for Healthcare in the Developing World," 2009, www.vitalwaveconsulting.com/insights/articles/mHealth.htm.

¹⁵ "M-powered," *The Economist*, November 11, 2010, www.economist.com/node/17465455.

¹⁶ Dolan, Brian, "U.S. Home-based Wireless Healthcare Market: \$4.4B in 2013," MobiHealthNews, August 5, 2009, <http://mobihealthnews.com/3727/us-home-based-wireless-healthcare-market-44b-in-2013/>.

¹⁷ "M-powered," *The Economist*, November 11, 2010, www.economist.com/node/17465455.

¹⁸ "Qualcomm Forms Qualcomm Life Subsidiary to Deliver Comprehensive Wireless Solutions for Medical Devices," Qualcomm Press Release, December 5, 2011, www.qualcomm.com/media/releases/2011/12/05/qualcomm-forms-qualcomm-life-subsidiary-deliver-comprehensive-wireless-sol.

Hospitals and other health care agencies are beginning to invest in upgrades to equipment and facilities to prepare for mHealth in the future. After testing various mHealth and electronic records applications, the Department of Veteran Affairs recently purchased 100,000 tablet computers to be used throughout its hospitals that will incorporate mHealth monitoring and electronic record-keeping into routine health care practices.¹⁹ The hospitals are also opening proprietary mobile application stores where physicians and health care workers can download mobile applications designed for particular hospital's electronic record systems.

The health care industry is clearly interested in and motivated about the development of mHealth. What is it about wireless applications that make them uniquely positioned to solve so many health care problems?

The Role of Wireless Technology

Wireless technology is helping to solve problems in health through a number of key advantages:

- » **Cellular ubiquity:** Mobile phones are nearly ubiquitous. About 1.6 billion people in industrialized countries and 4.5 billion people in developing countries have mobile phone subscriptions—in total about 84 percent of the global population.²⁰ The main benefit of cellular ubiquity is that billions of people around the world, especially those in geographic regions that are difficult to reach, can take advantage of mHealth applications. However, a secondary effect of ubiquitous usage is that as more people use mHealth applications to monitor and record health data, public health data sets become more robust. A clearer picture of public health data provides immediate benefits for mHealth applications, such as disease tracking and outbreak prevention; and over the long term it provides a better understanding of macro-trends in health care and informs better policy making for disease prevention and control.
- » **Improved technology:** Cutting-edge applications running on smartphones offer a glimpse into the potential power of mHealth. Smartphones provide more interactive features, and their computer power and graphics capability allow them to be turned into a medical device, such as an ultrasound reader (described below). Improved wireless infrastructure coupled with the improved speed and power of data networks to transfer more information at greater speeds will continue to enhance the power of mHealth applications.
- » **Location-based services:** mHealth applications are well suited for a wireless world because patients generally have mobile devices with them almost all the time, which enables geolocation services to help deliver health care. Particularly in less-developed countries, wireless geolocation allows in-field health care workers to locate, track, and identify patients in extremely rural areas, and then provide diagnoses and remedies in real time through mobile applications without requiring the patients to make lengthy trips to medical clinics. Location-based services also support applications geared toward elderly patients, such as remote emergency sensors, that

¹⁹ Jackson, Sara, "VA's Massive 100K Tablet Buy Geared Heavily Toward Clinicians," Fierce Mobile Healthcare, October 27, 2011, www.fiercemobilehealthcare.com/story/vas-massive-100k-tablet-buy-geared-heavily-toward-clinicians/2011-10-27. See also Jackson, Sara, "First VA App Store Opens Network to Tablets, Smartphones," Fierce Mobile Healthcare, October 5, 2011, www.fiercemobilehealthcare.com/story/va-starts-app-store-opens-network-tablets-and-smartphones/2011-10-05.

²⁰ International Telecommunications Union, "Mobile-cellular Subscriptions, by Level of Development," 2011 (estimates), www.itu.int/ict/statistics.

automatically activate when the patient may be injured and alert emergency workers to the patient's location.

Through the benefits highlighted above, mHealth applications have evolved into several distinct categories of services, delivering basic applications through feature phones, and advanced applications through smartphones and wireless monitoring devices. Specifically, these can be categorized as:

- » Data collection and remote monitoring
- » Information dissemination
- » Disease tracking and outbreak surveillance
- » Chronic disease management
- » Remote diagnosis and treatment support
- » Emergency medical response

We cover each of these in more detail below.

DATA COLLECTION AND REMOTE MONITORING

Data collection applications provide a platform for patients or mobile health workers to gather, input, analyze, and update patient data in real time. Making it easier to collect and record data means that more data can be recorded, which helps to close information gaps, provide data on the effectiveness of health initiatives, and determine more efficient resource allocation and improve policy planning.²¹



Figure 3: Mobisante's pocket-sized ultrasound wand transforms a smartphone into a portable ultrasound machine. (Source: Mobisante)

Example 1: Smartphone Ultrasound Device

What it does:

MobiUS™ SP1 is a mobile ultrasound device that provides ultrasound images on a smartphone. The pocket-sized ultrasound wand is FDA-approved and capable of fetal, cardiac, abdominal, and pelvic scans. The system is battery powered and can be charged like a smartphone. It is Wi-Fi and 3G-enabled to transmit the images to a hospital or clinic.

How wireless helps:
Every minute, at least

²¹ Vital Wave Consulting, "mHealth for Development: The Opportunity of Mobile Technology for Healthcare in the Developing World," 2009, www.vitalwaveconsulting.com/insights/articles/mHealth.htm.

Coordinating health care workers with mHealth applications has real-world benefits:

- » mHealth applications helped prevent the spread of the H1N1 virus (swine flu) in Cambodia in 2009
- » mHealth helped coordinate medical relief efforts in Haiti after the earthquake in 2010
- » mHealth applications in Peru, Rwanda, and India have helped identify early warning signs of outbreaks before they become epidemics.

one woman in the world dies from complications related to pregnancy or childbirth, and 20 more suffer injury, infection, or disease.²² Doctors working in extremely rural or inaccessible locations now have the ability to perform an ultrasound to determine whether a woman is pregnant and detect common complications without sending patients to a faraway hospital. According to product-developer Mobisante, 70 percent of the world does not have access to ultrasound technology because it is too expensive and not portable. This product helps change that situation and will hopefully help doctors in rural areas treat patients more effectively.

Development stage: Available now.

More information: www.mobisante.com/product-overview/

Example 2: Wireless Health Data Monitoring and Recording with HealthPAL

What it does: HealthPAL, a small wireless device that looks like a first-generation mobile phone, is used to collect health data and automatically upload it to electronic health records. Users simply take standardized health readings from compatible devices for blood pressure, glucose, weight, and pulse readings, and HealthPAL automatically captures the data and wirelessly transmits it to the patient's health record.

How wireless helps: HealthPAL improves tracking and reporting of patient's health data by eliminating the need for a person to collect and manually enter data into a health record. Data collection rates are improved, and health care workers use the constant stream of updated data to identify problems before they become life-threatening. The device allows patients with chronic conditions to be monitored 24 hours a day from their home instead of requiring multiple trips to the hospital.

Development stage: Available now.

More information: <http://medapps.net/healthpal.html>

INFORMATION DISSEMINATION

Real-time information dissemination is useful for both health care workers in the field and patients. For health care workers, it means remote access to real-time information about their patient's individual health records and to the latest information on diagnosis and treatment methodologies. For patients, it means immediate access to health records and immediate access to health resources tailored to their personal needs to enable self-monitoring and thereby lower treatment costs.

Example: FrontlineSMS

What it does: FrontlineSMS is a software application used for sending and receiving group Short Message Service (SMS) messages. It was recently used across Africa to report and help monitor avian flu outbreaks, and NGOs frequently use it to conduct text-based surveys, run awareness campaigns, or provide advice to health care workers in the field. It was used to coordinate a blood donation program in Botswana, to send doctor's appointment reminders to patients in Tanzania who routinely fail to appear, and to provide HIV/AIDS information to teachers in South Africa.

²² Ibid.

How wireless helps: The unique feature of FrontlineSMS is that, unlike other bulk SMS services, it does not require internet connectivity. It works with any GSM network, which can be important in emergency situations if land-based services become unusable.

Development stage: Available and widely used.

More information: www.frontlinesms.com

DISEASE TRACKING AND OUTBREAK SURVEILLANCE

Outbreaks of infectious diseases usually begin in small pockets, which, if undetected, can quickly turn into epidemics. Wireless applications that provide platforms for field-based health care workers to track data, developments, vaccination progress, and other treatment options in real time through collaborative and centralized databases help contain potential outbreaks before they become epidemics. Applications used in Peru, Rwanda, and India have been successful in identifying early warning signs of outbreak.²³ They have also been used successfully to help track treatment for the patients during the 2009 swine flu (H1N1) outbreak in Southeast Asia and to help track disease outbreaks and deliver medical solutions after the devastating earthquake in Haiti in 2010.

Example: Preventing Disease Outbreaks with InSTEDD

What it does: Innovative Support to Emergencies Diseases and Disasters (InSTEDD) has developed a suite of wireless software tools that allow for mobile connectivity and information sharing in rural developing countries, especially when emergencies occur that could lead to outbreaks. One of InSTEDD's leading applications is GeoChat, an SMS-based program that allows distributed teams in the field to communicate with each other in real time and update shared databases of disease and treatment information, locate and see geographic visualizations of pockets of disease outbreak, and receive real-time updates and treatment guidance from teams at headquarters. The programs allow mobile teams in the field to confirm, refute, or update data on a shared map to ensure that teams know where their teammates in the field are and what they are doing in real time.

By identifying and treating diseases in their early stages health care workers can keep them from spreading and contain outbreaks. InSTEDD's tools were used to help prevent the further spread of the H1N1 virus (swine flu) in Cambodia in 2009, and they were deployed in Haiti after the earthquake in 2010 to help coordinate response efforts and knowledge-sharing through an SMS platform.

How wireless helps: InSTEDD's mobile platform allows for real-time communication and data transfer when access to the internet may be unavailable or when wired communication is impossible because of a natural disaster. The wireless tools have been particularly successful in Southeast Asia countries where disease outbreaks such as SARS, the swine flu, and avian-bird flu have originated. Health care workers in these areas often work in silos and do not have the data they need to diagnose and treat diseases. Outbreaks occur because health workers can't share information in real time. In countries where health resources are already stretched (Cambodia has 0.16 doctors for every 1,000 people, compared to 2.3 in the United States and 3.6 in Switzerland), the ability to connect in real time and from remote areas is a welcome development in the battle against disease outbreaks.

²³ Ibid.

Development stage: Available and scaling.

More information: <http://instedd.org/>

CHRONIC DISEASE MANAGEMENT

Applications that help individuals manage and record milestones and progress on diseases are targeted at patients with health conditions, such as diabetes or the administration of HIV drugs, which require constant monitoring and testing by the patient. These applications set up schedules for patients, send simple SMS reminders, and provide updated advice from physicians based on individualized data. In a 2010 study in Kenya, researchers found that applications that sent simple SMS text messages reminding patients to take HIV drugs improved adherence to the therapy by 12 percent.²⁴ A similar study in Thailand showed a 90 percent increase in adherence for tuberculosis patients.²⁵

Example: Diabetes Manager

What it does: Interactive smartphone applications help diabetes patients manage the intensive daily routines that come with managing diabetes care. Applications provided by companies such as WellDoc (described above) help patients record and track daily vital signs, including recording blood sugar levels, and can send reminders and updates to administer medicine or eat certain foods at certain times of day. A patient's physician can also monitor daily progress remotely, and the application wirelessly updates the patient's medical health records. The application currently tracks eating routines, exercise habits, sleep patterns, blood sugar levels, blood pressure, and other health inputs, and allows the doctor and patient to set goals together.



Figure 4: Glooko's Logbook and MeterSync Cable help diabetes patients easily download and organize health data to a mobile app. (Source: Glooko)

Other applications, such as Glooko's Logbook and MeterSync Cable, allow diabetes patients to move away from tracking data with pen and paper logbooks and keep data organized in a smartphone app. The MeterSync Cable connects to existing glucose meters and downloads data onto the app. The user can keep relevant notes in the app, review the data in an organized fashion, and share the data with a physician, who in turn can add the information to e-health records at

²⁴ "M-powered," *The Economist*, November 11, 2010, www.economist.com/node/17465455.

²⁵ Vital Wave Consulting, "mHealth for Development: The Opportunity of Mobile Technology for Healthcare in the Developing World," 2009, www.vitalwaveconsulting.com/insights/articles/mHealth.htm.

the doctor's office. "The application is designed to be incredibly simple for people with diabetes to use and monitor their blood sugars," explains Anita Mathew, Cofounder and Vice President of Marketing at Glooko. "Many people feel like they need an engineering degree simply to download so much data from meters. This application provides a nontechnical and easy way to download and sync with patient health records—all through your mobile phone."

How wireless helps: One study found that only 39 percent of patients with type 2 diabetes successfully manage the disease by themselves.²⁶ Wireless solutions improve recording, tracking, and adherence rates by being easy to use, helpful in terms of providing reminders and suggestions, and easy to integrate into a patient's daily life. Using the system also generates measureable health benefits.

Development stage: Available now.

More information: www.welldoc.com and www.glooko.com

REMOTE DIAGNOSIS AND TREATMENT SUPPORT

Several mHealth applications help solve the problem of too few health care professionals, particularly in rural areas of developing countries, by using mobile platforms to connect doctors in urban areas with patients in rural areas. Doctors can also help train health care workers in the field to help them diagnose diseases more accurately and to provide support and expertise for treatment options.

Example: Smartphone Touchscreen Diagnosis

What it does: Researchers in Korea are in the early stages of developing an application that will diagnose bacterial diseases by applying a small amount of saliva to a smartphone touch screen. Touchscreens work because your fingertips are able to store a small electronic charge, and the researchers are trying to figure out whether touch screens are sensitive enough to distinguish between very small changes in the electrical charges from bacteria as well. So far, the researchers have been successful in one early test. They also will likely develop a small protective film to place over the phone so as to avoid "direct application of biosamples" onto a new smartphone.

How wireless helps: Once finalized and approved, this application could be deployed in extremely remote areas to improve early diagnosis of disease and potentially prevent widespread outbreak of diseases. They could also be used to determine the extent of disease outbreak in real time, for example, by traveling among neighborhoods or villages to quickly diagnose people and determine how far an outbreak has spread.

Development stage: Experimental.

More information: www.newscientist.com/article/mg21228405.800-to-selfdiagnose-spit-on-an-iphone.html

EMERGENCY MEDICAL RESPONSE

One set of mHealth applications are geared toward elderly patients. A 2009 report predicted that 15 million wireless devices will be in use in North America

²⁶ Peyrot, M. et al, "Psychosocial problems and barriers to improved diabetes management," *Diabetic Medicine*, 2005, http://www.dawnyouth.com/documents/dawn%20materials/dawn_publications/10_psychosocial_problems_and_barriers.pdf.

by early 2012 that remotely monitor the well-being of elderly or at-risk individuals.²⁷ Most applications take advantage of wireless sensor technology that dynamically identifies emergency situations and sends automatic alerts to health care workers and family members. These applications are mostly deployed in the United States, but given the ubiquity of wireless infrastructure, they will likely expand into developing countries.

Example: Fall Detection System

What it does: Wellcore has developed a wireless sensor that can be worn on a belt to provide immediate one-touch emergency alerts, either automatically or manually. The device includes a built-in motion sensor that automatically detects when a person is falling. When a fall is detected and the patient does not respond, the device automatically sends an emergency alert to caregivers and family members. The emergency notification button on the device can also be manually activated to send an alert.

How wireless helps: The sensor's wireless mobility means that it goes with the wearer; users can live active lives with the comfort of knowing that they are protected at all times. The wireless alert also provides enhanced safety by automatically sending an alert if the user is nonresponsive.

Development stage: Available now.

More information: www.wellcore.com

Challenges to mHealth's Widespread Adoption and Deployment

Despite the exciting promise of mHealth applications, there are still several hurdles to overcome before widespread adoption and the accompanying health benefits will be realized.

- » **Insufficient guidance from regulators:** The FDA and FCC published draft regulations in 2011 to help guide mHealth developers, but industry developers are eagerly awaiting the final regulations. As one practitioner pointed out, it's frustrating for developers to know that technology with potentially significant health effects exists, but not know whether the FDA will approve it. Technology often moves faster than government, but this situation presents a particularly difficult challenge because a weak review process could put people's health at risk. It is hoped that the final regulations will provide sufficient guidance and a clear process for approval of new applications.
- » **Security concerns:** Securing sensitive private data is always a concern when untested technology is involved. One technology wizard who is also diabetic hacked into his own insulin pump machine to alter the readouts of his blood-sugar monitors. Such actions could lead to a diabetic patient receiving too much or too little insulin. Other similar attacks have already been demonstrated through pacemakers and defibrillators in experimental tests. While there is no evidence that anyone has hacked these machines maliciously, the fact that it can be done raises concerns about the widespread adoption of these devices.²⁸

²⁷ Dolan, Brian, "Report: 15M Wireless Health Devices by 2012," MobiHealthNews, July 22, 2009, <http://mobihealthnews.com/3390/report-15m-wireless-health-devices-by-2012>.

²⁸ Robertson, Jordan, *Insulin Pumps, Monitors Vulnerable to Hacking*, HuffPost, Aug. 4, 2011, http://www.huffingtonpost.com/2011/08/04/insulin-pumps-monitors-vulnerable-to-hacking_n_917987.html.

- » **Complex devices for users who are not tech-savvy:** Older people will generally be the recipients of several mHealth services. This group is generally less tech-savvy than younger generations. Will elderly people be able to effectively use mHealth devices intended for smartphone applications? What about for elderly individuals in developing countries? Perhaps a better way of evaluating mHealth products is to consider that when younger generations age over the next 20 to 50 years, they will not only know how to use these products, but they will *expect* smartphones to help them make daily health care decisions.
- » **Too many pilot programs:** A joke in the mHealth field goes that there are more pilots in mHealth than in the entire U.S. Air Force. Indeed, the majority of mHealth programs, especially in developing countries, are small pilot projects, and several are not generating accurate data on their effectiveness or demonstrating the business case by showing a clear ROI.²⁹ Before simply launching the next greatest program, perhaps there is room in mHealth space for more programs to learn from the mistakes previous projects have made and to design projects from the outset to generate useful data for the field.
- » **Lack of program coordination:** A problem related to the excess of pilots is a lack of coordination in the mHealth field among governments, developers, and funders. Coordination is important for several reasons. Field workers can become burdened with too many different phones running various programs and software; mHealth applications in Kenya, for instance, use at least seven different electronic health record systems. Plus mobile devices have not yet been integrated into business processes in several developing countries, which leads to ad hoc solutions that quickly become legacy systems.³⁰ Governments should work to identify key areas for development in mHealth and develop standards that will lay the groundwork for coordination. Developers and funders need to break through silos to ensure they are collaborating in ways that promote coordination rather than in ways that make the delivery of goods and services more difficult for field workers.

Looking Ahead

The applications described above are only the tip of the iceberg. The *New York Times* recently published an editorial describing the potential high-tech future of health care. Our “digital nervous system” of tomorrow will consist of:

Wireless sensors worn on your body and placed in your home that would continuously monitor your vital signs and track the daily activities that affect your health, counting the number of steps you take and the quantity and quality of food you eat. Wristbands would measure your levels of arousal, attention, and anxiety. Bandages would monitor cuts for infection. Your bathroom mirror would calculate your heart rate, blood pressure, and oxygen level.

Then you'd get automated advice. Software that could analyze and visually represent this data would enable you to truly understand the

²⁹ University of Cambridge and China Mobile, *Mobile Communications for Medical Care*, Apr. 21, 2011, report available from <http://mhealthinsight.com/2011/04/27/cambridge-university-launches-mhealth-report/>.

³⁰ Glassman, Amanda, “The Elusive Power of mHealth,” Center for Global Development, Global Health Policy Blog, October 4, 2011, http://blogs.cgdev.org/globalhealth/2011/10/the-elusive-power-of-mhealth.php?utm_.

impact of your behavior on your health and suggest changes to help prevent illness—by far the most effective way to cut health care costs.³¹

For this vision to become a reality, Anand Iyer of WellDoc believes that all mHealth applications must continue to do three things or the industry will fail:

- » Applications must continue to show health outcomes through clinical trials. This is paramount for obvious reasons—if the products can't demonstrate through rigorous study that they are improving people's health, then people won't use them.
- » Applications must be available on multiple platforms. Not everyone has a smartphone. Some elderly patients may not feel comfortable using smartphones, but could benefit tremendously from the services mHealth applications can provide. Developers need to think broadly about how their services can reach the greatest number of people.
- » Applications must be integrated into the clinical workflow. They must improve the doctor-patient relationship through greater connectivity and information flows. Many mHealth applications are as helpful to the patients as they are to doctors, which will only strengthen the industry's foundation.

The demand for mHealth services and applications has never been greater. Although there will be challenges, the surge in mHealth applications over the past five years and the growing body of evidence that they are improving the health of people and communities all over the world will only strengthen the industry in the future.

³¹ Moss, Frank, "Our High-Tech Health-Care Future," *New York Times*, November 9, 2011, www.nytimes.com/2011/11/10/opinion/our-high-tech-health-care-future.html?_r=3.

Underbanked: May have current checking account and/or current savings account if individual made one or more non-bank financial transactions in the past 30 days.

Unbanked: No current checking account and no current savings account.

Source: Center for Financial Services Innovation, 2008

Financial Information and Services

The challenge: Expanding Financial Access and Capabilities

Without a bank account, life is different. Depositing a paycheck means paying a check-cashing fee. Paying bills or sending funds—perhaps to relatives overseas—requires money orders and more fees. Everything requires cash and it is very difficult to save money safely.

Yet if you, like most Americans, have a cell phone, you can use it as the teller window of the 21st century. You can deposit funds to a mobile account, transfer money electronically to relatives overseas, pay for goods using mobile money, and carry less cash. If you have a little money left over, you can easily put it into a savings account, watch it accrue, tap into it when you need to, and know that it is safe (and bearing interest). All the while, you are paying fewer fees and building credit. Because you are concerned about incurring fees from the bank, you signed up to receive text messages when your balance gets low or you are at risk of garnering a fee.

Avoiding fees, after all, is a high-impact way of helping people keep money in their wallets. President Bill Clinton and California Governor Arnold Schwarzenegger wrote that, “Over a lifetime, the average full-time, unbanked worker will spend more than [US]\$40,000 just to turn his or her salary into cash.”³² As a result of saving such fees, Clinton and Schwarzenegger went on to assert that shifting the unbanked into the financial mainstream, “will put money in the pockets of individuals and grow the economy.”³³

The unbanked and underbanked represent a large potential market too. According to an article in *Forbes* citing U.S. data from Core Innovation Capital and the Center for Financial Services Innovation, “People who don’t rely on banks for their financial needs spend [US]\$45 billion in fees and interest alone.”³⁴ These funds covered the processing of about US\$455 billion in 2010.³⁵ In the United States alone then, there are enormous opportunities to reduce and redirect money spent on fees and interest to more constructive financial services that serve the unbanked and underbanked.

Not having a bank account presents difficulties for businesses too. For a business, the inability to access simple financial tools can make it difficult to pay employees, find the best prices for inputs, conduct transactions with customers, optimize operations, and get the financial services required to grow. As a result, improving financial services capabilities has the potential to profoundly improve peoples’ lives, driving economic and societal benefits.

The Role of Wireless Technology

Mobile technology is already providing powerful and exciting ways to reach the unbanked and underbanked, as well as to facilitate simpler and more convenient financial transactions for all. Beyond what is already happening, there is enormous additional potential in the United States and globally.

³² Clinton, William J., and Arnold Schwarzenegger, “Beyond Payday Loans,” *Wall Street Journal*, January 24, 2008, <http://online.wsj.com/article/SB120113610711211855.html>.

³³ Ibid.

³⁴ Schütte, Arjan, “Not Unbanked: Untapped. Underserved Spend \$45B on Financial Services,” *Forbes*, November 2, 2011, www.forbes.com/sites/arjanschutte/2011/11/02/not-unbanked-untapped-underserved-spend-45b-on-financial-services/.

³⁵ Ibid.

“Mobile banking has the potential to be transformational because:

- » It uses existing mobile communications infrastructure which already reaches unbanked people.
- » It may be driven by new players, such as telecommunication companies, with different target markets from traditional banks.
- » It may harness the power of new distribution networks for cash transactions, such as airtime merchants, beyond the conventional merchant POS or ATM networks of banks.
- » It may be cheaper than conventional banking, if the offering is competitive.”

Source: David Porteous, “The Enabling Environment for Mobile Banking in Africa” 2006

Wireless-enabled financial services and information systems can take many forms. The provider might be a telecommunications company, an established financial institution, an NGO, an entrepreneurial endeavor, or some partnership among those parties. Furthermore, the range of wireless-enabled financial services is broad and can cover everything from money transfers to bank accounts to market intelligence for businesses. Different approaches and services will work better for different purposes and operating environments. Ultimately, each market will determine the best approaches to serve its needs.³⁶

Mobile financial services and information systems can also play different roles depending on whom they serve. Some services are additive, such that “the



Figure 5: Mobile banking can create new opportunities for financial institutions, existing bank consumers, and the underbanked and unbanked.

mobile phone is merely another channel to an existing bank account.” Other services are transformative, where “the financial product linked to the use of the phone is targeted at the unbanked, who are largely low-income people.”³⁷ In either case, mobile solutions can expand and facilitate access. Even in the case of additive services, there is potential to make it easier for people to use services, even if they already have an account. Given that the underbanked have bank accounts but still spend large sums on services, there are likely opportunities to use mobile technology to make it easier for people to use existing services and avoid fees.

Mobile banking also offers financial institutions efficiencies, value, and opportunities. Check deposits, account transfers, balance inquiries—such mobile services can help banks provide easier, less expensive, and more efficient customer service. The benefits to financial institutions are particularly notable for traditionally underserved populations. An article in the *Asian Journal of Communication* notes, “Financial institutions, which have had difficulty providing profitable services through traditional channels to poor clients, see m-banking/m-payments as a form of ‘branchless banking’ . . . which lowers the costs of serving low-income customers.”³⁸ Thus, mobile technology has the potential to lower banking costs and change business models to enable wider service to the poor and underbanked.

³⁶ Donner, Jonathan, and Camillo Tellez, “Mobile Banking and Economic Development: Linking Adoption, Impact, and Use,” *Asian Journal of Communication*, 18(4), 2008, www.jonathandonner.com/donner_tellez_mbanking_use.pdf.

³⁷ Porteous, David, “The Enabling Environment for Mobile Banking in Africa,” Department for International Development, <http://www.bankablefrontier.com/assets/pdfs/ee.mobil.banking.report.v3.1.pdf>.

³⁸ Donner, Jonathan, and Camillo Tellez, “Mobile Banking and Economic Development: Linking Adoption, Impact, and Use,” *Asian Journal of Communication*, 18(4), 2008, www.jonathandonner.com/donner_tellez_mbanking_use.pdf.

Among all of these different forms and services, there is strong potential for wireless technology to enable effective and compelling financial solutions. Mobile phones can enable greater access to financial tools, improve personal financial management, increase access to important information about markets, and enable mobile money and payments.

“U.S. consumers who lack a depository bank or credit union account are:

- » Less likely to have a landline phone connection, by 10 percentage points
- » More likely to have a mobile phone, by six percentage points
- » Slightly more likely to own a smartphone”

“Sixty-eight percent of underbanked consumers own a mobile phone, therefore, reaching the underbanked by mobile is ideal.”

Javelin Strategy & Research, 2011

WIRELESS CAN INCREASE ACCESS TO FINANCIAL SERVICES

According to the Federal Deposit Insurance Corporation (FDIC), an estimated 7.7 percent of U.S. households—approximately 9 million—are unbanked, with at least 17 million adults residing in these households. Other estimates put the number of unbanked Americans as high as 50 million.³⁹ The FDIC indicates that a further 21 million households are underbanked, covering about 43 million people. Among certain demographics the numbers are particularly high. For example, an estimated 21.7 percent of black households are unbanked, along with 19.3 percent of Hispanic households.⁴⁰ It's easy to think of insufficient financial services purely as a problem of the developing world, but these figures highlight that lack of access is a problem even in the United States.

Globally, though, the numbers are even more staggering. As of 2009, 2.5 billion adults did not use formal financial services. In Asia, Africa, Latin America, and the Middle East, 62 percent of adults were not served.⁴¹

At the same time, access to mobile phones is widespread and growing. In the United States, there are around 323 million wireless subscriber connections—greater than the population. Furthermore, more than 30 percent of U.S. households are wireless only.⁴² Globally, there are more than 6 billion mobile phone connections. Given uneven distribution patterns, this statistic does not mean that nearly everyone in the world has a mobile phone. However, access to a mobile phone is common and proliferating.

All of these figures point to significant numbers of unbanked and underbanked who have access to mobile phones. In the United States, according to Javelin Strategy & Research, “68 percent of underbanked consumers own a mobile phone therefore reaching the underbanked by mobile is ideal.”⁴³ Globally, the Consultative Group to Assist the Poor and the GSM (Global System for Mobile Communications) Association estimate that, “By the year 2012 . . . there will be 1.7 billion people with a mobile phone but not a bank account.” Furthermore, they note that, “As many as 364 million unbanked people could be reached by agent-networked banking through mobile phones.”⁴⁴ There are surely others who have bank accounts and might not qualify as “underbanked,” but who might use more services if they had easier access through mobile phones.

³⁹ Roberts-Grey, Gina, “The Plight of the Unbanked: Why 50 Million Americans Don’t Use a Traditional Bank,” *Daily Finance*, November 6, 2009, www.dailyfinance.com/2009/11/06/the-plight-of-the-unbanked-why-50-million-americans-dont-use-a/.

⁴⁰ FDIC, “Survey of Unbanked and Underbanked Households,” December 2009, www.fdic.gov/householdsurvey/full_report.pdf. Given that these figures date to 2008, it is possible that the numbers of unbanked and underbanked have grown in the wake of national financial turmoil.

⁴¹ Financial Access Initiative, “Half the World Is Unbanked,” October 2009, http://mckinseyonsociety.com/downloads/reports/Economic-Development/Half_the_world_is_unbanked.pdf.

⁴² National Center for Health Statistics, “Early Release of Estimates from the National Health Interview Survey, January – June 2011,” December 2011, cited in CTIA Advocacy, “Wireless Quick Facts,” <http://ctia.org/advocacy/research/index.cfm/aid/10323>.

⁴³ Javelin Strategy & Research, “Engaging the Underbanked and Unbanked in the U.S.,” www.javelinstrategy.com/Engaging-the-Underbanked-and-Unbanked-in-the-U-S-How-to-Target-the-Growing-Immigrant-Population-Through-Mobile-Financial-Services.

⁴⁴ CGAP, “Mobile Banking Overview,” www.cgap.org/p/site/c/template.rc/1.11.14910/.

Reasons for remaining unbanked vary. In the United States, the reasons are often financial. More than one-third of never-banked households cited not having enough money to need an account as the key reason for not having a bank account. Others noted that they do not write enough checks to merit an account or that they are concerned about high minimum balance requirements. Some people without bank accounts cite prior bad experiences with banks. Still, many offered reasons that could be remedied by easier access to mobile banking, such as inconvenient bank hours and feeling banks to be uncomfortable or unwelcoming.⁴⁵ The prevalence, convenience, and accessibility of alternative financial transaction services—such as check cashing businesses—attract many customers. There are many neighborhoods in the United States where check-cashing facilities are ubiquitous, but there are no bank branches.

In the developing world, reasons for lower banking rates may differ. With fewer stable and affordable banking solutions and more difficult physical access, there are simply fewer viable banking options. In those areas, mobile banking can offer easier service to people who have bank accounts as well as the opportunity for the previously unbanked to access financial services.

Wireless also has an important role to play in financial services for businesses. The idea of “global business” is the stuff of hackneyed speeches and annual report stock photos. For decades, technology has helped multinational corporations operate nearly anywhere, anytime. Yet lack of technological access has left many people out of these enormous shifts. In both developed and developing economies, many people are still bringing paper to a pixel fight—or were, until recently.

Beyond more basic, individual-focused mobile financial services, wireless enables a raft of financial tools for enterprises. These tools include access to market information, as well as to services such as financing, insurance, and payments. Such tools can have an impact everywhere from grain markets in Niger to flea markets in Brooklyn.

It is important to note that the ultimate effects of these tools are still being determined in the developing world. Preliminary evidence indicates that—rather than reaching new enterprises—mobile technology primarily improves existing businesses. As one researcher explains, “[W]ithin the [micro and small enterprise] sector, benefits of mobile use accrue mostly (but not exclusively) to existing enterprises, in ways that amplify and accelerate material and informational flows, rather than fundamentally transform them.”⁴⁶ These benefits are, nonetheless, still valuable in improving economic and social conditions in the developing world.

And while these effects are most evident in the developing world, they are also important in the United States and other developed countries. Some small-scale businesses might be underbanked and cash-reliant. In those instances, using electronic payments and financial services can lower cash needs to improve security, improve cash flow management, and make it easier to accept electronic payments to access new customers. Mobile technology thus plays a role in improving financial capabilities, economic growth, and concordant social areas even in the developed world.

⁴⁵ FDIC, “Survey of Unbanked and Underbanked Households,” December 2009, www.fdic.gov/householdsurvey/full_report.pdf.

⁴⁶ Donner, Jonathan, and Marcela X. Escobari, “A Review of Evidence on Mobile Use by Micro and Small Enterprises in Developing Countries,” *Journal of International Development*, July, 2010, www3.interscience.wiley.com/journal/123566679/abstract.

IMPROVING ACCESS TO FINANCIAL INFORMATION FOR CONSUMERS AND BUSINESSES

Everyone hates hidden fees and costs. Beyond creating consumer frustration, however, these costs can turn people away from banks. Instead of unknowingly incurring a fee when their balance is low, with mobile technology, consumers can receive a simple, timely, targeted SMS alert. The feeling of “not knowing where you stand financially” can be alleviated with mobile information. Through such simple mobile tools, wireless technology can provide more information and capabilities to promote better financial management.

These tools can be as simple as the SMS message described above or as complex as a full-featured smartphone application. For example, in 2010 the Center for Financial Services Innovation (CFSI) partnered with Ready Credit Corporation, a prepaid program manager, on a program to assess how email

Mobile Service	Description
Account Alerts	Customers can set up alerts that are triggered when the account reaches a certain threshold balance; the financial provider then pushes this information out to the consumer automatically.
Balance Inquiries	Account holders can request various types of information, including transaction history, by texting codes to the financial institution.
Messaging and Reminders	Mobile phones can be used to transmit information to consumers about, for example, how to reduce certain costs (e.g. the fees assessed at foreign ATMs), or to remind a customer about a pre-defined savings goal.
Bill Pay and Alerts	Although bill pay is not generally available via text message, reminders about bills coming due soon can be issued automatically through text messages.
ATM Locations	Text message codes can be used to request information about the nearest ATM, and about the nearest ATM with the most favorable fee structure.

Table 1: Financial Capability Features on Mobile Phones, table contents quoted directly from CFSI⁴⁷

messages could change behavior. The program involved sending targeted email messages with tips about how to avoid or reduce ATM fees. Those who opened the emails made an average of 6.7 fewer ATM transactions per month, driving more than US\$11 in savings per person each month.⁴⁸ This study demonstrates the potential for simple, targeted messages to change financial management behavior. And while the study used email rather than text messages because of

⁴⁷ Chart is visually adapted from content in Kate Marshall et al., “Reaching Underbanked Consumers Through Mobile Services,” CFSI, 2011, <http://cfsinnovation.com/content/reaching-underbanked-consumers-through-mobile-services>.

⁴⁸ “Can Email Alerts Change Behavior? An Experiment with Ready Credit Corporation,” CFSI, June 2010, http://cfsinnovation.com/system/files/inbrief_RedyCredit_june2010.pdf.

opt-in rules for text messages, SMS reminders are far more likely to be opened and could have an even broader impact.⁴⁹ Furthermore, a host of other mobile services are possible, as outlined by groups such as CFSI (see Table 1).

Mobile phones also help increase the financial and business capabilities of businesses by providing access to financial and market information. Many enterprises, particularly in the developing world, are beset with a lack of quality, timely, and diverse information. For example, a review of recent literature concluded that in Kenya and Botswana, “Enterprises relied on informal information sourcing, which was largely inadequate for their needs and which resulted in high search costs and poor quality information.”⁵⁰ Mobile technology can deliver simple, accurate, and crucial financial and market information. This access to high-quality information in turn helps businesses optimize production and sales, as well as minimize opportunity and transaction costs associated with searching for market information (e.g., visiting a market in person to check prices).

For example, a study of the use of mobile phones in grain markets in Niger found that the financial information available through mobile phone contacts had a positive impact on enterprise. “The primary mechanism by which cell phones



Figure 6: Mobile technology helps farmers find the best markets in which to sell their goods, thereby decreasing search costs, increasing availability, and improving economies.

affect market-level outcomes appears to be a reduction in search costs, as grain traders operating in markets with cell phone coverage search over a greater number of markets and sell in more markets. The results suggest that cell phones improved consumer and trader welfare in Niger, perhaps averting an even worse outcome during the 2005 food crisis.”⁵¹ Improved financial information, then, can have valuable effects on economic and social issues. Similar examples that cover dairy farming in Bhutan and onion trading in Ghana

demonstrate the value of mobile phones for delivering financial services through pricing information.⁵²

ENABLING MOBILE ACCOUNTS, PAYMENTS, AND MONEY TRANSFERS

Mobile accounts, payments, and transfers are an increasingly important financial service. Mobile technology enables the flow of funds among people and businesses that were once difficult or impossible to reach. Mobile payments enable more distant transactions, lower transaction costs, increase security by

⁴⁹ Marshall, Kate et al., “Reaching Underbanked Consumers Through Mobile Services,” CFSI, 2011, <http://cfsinnovation.com/content/reaching-underbanked-consumers-through-mobile-services>.

⁵⁰ UN Conference on Trade and Development (UNCTAD), *Information Economy Report, 2010: ICTs, Enterprises, and Poverty Alleviation*, UN, 2010, www.unctad.org/en/docs/ier2010_embargo2010_en.pdf.

⁵¹ Aker, Jenny C., *Does Digital Divide or Provide? The Impact of Cell Phones on Grain Markets in Niger*, University of California, Berkeley, Job Market Paper, January 15, 2008, www.cgdev.org/doc/events/2.12.08/Aker_Job_Market_Paper_15jan08_2.pdf.

⁵² UN Conference on Trade and Development (UNCTAD), *Information Economy Report, 2010: ICTs, Enterprises, and Poverty Alleviation*, UN, 2010, www.unctad.org/en/docs/ier2010_embargo2010_en.pdf.

“Mobile banking is gaining more popularity with the underbanked than it is with conventional bank customers.”

For the underbanked, who use the service with prepaid cards, the attraction of mobile banking lies in its price, ease-of-access and portability, compared to other means of going online.”

Daniel Wolfe, American Banker, August 2010

lowering reliance on cash, and allow businesses to access more customers. These payments are already a huge force and are growing rapidly. By 2015, it is estimated that the total mobile payments market will be worth more than US\$670 billion, with the most activity in North America.⁵³ These payments enable easier payrolls, greater reach to suppliers, access to additional customers, and other elements that are key to fostering business success.

Several technologies are bringing mobile payments to life, particularly in the United States. For example, Square is a company that provides users with the ability to easily accept credit card payments on their smartphones. The company makes a tiny credit card reader that users plug into a smartphone and use to scan cards. This technology and others like it have become popular among small businesses and individuals as a low-cost, easy, and mobile way to accept electronic payments.⁵⁴ Google Wallet is another example of a mobile transaction technology. Google Wallet lets a user pay for goods and services with a credit or debit card by flashing his or her mobile phone. Near Field Communication technology is used to securely transmit payment information to a credit card reader. Mobile technologies like these allow small businesses to reach more customers, people to purchase more securely, and all to build a more dynamic and strong economy.

Furthermore, for people without access to formal banking services—in the United States and abroad—mobile money is a powerful tool for transferring funds. Rather than traveling to wire transfer locations, paying fees, and handling cash, people can simply use a mobile phone to send and receive funds. This approach can prove more secure, convenient, and less costly. Juniper Research projects that the global mobile remittance flows will increase from an estimated US\$12 billion in 2011 to almost US\$55 billion in 2015. This transfer of funds has an enormous impact on global economics and social conditions, representing a major source of funds for the world's poor. It is not solely a matter for developing countries though. Because many of the funds are flowing from developed economies like that of the United States, it is an important force in domestic economic and social issues as well.

Another way in which mobile devices enable accessible financial services is through prepaid programs. These programs allow consumers to use cash at local stores to load mobile phone debit accounts. They can then use the phones and mobile internet platforms to pay for goods and services, check account balances, and even issue paper checks. Prepaid accounts offer consumers many of the benefits of a banking experience—in terms of fees, services, security, etc.—without having to open a bank account. This industry is evolving rapidly, led by companies such as Plastyc. As the CFSI concluded, “Thus, one of the best roles for mobile financial services for the U.S. underbanked population may be to increase access to [general purpose reloadable] prepaid accounts. We see clear opportunities for partnerships between prepaid mobile operators and prepaid program managers for improving access to financial services.”⁵⁵

⁵³ Juniper Research, *Mobile Money Goes Mainstream*, www.juniperresearch.com/shop/download_whitepaper.php?whitepaper=143.

⁵⁴ Madrigal, Alexis, “Square, the iPhone Credit Card Machine, Goes Mainstream,” *The Atlantic*, August 26, 2011, www.theatlantic.com/technology/archive/2011/08/square-the-iphone-credit-card-machine-goes-mainstream/244088/.

⁵⁵ Marshall, Kate et al., “Reaching Underbanked Consumers Through Mobile Services,” CFSI, 2011, <http://cfsinnovation.com/content/reaching-underbanked-consumers-through-mobile-services>.

Challenges and Looking Ahead

In many of the cases discussed, the use of mobile technology to facilitate global financial information systems and financial services is still in its early stages. Studies to assess the precise effects of these systems are emerging. Perhaps the biggest challenge to overcome is the dearth of information about mobile financial services. There is a limited amount of hard data on current use, potential, and best practices. This challenge is only increased by the diversity of customers, geographies, existing infrastructures, cultural norms, and economic factors that must be considered when rolling out mobile financial services. Going forward, it is critical for all parties—including businesses, financial services institutions, telecommunications providers, governments, and public service groups—to invest in studying and experimenting with different approaches to discover the keys to success. It is important to recognize that this is not a charity endeavor; this is a real market with real potential to improve the lives of individuals and the strength of economies.

In the end, many people and businesses lack access to financial services and information, but they do have access to mobile phones, which are an excellent conduit for delivering financial services. Mobile phones are playing a huge role in improving the reach and quality of financial services in the United States and abroad, and that role will only grow. It is up to regulators, potential providers, and civil society partners to collaborate to expand access and tools for mobile financial services. Such endeavors are already having a profound impact on economic and social conditions, an effect that will only grow with the market.

Education

Sitting with a teacher in the corner of the classroom, a student takes a one-minute literacy assessment on a handheld device. The student—eager to see how she did—immediately checks her score with the teacher to assess her progress. The teacher then suggests a few additional lessons for the student, which the student downloads at home using her school-issued wireless tablet. She uses the tablet to send a message to a classmate when she is stuck on a tough problem, and looks up some crucial definitions online. Her work zips along over a 4G network, even though the student's family does not have a computer or home internet connection. A few weeks later, another one-minute assessment demonstrates improvement, to the teacher's and student's delight. The teacher suggests new lessons, the student downloads them, and the progress continues.

As U.S. schools continue to experiment with and roll out wireless educational technology, such stories—or components of them—are increasingly common. Only a few years ago, schools were struggling to keep mobile phones and internet devices out of kids' hands. Now, many schools are doing their best to encourage students to use smartphones, tablets, and laptops featuring wireless technology. Many people in education and the technology industry now see wireless-enabled technology as a critical tool to enhance students' learning experiences and provide powerful educational opportunities. School systems throughout the country—in states such as Michigan, Maine, and Texas—are deploying 1:1 tablet programs to give each student a tablet computer.⁵⁶

The Challenge: Improving Education and Opportunities

The U.S. educational system is struggling. Among Organisation for Economic Co-Operation and Development (OECD) countries in 2009, scores from the Programme for International Student Assessment ranked U.S. students 14th out of 34 in reading and 25th out of 34 in mathematics. Only eight OECD countries have lower high school graduation rates.⁵⁷

Improvements to the education system are important for many reasons, including economic. In 2010, attaining a high school diploma correlated to a 41% increase in median weekly earnings and a 4.6 percentage point decrease in the unemployment rate compared to individuals with “less than a high school diploma”. Completing an Associate Degree correlated to a 73% increase in median weekly earnings and 7.9 percentage point decrease in the unemployment rate compared to those without a high school diploma.⁵⁸ These correlations highlight the potential value of education to individuals and the nation.

Educators are searching for ways to increase educational effectiveness, especially with the recent focus on student and teacher performance evaluation.

⁵⁶ Smith, Mark W., “iPads for Every High School Student in Michigan District,” *Detroit Free Press*, September 20, 2011, www.usatoday.com/tech/news/story/2011-09-20/schools-education-ipad-students/50480836/1; Porter, Tom, “Maine Schools Give iPads to Kindergartners,” *Voice of America*, November 7, 2011, www.voanews.com/english/news/usa/Maine-School-Gives-iPads-to-Kindergartners-133369053.html; HP, “HP Tablet PC Technology Chosen for 1:1 Program,” <http://h20195.www2.hp.com/v2/GetPDF.aspx/4AA0-2515ENW.pdf>.

⁵⁷ Armario, Christine, “‘Wake-up call’: U.S. students trail global leaders,” *MSNBC.com*, December 7, 2010, www.msnbc.msn.com/id/40544897/ns/us_news-life/#.TzBeGMVAYbQ.

⁵⁸ Bureau of Labor Statistics, “Education pays...,” May 4, 2011, www.bls.gov/emp/ep_chart_001.htm.

Combined with funding pressures, many in the education community are seeking radical innovations to enhance learning, schools, and measurable educational outcomes.



Figure 7: Mobile technology can put stacks of textbooks on a tablet, adding interactive elements, web information, and easy updates.

Technology could improve education dramatically, and some people have looked to the internet and computers as important educational tools. These technologies certainly have potential, but there are limiting factors. For example, wiring classrooms for the internet can be an expense and infrastructure challenge. Outside of schools, many students lack wired internet and computer access at home. FCC Chairman Julius Genachowski noted, “Unfortunately, more than 13 million school-age children don’t have broadband at home, and many have only limited access to broadband connections at school. That means 25 percent of U.S. children—one out every four kids—are missing out on the opportunities of broadband.”⁵⁹ Despite the promise of technology to improve education, infrastructure and access are leaving out many American children.

Internationally, educators are also trying to find ways to provide opportunities to children in developing countries. Many domestic education and access problems are only exacerbated in other parts of the world. Often, children have minimal access to the resources and infrastructure that are vital to providing a basic education. This limited access affects global education, development, social issues, and economic vitality.

The Role of Wireless Technology

Wireless technology can play a valuable role in improving education in—and out—of the classroom. It does so in at least three ways:

⁵⁹ Prabhu, Maya, “FCC announces Children’s Agenda for broadband,” eSchool News, March 15, 2010, www.eschoolnews.com/2010/03/15/fcc-announces-childrens-agenda-for-broadband.

- » **Creating “asynchronous, anywhere” learning opportunities.** With wireless technology, students can learn whenever, wherever—they no longer need to be in the classroom with a teacher during school hours to learn and engage. Students can learn on their own, engage in educational activities, and interact at their own pace and at any time. They can search for guidance, collaborate with classmates, and become teachers themselves. Especially where infrastructure and wired access are lacking or are too costly for households, wireless can provide important access to educational technology tools.
- » **Providing wireless within school walls.** Many schools lack the wired infrastructure to securely support network access for a high proportion of their students. Accessing existing wireless broadband networks obviates the need for wired infrastructure and the associated investment. In the United States, this option can facilitate access in underserved areas and for old facilities; in the developing world, it offers the opportunity to leapfrog wired infrastructure to connect remote areas to the network.
- » **Enabling a range of teaching tools.** These tools foster improved assessment and guidance, increased interactivity with material and peers, enhanced student-teacher interaction, customized learning experiences, student-driven learning, and location-based lessons.

The advantages of wireless manifest in many ways, including in classroom applications, educational programs, digital textbooks, and other educational opportunities in underserved areas.

CLASSROOM APPLICATIONS

Wireless educational technology can create comprehensive educational technology platforms to improve classroom work. These platforms can cover almost any aspect of the educational experience, including lessons, information access, collaboration, teacher organizational tools, and assessment programs. Such platforms create new opportunities to increase the efficiency and effectiveness of classrooms, and provide opportunities to expand the learning environment to students' homes.

For example, Wireless Generation develops wireless educational technology. The company's mCLASS programs center on using rapid student assessments to track student progress, encourage improvement, and provide teachers with valuable information to help them work with students. Based on the results of two studies, a white paper by the company looked at how one-minute, teacher-administered assessments performed on handheld devices improved literacy outcomes. The paper examined data from 200,000 students and found that more frequent progress monitoring assessments enabled by handheld devices drove strong improvements in literacy. The paper concluded that “progress monitoring has an impact on students' academic growth. More specifically, [the results] imply that students who receive frequent progress monitoring are experiencing greater reading gains than those students who receive infrequent or no progress monitoring.”⁶⁰

Wireless Generation cited three key reasons why progress monitoring improved outcomes. First, the exercise provided an opportunity for teachers and students to sit quietly and read a text, with the teachers able to closely monitor the

“The results are instant; you can Progress Monitor every day. The mCLASS:DIBELS web reports give you an overview of whether a child has been Progress Monitored, benchmarked, and a breakdown of their subsequent proficiency levels over time. And because it is so quick and so accurate, the teachers have a 99.9 percent confidence rate in how they approach student instruction.”

*Lawrence Grisanti,
Reading First Elementary
School Principal,
Buffalo Public Schools*

⁶⁰ Hupert, Naomi et al., *An Analysis of Technology-Assisted Progress Monitoring to Drive Improved Student Outcomes*, Wireless Generation, August 2006 (rev. October 2007), www.wirelessgeneration.com/pdf/white-papers/Progress_Monitoring_White_Paper.pdf.

“For these students mobile devices and internet access empower them to fully participate in their learning in a more engaging, interactive and relevant way

Students are demonstrating that the ability to discuss problem-solving strategies and teach each other math translates into success on their North Carolina End of Course assessments.”

*Project Tomorrow,
Project K-Nect Evaluation
Report, 2010*

students’ reading. Second, by giving immediate feedback, the program encouraged students to participate in the process and engage in their own improvement. Third, the progress monitoring enabled teachers to tailor goals and lessons to students based on their performance.

The Wireless Generation software has been implemented successfully several times. For example, one year after deploying the literacy program in Buffalo Public Schools, “29 percent of students in BPS’ Reading First Schools moved out of the Intensive category, the . . . category for students who require the greatest support and intervention.”⁶¹ After a second year, 43 percent of students moved out of the Intensive category.⁶² While mCLASS does not require a cellular connection, a cellular connection allows the software to work wirelessly in schools and areas without Wi-Fi infrastructure.

Project K-Nect is a wireless program that further demonstrates the power of mobile educational technology. Funded in part by Qualcomm’s Wireless Reach initiative, the project was implemented in multiple schools in Onslow County, North Carolina, in spring 2008. Giving math students smartphones, the program enabled an asynchronous, learn-anywhere environment where students could “use mobile devices to look up information on the Internet, communicate with classmates, receive alerts about homework and tests, and work on projects with classmates.”⁶³ In doing so, mobile devices changed the learning environment: “The teachers report [that] they now rely more on facilitation and less on direct instruction, encourage students to talk with and teach each other, and create relevance for students by creating assignments that help them see math in their world outside of the classroom.”⁶⁴ Project K-Nect, then, effectively used technology to foster a more interactive, engaged, and student-driven classroom environment.

Participants in the Project K-Nect demonstrated impressive results. Students showed a dramatic increase in confidence and interest in studying math: 85 percent of participants reported feeling more successful in math, and 94 percent reported increased confidence as they became more comfortable with the subject. More than half of participants are now thinking about a career in math “as a result of participating in Project K-Nect.” Furthermore, participants achieved higher test scores than their peers, as shown in Figure 8 by the K-Nect Student scores from the SouthWest and Dixon schools.⁶⁵

⁶¹ Wireless Generation, *Buffalo Public Schools and the mCLASS:DIBELS Software*, www.wirelessgeneration.com/pdf/case-studies/DIBELS_Results_Buffalo_CaseStudy_2006_01.pdf.

⁶² Ibid.

⁶³ Project Tomorrow, “Students leverage the power of mobile devices through the Project K-Nect Mobile Learning Initiative in Onslow County,” www.tomorrow.org/docs/Project_K-Nect_EvaluationReport_Final_Jul7.pdf.

⁶⁴ Ibid.

⁶⁵ Ibid.

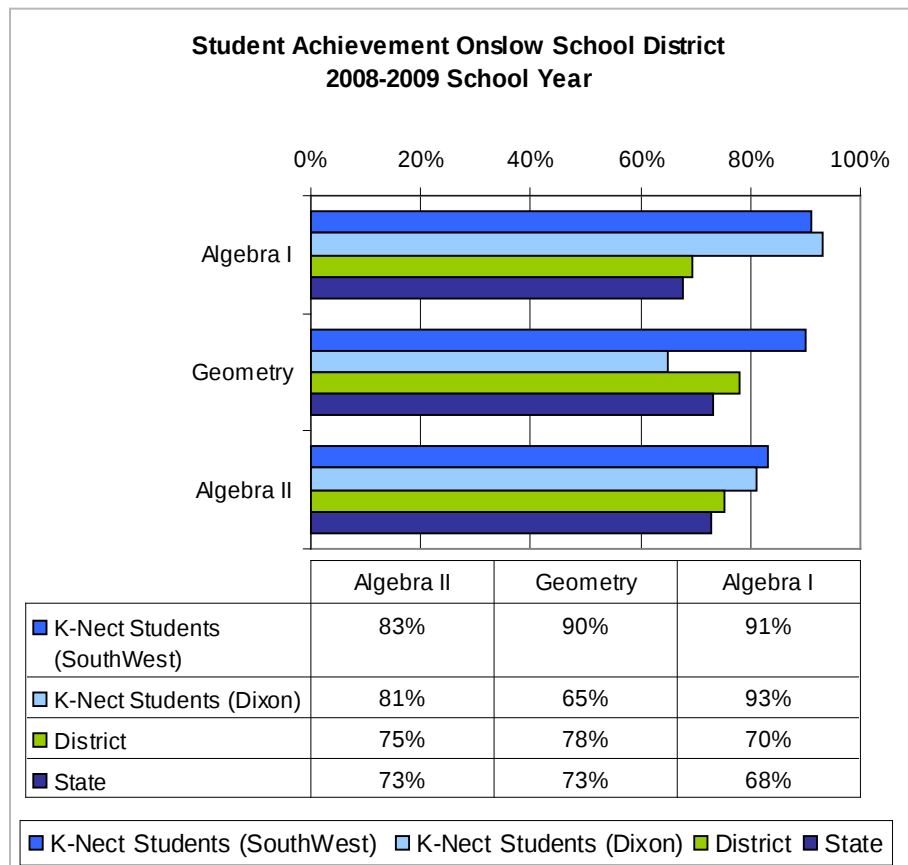


Figure 8: Student Achievement Onslow School District, 2008-2009 School Year, North Carolina, End of Course Assessment Test Scores. (Source: K-Nect)

GENERAL EDUCATION PROGRAMS

On mobile phones and tablets, education apps provide exciting and fun educational opportunities. Apps can help students study and learn in a variety of ways, including remembering information, understanding lessons, applying lessons, analyzing information, evaluating ideas, and working creatively.⁶⁶

An excellent example of an educational app is the Star Walk app for Apple's iOS. The app allows for "augmented stargazing" in which users can point a mobile phone or tablet at the sky to reveal astronomy data, pictures, and other information about wherever they are looking.⁶⁷ This is something no textbook or traditional computer can provide, but wireless and mobile devices make such an enthralling learning experience possible.⁶⁸

Language learning is another area where mobile technology creates innovative educational opportunities. Voxy, for instance, is a "flexible, contextual, convenient and fun" app for learning a new language. Available through multiple channels including SMS and mobile devices, Voxy uses lessons, media stories, quizzes,

⁶⁶ Darrow, Diane, "K-5 iPad Apps According to Bloom's Taxonomy," Edutopia, October 25, 2011, www.edutopia.org/ipad-apps-elementary-blooms-taxonomy-diane-darrow.

⁶⁷ Apple iTunes, "Star Walk—5 Stars Astronomy Guide," <http://itunes.apple.com/us/app/star-walk-5-stars-astronomy/id295430577?mt=8>.

⁶⁸ Voxy Blog, "Voxy iPhone App Turns Your Location Into a Language Classroom," Voxy, <http://voxy.com/blog/index.php/2011/04/voxy-location-based-iphone/>.

"When we talk about transitioning to digital textbooks, we're not just talking about giving students e-readers so they no longer have to carry around backpacks filled with 50 pounds of often out-of-date textbooks.

We're talking about students having interactive learning devices that can offer lessons personalized to their learning style and level, and enable real-time feedback to parents, teachers, or tutors.

Imagine a student who has trouble doing his geometry homework; the digital textbook automatically inserts a supplemental lesson.

Imagine a teacher who has instant access to the results of a pop quiz; she can immediately see that four of her students didn't understand the concept of photosynthesis and is able to offer an extra lesson."

Julius Genachowski, FCC Chairman, February 2012

and other tools to teach. On the mobile app, users can get language lessons based on their geographic location.⁶⁹ For example, if the user is in a bank, Voxy can provide a lesson on the vocabulary commonly used for banking transactions.⁷⁰ Voxy is also available for use in schools.⁷¹

Mobile phones and tablets also bring to life new possibilities for educational games that can students can use anywhere, participate in with other students, and leverage the full resources of the mobile web to learn with. Since many students already have mobile phones, creating fun, engaging educational games is a powerful way to put nearly unlimited learning opportunities into each student's pocket.

DIGITAL TEXTBOOKS

The idea of a tattered, printed textbook full of someone else's highlights may someday look outdated. Wireless, mobile technology is helping pave the way for innovative textbooks to improve education. With textbooks on wireless tablets, students can follow links to videos or images, upload and download content, receive timely updates, exchange ideas with classmates, and engage in a much more interactive experience.

Several companies provide and develop digital textbooks. Companies such as Kno and Inkling offer e-textbooks and related software, sometimes in partnership with major publishers of traditional textbooks. Apple's recently launched iBooks textbooks program aims to bring "dynamic, current, engrossing, and truly interactive" textbooks to the more than 1.5 million iPads in use in educational environments as of January 2012.⁷²

The U.S. government has recently announced a major push for e-textbooks. In February 2011, Education Secretary Arne Duncan and FCC Chairman Julius Genachowski announced an ambitious target to get digital textbooks in the hands of all students in the United States within five years.⁷³ The goal comes in response to several challenges, including the prevalence of outdated textbooks, lack of widespread e-textbook adoption in the United States, and lack of broadband access for many Americans.

In response, the FCC unveiled a *Digital Textbook Playbook* that is "designed to help K-12 educators implement rich and effective digital learning environments in their schools."⁷⁴ Highlighting the importance of educational technology, the FCC and Department of Education (DOE) claimed, "Technology-based instruction can reduce the time students take to reach a learning objective by 30 to 80 percent."⁷⁵ Additionally, the FCC noted several examples of schools, districts,

⁶⁹ Voxy, "How & Why Voxy Works," <http://voxy.com/about/how-it-works/en/>.

⁷⁰ "Contextual, Location-based Language Learning - the Voxy iPhone App (Mini-Case Study Assignment)," Patricia the Librarian, July 6, 2011 <http://patriciathe librarian.wordpress.com/2011/07/06/contextual-location-based-language-learning-the-voxy-iphone-app-mini-case-study-assignment/>.

⁷¹ Voxy, "How & Why Voxy Works," <http://voxy.com/about/how-it-works/en/>.

⁷² Wiegler, MG, "Some Key Subtle Details from Apple's Textbook Event," TechCrunch, January 19, 2012, <http://techcrunch.com/2012/01/19/apple-textbook-event/>; Apple in Education, "iBooks Textbooks for iPad," Apple, www.apple.com/education/ibooks-textbooks/.

⁷³ Blagdon, Jeff, "Obama administration wants all students using digital textbooks in five years," The Verge, February 3, 2012, www.theverge.com/2012/2/3/2767593/obama-administration-digital-textbooks-5-years.

⁷⁴ Federal Communications Commission, "FCC Chairman Genachowski joins secretary of education Duncan to unveil new "Digital Textbook Playbook," http://transition.fcc.gov/Daily_Releases/Daily_Business/2012/db0201/DOC-312244A1.pdf.

⁷⁵ Ibid.

and states from Florida to California that are making the transition to digital textbooks.

The playbook includes a section on the merits of digital textbooks using mobile broadband services over 3G and 4G networks. It notes that such networks demand less from school networks and offers greater range than Wi-Fi networks, broad availability, and up-front cost advantages. Beyond these advantages, 3G and 4G connections allow students to be connected at home, even if they lack internet access. The playbook also noted, however, that there are some potential drawbacks to mobile wireless access, including concerns about cost, data caps, and coverage.⁷⁶ Additionally, commentators pointed out that although they are highly valuable, digital textbooks are only one part of the broad commitment required to improve the country's schools.⁷⁷

REACHING UNDERSERVED AREAS

Classroom solutions, education applications, e-textbooks, and other digital, wireless education applications are highly beneficial in well-served educational areas; in underserved areas, they have the potential to be transformational. Where excellent schools, heavy infrastructure, and traditional educational systems are lacking, wireless technology can make powerful connections.

The FCC's proposed Mobility Fund has the potential to further expand the reach of mobile wireless service, which could enhance access for underserved areas. The Mobility Fund, proposed in October 2010, will provide one-time support to spur the country's efforts to close gaps in mobile wireless service. Using US\$100 - 300 million, the fund will identify areas not served by 3G mobile wireless services and administer a reverse auction to find service providers to reach those areas. By expanding mobile wireless service, it might be possible to enable more schools and students to use 3G mobility to support educational technology.

In the United States, these efforts mean reaching remote areas with limited school infrastructure (and limited wired internet infrastructure). Internationally, wireless can facilitate a vast expansion of educational possibilities to places that were previously difficult or impossible to serve. Throughout the globe, wireless can reach students in remote areas so that they can access extraordinary opportunities through phones, smartphones, tablets, and laptops.

Challenges and Looking Ahead

Despite the tremendous promise of mobile, wireless educational technology, there are challenges to address. Some of these challenges center on educational concerns. Critics assert that the small screens and discrete lessons of mobile educational technology may limit its scope and potential impact. Getting the full depth and breadth of a classroom experience may be difficult or impossible on a phone. There may be some cultural barriers too; some people in the United States are resistant to using mobile technology for education. Some other countries, such as South Korea, that have focused on mobile educational technology have a much stronger cultural acceptance of mobile phones than the United States does. Additionally, while mobile educational technology is promising, there is a lack of broad, concrete data to demonstrate its

⁷⁶ The Digital Textbook Collaborative, "Digital Textbook Playbook," February 1, 2012, http://transition.fcc.gov/files/Digital_Textbook_Playbook.pdf.

⁷⁷ Klein, Joel, "The Promise of Education Technology," Huffington Post, February 3, 2012, www.huffingtonpost.com/joel-i-klein/digital-textbooks-education-technology_b_1253009.html.

effectiveness. Most studies to date have been relatively narrow and specific in scope.

These educational challenges point to three key lessons. First, mobile educational technology is only one part of improving schools; it is not a panacea. Second, it is important to continue studying mobile educational technology to assess its effects, determine its value, and learn how to optimize effectiveness. Third, investments—financial, cultural, and pedagogical—will be required to scale programs and maximize their impact.

Additionally, there are some technological challenges to overcome. The FCC's *Digital Textbook Playbook* highlighted a few of these—cost, data caps, and coverage. As the industry develops, it will be important for device manufacturers, software providers, telecommunications companies, educators, and policymakers to work on solutions to overcome these challenges. Furthermore, as technology evolves, some of these challenges might be addressed, for instance, through more affordable devices, cheaper data plans, and continually increasing wireless broadband coverage.

Community Empowerment

Here's a quick test to determine whether mobile technology could empower your life:

- » How many bills are currently pending in Congress? How many have your senator or representative introduced and on what topics? Do you know who your senators and representatives are?
- » Can you think of any films that might trigger symptoms of post-traumatic stress disorder (PTSD) in victims of domestic violence? Where would you look to find the answer?
- » What is the currency conversion rate between the Philippine Peso and the U.S. dollar? How about the Singapore dollar? Do you know how to send money from the United States to a village in the Philippines?

One answer to all of these questions boils down to a clichéd response we've all heard a million times over the last five years: "There's an app for that." While that's certainly true, the mobile applications that would provide all of the answers to the questions above do a lot more than increase your chances of winning the next trivia night. They can provide people with information they otherwise wouldn't have and, thereby, empower them to improve their lives.



Figure 9: Wireless applications are connecting people around the world and leading to greater civic engagement and community empowerment.

Making it easier and more fun to track bills in Congress when we have a free moment may not reduce the national debt, but it could make all of us a little more informed, concerned, and engaged as citizens. Knowing which films trigger PTSD responses by instantly checking a list of films updated by a community of other people living with PTSD can avoid painful and isolating triggering moments. Most of us don't need

the current exchange rate of the Philippine peso, but for the 11 million overseas Filipino workers trying to calculate how much money they need to send back home, having a quick currency converter in their pocket makes life a little easier every day.

Many mobile applications make our lives easier or more convenient, but applications that improve people's lives in tangible ways, help empower disenfranchised groups, and ultimately improve the society in which all of us live, have the potential to change the world.

This section explores how mobile technology empowers people's lives through citizen engagement and community empowerment. The ubiquitous availability of mobile technology provides ways to close information gaps anywhere and

anytime and connect groups of people who will draw new voices into the political and social conversation. The value of these programs and services to strengthen the fabric of modern society will only increase as mobile technology becomes more widespread.

The Challenge: Connecting People with What They Need to Take Action

All too often, people lack the information or interaction needed to improve their lives or solve a problem. Whether it's schools in small towns with limited internet access, citizens with limited information and the ability to influence government policies, or individuals like migrant workers with common concerns but no way to easily share information and support each other, many people face a set of common challenges. In particular, they struggle with a lack of information when and where it's needed, a lack of resources to address a given problem, and a lack of influence needed to encourage others to take actions that could help them all. Wireless technology can help with all of these challenges.

The Role of Wireless

Wireless technology helps address these needs for information, resources, and influence in a variety of ways, particularly:

- » **Ease of use.** Wireless helps information flow with incredible ease and convenience, especially in the case of mobile phone applications that receive information from and present information to users through a consolidated and well-designed interface.
- » **Access to information where and when it is needed.** Wireless access to information lets people better understand issues and take action at appropriate times.
- » **Access to resources.** Wireless improves access to a wide range of benefits, from government and emergency services to educational resources.
- » **Access to community.** Whether students seek to interact with each other or citizens want to solve a common problem, wireless improves the people's ability to share their experiences and work together. This has three distinct benefits:
 - **Connecting people** enables information to flow among community members who were previously disconnected. Whether sharing information about bills before Congress or local road or weather conditions, as information flows more easily among people, the collective knowledge of the group increases. As a result, more people have access to previously unavailable information that may improve their lives.
 - **Connecting to a broader community** provides important support structures, especially to members of disenfranchised groups. Disenfranchised individuals, victims of crimes or disasters, or those in difficult life situations can find a support system that makes the difference between surviving another day alone or enjoying the support of someone who may understand their situation.
 - **Connecting to communities** gives people collective power to change their predicament. Whether this change means using collective knowledge to fight poor labor conditions through collective action or connecting lost refugees to one another, collective action can bring about change in a way an individual acting alone cannot.

In general, the ubiquity of mobile phones makes them a powerful force in reaching people from all socioeconomic backgrounds. The following sections explore these opportunities in civic engagement and empowering communities.

Democratization movements had existed long before technologies such as mobile phones and the internet came to these countries. But technologies have helped people interested in democracy build extensive networks, create social capital, and organize political action. Technology may not have created the desire for political freedom, but it is a tool democracy advocates have used to their advantage . . .

The first occupants of Cairo's Tahrir Square . . . found solidarity through social media, and then used their mobile phones to call their social networks into the street."

Howard et al., Opening Closed Regimes, 2011

CITIZEN ENGAGEMENT

Mobile technology's ability to put information at people's fingertips is playing a transformative role in interactions between governments and citizens. Where U.S. citizens once had to dig through stacks of the Congressional Record to figure out the daily goings-on in the U.S. Congress, they can now find that information with a few taps on a smartphone. In the wake of a flood where citizens were once stranded without access to communications devices, now they can communicate, map information, access government resources, and coordinate response efforts. Mobile technology makes it possible for citizens to access and communicate information that increases citizen and civic engagement and societal transparency and make each citizen a powerful agent of change in society.

Government Transparency

With government information now available on mobile phones, citizens can quickly and easily learn what is happening in government. The Sunlight Foundation provides several mobile applications that allow users to see information about happenings in the U.S. Congress. For instance, the Real Time Congress iPhone app delivers live updates from the Congressional floor, key documents (e.g., Congressional budget office memos, party policy committee information, and Office of Management and Budget reports), daily notices from the House Majority and Minority Whips, and a schedule of upcoming committee meetings. The Sunlight Foundation's Congress app for Android offers a pocket directory of members of congress, voting rolls, activity on bills, and committee meetings.⁷⁸

Citizen Action

As protesters jammed Tahrir Square in Cairo during January and February of 2010, they organized—and the world watched—on mobile phones. Mobile phones were crucial to helping protestors organize, swap germane photos and videos, stream video of news updates, and communicate with the rest of the world. Today's protesters don't need a megaphone; they need a mobile phone.

Mobile tools are valuable for enabling citizen action both globally and in North America. For example, a free, open-source application called FrontlineSMS turns a phone or laptop into a central communications hub, making it possible for users to send and receive texts through contact groups. FrontlineSMS has been used in the United States to organize voting, help student organizers, and support civil rights campaigns.⁷⁹ In Oklahoma, FrontlineSMS technology was used to build an SMS-based system called FamilyFIRST that "allows victims of domestic violence to reach out to police, crisis counselors, and to document abuse incidents all via simple SMS messaging." In just two and a half months, the system processed more than 4,000 messages from victims of violence. One of the developers estimated that such a system can be built for less than US\$700.⁸⁰

Another example is Ushahidi, a nonprofit software company that builds free, open-source software as "tools for democratizing information, increasing transparency, and lowering the barriers for individuals to share their stories."⁸¹ Ushahidi provides a series of tools that enable citizens to share information and coordinate action for election monitoring, citizen journalism, disaster response, and other applications. Mobile is critical to Ushahidi—it makes the platform easy

⁷⁸ Sunlight Foundation, www.sunlightfoundation.com.

⁷⁹ FrontlineSMS, "User Map," www.frontlinesms.com/frontlinesms-in-action/user-map/.

⁸⁰ FrontlineSMS, "Update: Domestic Violence—An SMS SOS," July 22, 2009, www.frontlinesms.com/2009/07/22/update-domestic-violence-an-sms-sos/.

⁸¹ Ushahidi, <http://ushahidi.com>.

to access, inexpensive, and usable in real time.⁸² And while many of Ushahidi's most notable uses have been in places like Haiti and Libya, it has also played a valuable role in mobile communications and disaster response in North America. Following the massive blizzard on the East Coast in 2010, the *Washington Post* used Ushahidi's platform to build a website to gather information and coordinate citizen action in response to the crisis.⁸³ In Manitoba and Saskatchewan, Ushahidi has been used to track and respond to floods.⁸⁴

EMPOWERING COMMUNITIES

In addition to government and education, mobile technology is being used all over the world to connect and empower communities that may not fall within traditional definitions of "community." Traditionally, a community would require geographic proximity, but mobile technology bridges the geographic barriers and political borders to connect people who may otherwise be disenfranchised, alienated, or alone. From migrant and overseas worker communities to groups of women around the world, mobile technology is connecting people to other similarly situated people to engage, empower, and create communities.

Empowering Women

Several organizations emphasize the empowerment of women around the world through wireless. mWomen, a set of mobile application designed specifically for women, has spurred developers to think about ways that technology can not only help women but also empower them. Several companies are hosting



Figure 10: Several mobile applications are designed specifically for women, including applications that provide immediate emergency services for victims of domestic violence and help prevent onset of PTSD episodes.

⁸² Ibid.

⁸³ Giridharadas, Anand, "Africa's Gift to Silicon Valley: How to Track a Crisis," *New York Times*, March 13, 2010, www.nytimes.com/2010/03/14/weekinreview/14giridharadas.html?scp=1&sq=ushahidi&st=cse; Washington Snow Cleanup, http://snowmageddoncleanup.com/page/index/2.

⁸⁴ Ushahidi Blog, "Canadian Mappers Prepare for Spring Floods," Ushahidi, <http://blog.ushahidi.com/index.php/2011/03/20/canadian-mappers-prepare-for-spring-floods/>.

competitions to develop applications focused on women, such as Nokia, for instance, which sponsors the annual Apps to Empower Women challenge in which application developers compete to develop women-focused apps.⁸⁵

One interesting application and last year's winner of the mWomen Bottom of the Pyramid App Challenge is Next Drop, an application for women in rural India that alerts them to the time when authorities will turn on regulated water taps.⁸⁶ Authorities do not turn on water at regular and predictable times, and so women, who are traditionally tasked with collecting water for their family, waste significant amounts of time simply waiting for the water to come on. This mobile application helps close that information gap effectively and efficiently. Other applications geared toward women in the developing world focus on education, health, and access to agricultural information.⁸⁷

Women in the industrialized world are also benefiting from increased focus on technology as a tool for women's empowerment. Vodafone has developed TecSOS, a mobile handset specifically for women who may become victims of domestic violence.⁸⁸ The device consists of a stand-alone mobile device with a button that the user presses in an emergency situation to immediately alert authorities without requiring a phone call. The handset automatically provides emergency workers with details of the user's location and automatically begins recording all activity within range of the handset. Audio recordings of abuse can serve as powerful evidence in court. A similar application, called Fight Back and developed in India, sends an SOS message to authorities and also a text message, email, and Facebook message to friends so they can help provide immediate assistance to the victim.⁸⁹

Another creative use of mobile technology designed specifically for women is an application for victims of sexual abuse called Trigger Free.⁹⁰ Victims of domestic abuse or sexual assault often suffer from severe forms of PTSD. Visual depictions of sexual violence or assault, which often show up in books or films suddenly and unbeknownst to a reader or viewer, can trigger PTSD episodes and great physical and emotional discomfort for victims and often lead to further alienation because their friends and family may not understand what they are experiencing. Trigger Free is currently in development, and once complete will provide a mobile phone application with a database of books and films that may contain scenes sensitive to PTSD victims. Users can look up the movie or book in the database to avoid being exposed to these sensitive scenes. The database is updated by a community of PTSD victims, and allows victims to connect to each other to provide support and resource networks. According to the founder, establishing the database through a mobile device means that users, especially the target audience of women younger than 30, are more likely to update the database remotely. It also adds increased protection for privacy and discretion and allows PTSD sufferers to make decisions in real time when they are unable to access the internet.

⁸⁵ Parmar, Belinda, "Apps That Empower Women," *Fast Company*, November 14, 2011, www.fastcompany.com/1794983/can-apps-empower-women.

⁸⁶ Next Drop, <http://nextdrop.org/>.

⁸⁷ Vodafone and Accenture, "Connected Agriculture: The Role of Mobile in Driving Efficiency and Sustainability in the Food and Agriculture Value Chain," September 2011, www.vodafone.com/content/index/about/sustainability/news_views_research/news/connected_agriculture.html.

⁸⁸ Vodafone, TecSOS product description, www.vodafone.com/content/index/about/foundation/mobiles_for_good/tecsos.html.

⁸⁹ "Mobile App to Help Indian Women Fight Sex Assault," AFP, December 21, 2011, www.dawn.com/2011/12/21/mobile-app-to-help-indian-women-fight-sex-assault.html.

⁹⁰ Grinblo, Evgenia (Jenny), "Apps to Empower Women," October 2011, PowerPoint presentation available at www.ideasproject.com/docs/DOC-8622.

Empowering Workers

Workers also benefit from the ability to connect to others around the world using mobile applications. One of the most effective mobile applications for international workers in the United States provides support structures for the large community of overseas Filipino workers (OFWs). There are approximately 11 million overseas Filipino workers, many of whom are located in the United States. But they are often disconnected from family and friends and other social support structures in the countries in which they work. Myrna Padilla, the founder of OFWatch and a former overseas Filipino worker for 20 years, started the mobile application to help overseas workers connect to each other and ensure that they have access to much needed resources. OFWatch allows overseas workers to send messages to their family members back home with updated information about their location, receive information about safe and licensed recruiting agencies, understand local labor laws where they work, view maps of foreign countries, and access hotline numbers to seek help from local community groups. The application also includes a translator, a currency converter, and a news feed tailored with updates from their home provinces in the Philippines.

"I see this as a way to prevent exploitation of overseas workers abroad," explained Padilla. "By using social media, we'll be able to link together OFWs and help them whenever we can. This is also a way for me to aid the kind of people who, like me, have also toiled to get their families out of poverty."⁹¹

Beyond U.S. borders, Labor Voices, a for-profit social business venture, is one the newest and most widely anticipated applications that will help connect migrant factory workers in places like China and India.⁹² The application is still in development, but once it is complete it will allow workers to confidentially share information about factory conditions, wages, and trusted employment contractors. The system is currently being piloted in India and will likely be expanded later this year.

Opportunity for U.S. Migrant Farmworker Applications

There are currently about 3 million farmworkers in the United States commonly known as "migrant farmworkers." Migrant farmworkers work legally in the United States and move around the country following growing seasons to obtain harvesting work throughout the year. This group of migrant U.S. farmworkers could benefit immensely from mobile applications to help them find work, learn about local resources in new communities, and communicate with each other about employment opportunities, yet virtually no mobile applications exist to help improve their lives.

As they have for workers in other parts of the world, mobile applications could partially address problems that many migrant farmworker communities face. Many migrant workers are foreign-born, and thus do not have access to traditional social institutions in the United States. A study recently conducted by the Julian Samora Research Institute experimented with whether simply showing videos about American social institutions, such as public education, health care facilities, financial planning services, and the U.S. legal system would improve their ability to take advantage of these services. The experiment demonstrated "significant increases" in migrant workers' ability to understand and take

⁹¹ Yapa, Seuwand, "Former Domestic Helper Finds Success Setting Up Own Web Design Firm," January 11, 2012, <http://community.telecentre.org/profiles/blogs/former-dh-in-finds-success-setting-up-own-web-design-firm>.

⁹² Labor Voices, www.laborvoices.com.

While mobile technology has the potential to empower people, create new communities of people, and ultimately improve the world, its success hinges on how we choose to use it.

advantage of these basic services.⁹³ While it's difficult to host video viewing sessions for workers who may be moving from community to community, offering streaming video through mobile devices, or providing applications that allow for access to this information through mobile devices could significantly improve delivery and retention of this vital information.

Several mobile applications for migrant farmers in developing countries have been quite successful and could easily be replicated in the United States. These applications provide information about real-time commodity prices, weather reports that affect crop yields, and mobile payment and finance tools.⁹⁴ Applications in the United States could include, for example, information about access to public services, educational resources, family resources, and health care resources, as well as mobile payment solutions to help ensure timely payment and information about open jobs or farms who need additional seasonal help.

Although migrant farmworkers may not have the latest smartphone, that could change over the next three to five years as advanced technology becomes cheaper and more widespread. Several simple information-based applications could be developed for feature phones as well. Eventually, if mobile applications are shown to materially improve the lives of migrant workers, people will find a way to obtain them. That will present an enormous market opportunity and an important and often overlooked positive social impact.

Challenges and Looking Ahead

It's important to recognize that while all of the applications featured in this section have great potential to engage people, spark greater flows of information, and empower communities, their impact will not be realized unless we choose to use the applications and information in effective ways.

If you read about the most current legislation in Congress but do not become involved in the political process or contact your congressperson, can the application be said to "empower" you? Has the application improved our society or democracy? If no one updates the database of books and movies in Trigger Free, the app designed to help women avoid media that triggers PTSD, the app will largely have failed.

While mobile technology has the potential to empower people, create new communities of people, and ultimately improve the world, its success hinges on how we choose to use it. Many of these applications are only the tip of the iceberg. As technology continues to improve and prices decrease, they will become more widespread and available to more groups of people who will reap their benefits. At that point, the technology will have done its part. It then becomes incumbent on us to ensure we are using it in a way that realizes its full potential.

⁹³ Julian Samora Research Institute, "Using Technology to Enhance Survival Skills Among Latino Migrant Farmworkers," *Nexo Newsletter*, Spring 2010, www.jsri.msu.edu/pdfs/nexo/Nexo%20Spring%202010.pdf.

⁹⁴ Vodafone and Accenture, "Connected Agriculture: The Role of Mobile in Driving Efficiency and Sustainability in the Food and Agriculture Value Chain," September 2011, www.vodafone.com/content/index/about/sustainability/news_views_research/news/connected_agriculture.html.

Wireless and Social Concerns

As noted in *Wireless and the Environment*, wireless equipment has substantial environmental costs that are generally well-understood and are being addressed. Similarly, wireless equipment and applications are not without risks of negative social impacts, from supply chain labor and human rights to concerns about privacy and informed use.

Supply Chain Labor and Human Rights

One of the single most common social responsibility concerns about electronics manufacturing relates to supply chain labor and human rights conditions. Industry efforts such as the EICC have helped address some of the most serious issues in major manufacturing suppliers, such as child or slave labor, but the industry continues to deal with concerns about excessive working hours, quality of life, and other issues.

At the same time, expectations that companies will address concerns deeper in their supply chains continue to grow. A prime example involves so-called conflict minerals—tin, tantalum, tungsten, and gold—from the Democratic Republic of the Congo whose extraction and trade can help illegally finance armed groups in that country. Although mining does not cause the conflict itself, it is a contributing factor. NGOs and governments increasingly expect companies to identify whether they use these materials, and if possible go “conflict-free” (ideally while continuing to source from central Africa so that they continue to contribute to the local economy and livelihoods). The electronics industry has helped lead efforts to address these concerns for a number of years, and wireless equipment manufacturers and service providers have been active in this work.

Privacy

As people use their wireless devices for an increasing range of activities, from checking the price of an item in a store to discussing attendance at a political rally, cell phones have become the connection point to growing amounts of personal data. This data can be used to offer tailored products or location-based services or provide other sorts of assistance, but it can also be used to spam users with unwanted advertisements, make identity theft easier, or even be tracked or controlled by governments or other groups monitoring for illegal or “undesirable” activities. In one recent example, Oprah Winfrey touted the benefits of a wireless child-monitoring device, only to have someone demonstrate that it could be hacked to provide information about the child’s whereabouts to others or even to provide false location data.⁹⁵

Internationally, the governments of United Arab Emirates, Saudi Arabia, India, and others have demanded access to BlackBerry messaging networks, while several Arab regimes facing revolt have used the wireless system to send pro-government messages. While ICT industry leaders, such as the GNI, have supported ongoing dialogue and work to address such concerns about privacy and freedom of expression, this will continue to be a growing area of concern that could undermine trust in wireless applications and slow their development.

⁹⁵ Mills, Elinore, “Personal Safety GPS Device Presents Security Risk,” CNET, April 22, 2011, http://news.cnet.com/8301-27080_3-20056540-245.html.

Responsible Use and Consumer Education

Similar to concerns that financial institutions took advantage of loose regulation and lack of consumer understanding before the 2008 financial crisis, companies or other groups could perhaps use their ability to connect rapidly and intimately with consumers via wireless unethically. With wireless services for health, finance, education, and other areas very close to people's lives, it will become increasingly important to ensure that consumers are fully aware of the details of these services and any risks that they may entail.

Looking Ahead

The wireless industry and the ICT industry as a whole will continue to work on these and other emerging challenges in a variety of ways, including through existing efforts like the GNI and EICC. As noted in a 2010 GNI-BSR report, the industry should continue to explore a range of issues, including:

- » The most appropriate and ethical ways to work with governments to limit risks of abuse and ensure the protection of human rights
- » Designing products and networks in a way that minimizes the possibility of censorship, illegitimate access to personal information, and other risks to privacy and freedom of expression
- » Developing effective due diligence to assess risks that customers may use products inappropriately
- » Appropriately engaging with users, employees, and others to communicate about privacy and freedom of expression risks⁹⁶

⁹⁶ BSR, *Protecting Human Rights in the Digital Age*, February 2011, www.bsr.org/en/our-insights/report-view/protecting-human-rights-in-the-digital-age/.

Conclusion

Wireless technology has been at the forefront of a technological revolution that has materially improved the lives of many people. The rapid development and deployment of this technology, coupled with its ability to reach almost everyone, anywhere, through applications and services that can improve lives around the world is unprecedented.

The future of wireless technology to continue improving society is bright. While this report examines the benefits in health care, the financial sector, education, and community empowerment, the possibility for positive social impact and transformational social change is endless.

As the deployment of wireless devices continues to expand and the development of mobile technology continues to improve, wireless technology will help society beyond what we can currently imagine—perhaps by creating entirely new economies and micro-economies that generate hundreds of thousands of new jobs, by reducing crime in impoverished neighborhoods, or by enabling new ways to meet basic needs. Quite literally, the sky is the limit. What has been done so far is staggering; what can be done in the future is almost inconceivable.

But these advancements do not come without costs, some of which are well understood while others might yet lurk the shadows. As we demand more hardware to power wireless technology, the effects will be felt through supply chains that in some instances might not produce manufactured goods in socially responsible ways. Some countries struggle with human rights violations that could result from the abuse of powerful wireless technologies by authoritarian governments. As people rely on wireless devices for more personal needs, a vigilant eye must be kept on governments and businesses that may be tempted to intrude too far into the privacy of others.

These challenges can be met with strong industry leadership, collaborative partnerships with government and civil society, and engagement with end users at each step along the way. The opportunity for the greatest social impact will come when each of these groups is aligned.

Governments must embrace the responsibility to provide clear policy guidance to businesses and technology developers, and to ensure that the proper infrastructure is in place to enable wireless solutions that will flourish. Business must continue to develop products that innovate, inspire, and unleash the power of the individuals to improve their lives and communities, while working to minimize social consequences. Consumers must harness the opportunity to shape the future of wireless technology by being active and engaged users and by tapping into endless supplies of creativity. We are quite certain that wireless technology will continue to improve society and change the way we live.