

1 MOBILE TECHNOLOGY

MOBILE TECHNOLOGY IS RESHAPING society, communications, and the global economy. With cell phones, smartphones, and tablets now outnumbering desktop computers, there has been a sea change in the way people access, use, and share information. Powerful mobile devices and sophisticated digital applications enable users to build businesses, access financial and health care records, communicate with public officials, and complete online transactions. More globally, such devices and applications have helped reduce social inequality, increased participation in civic life, and increased education levels, all of which spur national economic development.¹

This revolution in how consumers and businesses access information, and the far-reaching consequences of such uses, represents a fundamental turning point in human history. For the first time, people are able to connect with one another in a relatively inexpensive and convenient manner around the clock. In both developed and developing countries, the growth in mobile technology has been accompanied by job creation and knowledge transfer, as well as deepened social and economic connections. With the mobile industry generating \$1.6 trillion in revenues, it is important to understand how mobile telephony is reshaping our

world—our social connections, economic markets, and political development.² It is this fundamental transformation that I explore in this book.

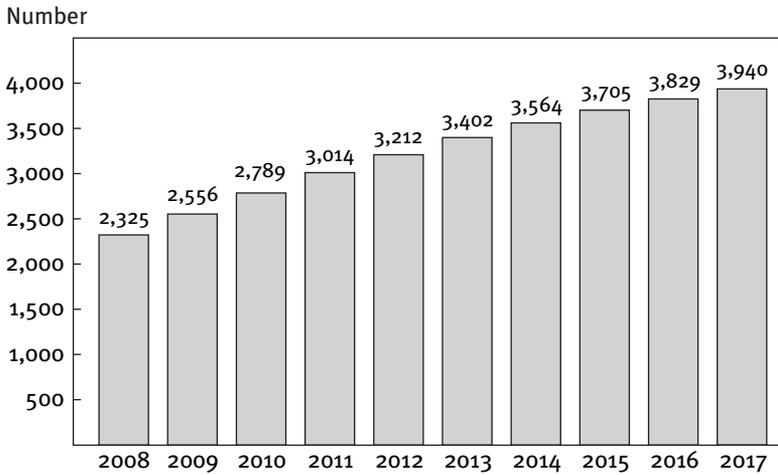
The Rise of Mobile Technology

Mobile technology is the fastest-growing technology platform in history. According to a GSMA Wireless Intelligence report, the number of mobile subscribers around the globe has risen dramatically, from 2.3 billion in 2008 to 3.5 billion in 2014, and is expected to surpass 3.9 billion by 2017 (figure 1-1).³ The growth in number of mobile devices is even more dramatic, for many people have more than one cell phone, smartphone, or tablet. Thus, the total number of cellular connections exceeded 7.4 billion in 2013 and is expected to reach 9.7 billion by 2017.⁴ At current growth rates it will take only two and one-half years for the next billion mobile connections to be made.

High growth is especially the case in the developing world as users have skipped the desktop and laptop phases of information technology and shifted directly to handheld devices. People are using cell phones, smartphones, and tablets for communications, commerce, and trade.⁵ According to Jenny Aker and Isaac Mbiti of Tufts University, mobile devices represent a significant enabler of economic development,⁶ creating many opportunities for entrepreneurs and businesspeople.

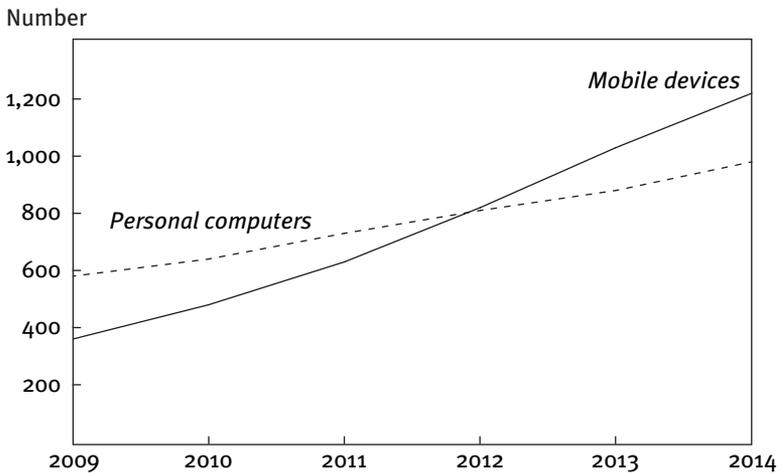
The dramatic switch to mobile technology becomes evident if one examines the trend lines for installed mobile devices and personal computers, which crossed at the end of 2012.⁷ As shown in figure 1-2, the total number of Internet protocol (IP) network-enabled desktops, notebooks, and netbook personal computers in the years before 2012 exceeded that of cellular phones. As more consumers and businesses adopted smartphone technology, however, those devices exceeded the number of personal computers in 2012. Smartphone installation currently is growing at about three times the rate of personal computer installation.

FIGURE 1-1. Growth in Mobile Subscribers, 2008–17



Source: A. T. Kearney, “GSMA: The Mobile Economy” (London, 2013).

FIGURE 1-2. Trends in Mobile Devices and Personal Computers, 2009–14



Source: Ken Hyers, “A Peek into the Future of Mobile” (Boston, Strategy Analytics, January 2011).

TABLE 1-1. Percent of Mobile Phone Owners Using Various Services, 2013

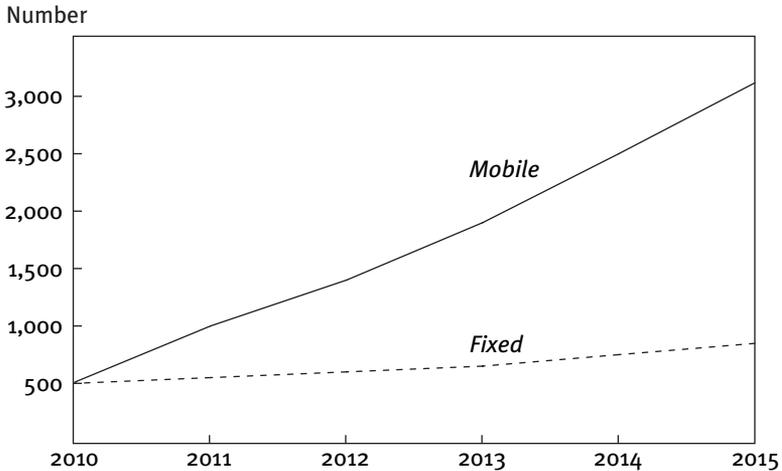
<i>Service</i>	<i>Percent</i>
Send or receive text messages	81
Access the Internet	60
Send or receive e-mail	52
Download an app	50
Get location-based directions	49
Listen to music	48
Participate in a video call or chat	21
Share location	8

Source: Pew Research Center, Internet & American Life Project Survey 2013 (Washington, 2013). The survey was conducted April 17 to May 19, 2013.

Consumers like the convenience of mobile devices. They enjoy being able to access e-mail, conduct e-commerce, and access a wide range of applications on the go. In the United States, a survey by the Pew Research Center found that 90 percent of American adults own a cell phone, 58 percent have a smartphone, and 42 percent own a tablet computer.⁸ When asked whether they used various services, mobile phone users indicated that they employed their mobile devices to send or receive text messages (81 percent), access the Internet (60 percent), download apps (50 percent), get directions or location-based information (49 percent), or listen to music (48 percent) (table 1-1).

A second important trend is the growth in number of mobile broadband subscribers around the world, which surpassed that of fixed broadband subscribers at the end of 2010 (figure 1-3). It is anticipated that by 2015, there will be 3.1 billion mobile broadband subscribers worldwide, compared to 848 million fixed broadband subscribers. The extraordinary growth in mobile broadband adoption means that within a span of four years, mobile broadband will have increased to about 80 percent of all broadband subscriptions and will be the dominant means of Internet connectivity. Emerging markets have kept pace: mobile

FIGURE 1-3. Trends in Mobile and Fixed Broadband, 2010–15



Source: A. T. Kearney, “GSMA: The Mobile Economy” (London, 2013).

broadband is expected to increase to 79 percent of all broadband subscriptions by 2015, up from its 2010 level of 37 percent.

Not surprisingly, in light of its long-term potential, a number of countries have identified broadband and wireless technology as crucial infrastructure needs for national development. Broadband is viewed as a way to stimulate economic development, enhance social connections, and promote civic engagement. National leaders understand that broadband technology is a cross-cutting technology that speeds innovation in such areas as health care, education, energy, and transportation. When combined with organizational changes, digital technology can generate powerful new efficiencies and economies of scale. Moreover, the creation of new digital platforms across a variety of domains spurs utilization and innovation and brings additional people, businesses, and services into the digital revolution. To cite only two examples, both entrepreneurs and underserved populations stand to benefit from a greater use of mobile technology.

Entrepreneurs play a major role in the economy of many countries. They launch companies, build businesses, and provide jobs. As the world moves toward a global digital economy, entrepreneurs increasingly rely on mobile technology to develop their businesses, reach markets, and pay vendors. This helps them stay in close contact with individuals and entities upstream and downstream of the business and build relationships.

Mobile technology also offers important advantages for those in underserved rural communities, where limited access to broadband and other telecommunication services makes it more difficult to participate, socially and economically, in the modern world. Mobile devices offer a way to gain Internet access even in places that are geographically remote. In larger purview, because of their relatively low cost and ubiquitous connections, mobile devices help overcome digital disparities. There are well-established inequities based on race and ethnicity, as well as certain geographic distinctions, in socioeconomic well-being. In many countries, minorities have lower levels of educational achievement and lower incomes than non-minorities. Yet mobile devices have been able to narrow the gap in technology utilization. A December 2013 report by the Pew Research Center pegged smartphone ownership in the United States at 61 percent among Hispanics and 59 percent among African Americans, both rates slightly higher than among whites (53 percent).⁹ Mobile technology helps minorities start businesses, access mobile-based health care applications, engage in mobile-based learning, and otherwise tap into the benefits of the technology revolution.

The remainder of this chapter highlights the contributions of mobile technology to economic development, education, health care, civic and political engagement, and public safety. On each of these dimensions, which are taken up in turn and developed in subsequent chapters of the book, mobile technology has reshaped expectations, possibilities, and the interactions of humans both with each other and with the broader social and economic environment.

The Mobile Economy as an Engine of Job Growth and Economic Development

In the United States, mobile broadband is a significant contributor to job creation and economic development. Advanced digital infrastructure makes possible new businesses, products, and services. According to the management consulting firm Deloitte, U.S. investment in 4G (fourth-generation wireless) technology is expected to generate more than \$73 billion in GDP growth between 2012 and 2016, with between 371,000 and 771,000 new jobs created.¹⁰

A similar picture emerges in other countries, including both developed and developing economies. For example, in a 2010 study, Jenny Aker and Isaac Mbiti found dramatic increases in mobile telephony in sub-Saharan Africa: “There are ten times as many mobile phones as landlines in sub-Saharan Africa, and 60 percent of the population has mobile phone coverage.” With respect to the impact on economic development, the authors suggested “positive impacts on agricultural and labor market efficiency and welfare in certain countries.”¹¹ Mobile phones improve welfare by reducing job search costs and making it easier for farmers and fishers to access market information.

Some specific investments have produced significant economic benefits. For example, a July 2013 study by the London-based Strategic Networks Group of the construction of a fiber-optic network in the South Dundas township of Ontario, Canada, found that an investment of \$1.3 million led over several years to a “\$25.22 million increase in GDP for Dundas County and [a] \$7.87 million increase for the Province of Ontario,” and the creation of 207 jobs.¹² The authors used a survey of businesses and organizations in the county to conclude that an increase of \$3.5 million in provincial tax revenues and \$4.5 million in federal tax revenues could be directly attributed to the network. Fifty-four percent of the area’s businesses that had access to the

fiber-optic network reported job growth, compared to 27 percent of businesses that had dial-up Internet access and 5 percent of establishments with no Internet access.

Raul L. Katz and colleagues in 2009 examined the impact of broadband technology on job growth and GDP in Germany.¹³ Overall, they estimated that 968,000 new jobs and €170.9 billion would be added to the economy over ten years. This amounts to a 0.60 percentage point improvement in annual growth in the German GDP during the period 2010 to 2020 attributable to the implementation of broadband technology. Some of this growth was expected to occur in the form of jobs associated with network construction, with the remainder generated by rising broadband penetration and subsequent innovation in business activity.

A 2009 report on the GDP of 120 nations between 1980 and 2006 prepared by Christine Zhen-Wei Qiang estimated that each ten percentage point increase in broadband penetration increased the GDP of high-income countries by 1.3 percent and that of low- to middle-income countries by 1.21 percent.¹⁴ This observation suggests that growth comes not just in direct forms but also because broadband technology spurs new applications for businesses and consumers.

Education

A number of new mobile technology initiatives are reshaping education.¹⁵ Speaking at an education policy symposium in 2010, Mark Schneiderman, the senior director of education policy for the Software & Information Industry Association, said, “The factory model that we’ve used to meet the needs of the average student in a mass production way for years is no longer meeting the needs of each student,” and called instead for changes in education that would recognize the magnitude of the information changes that have taken place in U.S. society. In today’s world, he claimed, students “are surrounded by a personalized

and engaging world outside of the school, but they're unplugging not only their technology, but their minds and their passions too often, when they enter into our schools."¹⁶

In the years since Schneiderman's diagnosis, the digital learning landscape has changed remarkably. Wired classrooms, hand-held devices, and electronic instructional sets let pupils learn at their own pace and in their own manner. Personalization makes education more adaptive and timely from the student's standpoint and increases the odds of pupil engagement with and mastery of important concepts. It frees teachers from routine tasks and gives them more time to serve as instructional coaches and mentors for students.¹⁷

Smartphones and mobile devices are being utilized for educational purposes in a variety of institutions. A 2009 analysis by Jessica Briskin and colleagues of application stores for BlackBerry, the iPhone, and the Android smartphone found that popular education-oriented downloads included My Very First App, Star Walk, Ace Flashcard, Cookie Doodle, Wheels on the Bus, and Cosmic Discoveries. Several productivity-enhancing apps for use in administration, data collection, and collaboration were also prominently available.¹⁸

Technology has also enriched the social environment in which learning takes place. Some teachers have developed Facebook applications (and apps on other social media platforms) for personalized learning. They post comments, get reactions from students, set up meetings, and express views about the class. Research conducted at a private liberal arts university and presented in 2010 found that students enrolled in courses set up in this manner averaged an hour per day accessing the Facebook Learning Management System. Instructors commented that students responded almost immediately to messages about the course and that pupils "engaged more in questioning through Facebook messages directed to the instructor than asking them verbally in the face-to-face classroom."¹⁹

Chris Dede has looked at interfaces in the United States enabled by mobile-based learning for students and found three educational advantages: allowing multiple perspectives, facilitating situated learning, and transferring knowledge from one setting to another.²⁰ Each of these experiences enhances the learning process and allows students to gain new knowledge or apply insights to different areas.

Handheld devices enhance student learning in other ways as well. They have been found to bridge the socioeconomic gap between the haves and the have-nots, and to expose pupils to a rich array of instructional resources. Students find the use of technology engaging and report great satisfaction with mobile learning approaches. This was particularly true of underserved populations located either in geographically remote areas or in poorer districts.²¹

While most of the studies referenced to this point concerned U.S. institutions and learners, research on the educational use of mobile devices in other countries similarly provides strong evidence of the impact of technology. A project in Taiwan, for example, compared student vocabulary mastery after reading short messaging service (SMS) English lessons versus that based on reading textbooks. The analysis showed that pupils learned more vocabulary with the former than with the latter.²²

In China, after universities introduced mobile learning platforms in their classrooms, instructors found a sharp increase in student engagement and interaction. Instructors broadcast lectures and classroom videos to students' mobile devices. Class members could either attend the live lecture in a traditional classroom or watch via their smartphones. Teachers could use software to determine how students were engaged, what text messages were exchanged, and what pupils were learning through pop-up quizzes regarding lecture materials. In surveys and analyses conducted after the conclusion of the class, educators found that participants in the mobile learning program were more likely

than nonparticipants to have posted messages regarding the course. Students reported high satisfaction with mobile learning and felt that smartphone broadcasting enhanced their educational experience. Overall, more than 1,900 messages were posted on the course forum, which instructors found to be “phenomenal” and a stark contrast to the usual reticence of Chinese students in classroom discussions.²³

Although learning through mobile technology in countries other than the United States is in an early stage of its development, considerable research, outlined in chapter 5, “Mobile Learning,” points to similar outcomes in learning and achievement. Altering the social context in which learning takes place can be a powerful accelerator of the education process.²⁴

Health Care Provision

Health care delivery today is dominated by physicians, hospitals, the pharmaceutical industry, insurance companies, and government agencies. Patients seeking information or care must navigate networks of providers, order prescription drugs from pharmacies, and file claims for reimbursement from either public or private insurance plans. They have no choice but to spend hours connecting the dots and working out the best health care for themselves and their families. But health care does not have to be run this way.

Let us imagine a different system, one where, with the aid of the Internet, electronic medical records, and smartphones, the patient is in charge.²⁵ People monitor their own weight, blood pressure, pulse, and blood sugar levels and send the results by means of remote devices to health care providers. Medical records are stored online and accessible by patients regardless of where they are in the world. They receive personalized feedback via e-mail and reminders when they gain weight, have an uptick in cholesterol levels, miss taking a prescribed medication, or experience increased blood pressure. Social networking sites support

patients through discussion forums and the collective experience of other people with similar problems. Patients take responsibility for their routine health care and rely on physicians and hospitals for more serious medical conditions.

This system is not a futuristic vision but one that is well within our grasp. It would cut costs by reducing professional responsibility for routine tasks and record keeping while also facilitating improved patient care and satisfaction. The technologies for this kind of transformation of the health care system are available now in the form of cell phones, mobile broadband, remote monitoring devices, telemedicine, videoconferencing, and the Internet.

This list of basic technologies, moreover, is augmented by the advanced features of smartphones, such as web browsing, and application development. The increasing sophistication of smartphones has given rise to a variety of new medical apps that help doctors and patients stay in touch and monitor health status and needs. For example, a mobile application allows physicians to receive test results on their mobile devices. They can examine blood pressure records over time, view an electrocardiogram, or monitor a fetal heart rate. This capability allows them to detect conditions that place mother or fetus at risk. Applications like those described make physicians more efficient and speed the delivery of health care because physicians need not be in the physical presence of a patient to evaluate the patient. If a personal conference is required, physicians can use videoconferencing to speak to patients located in another locale.

The improved patient care possible through mobile technologies has already received research support. Work by Mirela Prgomet, Andrew Georgious, and Johanna Westbrook has found that mobile handheld devices have positive impacts on hospital physician work practices and patient care. When care providers were equipped with such devices, researchers observed benefits in terms of “rapid response, error prevention, and data management and accessibility.”²⁶ These benefits were especially profound in

emergency room settings, where time is of the essence in achieving a good outcome.

More broadly, beyond the individual patient and physician, mobile devices can be used to improve global health by tracking epidemics and assisting in disaster relief efforts. A majority of sub-Saharan Africa residents, to take one example, are served by cell phones with texting capabilities. A nonprofit organization called Medic Mobile seeks to use text messaging in that part of the world to track the spread of disease and help disaster relief personnel find those in need.²⁷ In this way, digital technology allows people to overcome the limitations of geography in health care and to access information and deliver care remotely to individual patients or populations.

Civic and Political Engagement

Fast mobile broadband promotes civic engagement and provides new ways to follow politics and government.²⁸ A number of organizations around the world have developed interactive mapping software that allows citizens to chart data patterns in their neighborhood or create videos or multimedia platforms that engage people in public debates.²⁹

Geographic information systems (GIS) are increasingly used for purposes of civic engagement. Interactive sites allow people to map a range of social, economic, political, demographic, and policy features onto local, state, national, or international jurisdictions by matching GIS coordinates. For example, a number of cities have mapping capacities on government websites that enable site visitors to see crime or safety data broken down by individual blocks. This allows them to chart crime statistics or transportation patterns along social, economic, or political dimensions. Such information may be used to determine government spending priorities or to direct elected officials' attention to overlooked needs.

In the noncriminal arena, Renate Steinmann, Alenka Krek, and Thomas Blaschke of the Salzburg Research Institute looked

at public participatory GIS applications that focus on ways to get citizens involved in civic decisions.³⁰ They evaluated GIS-based sites in the United States and Europe for interactivity, usability, and visualization. Among the projects analyzed were urban design visualization, resource management mapping, river basin analysis, and landscape planning. For example, the village of Bradford, United Kingdom, has online maps that allow people to zoom in and select specific features for study. The University of Salford, near Manchester, United Kingdom, employs an “Open-space” platform with 3D capacity; users “walk through” a virtual city and are able to submit design suggestions to city planners. The website of the Landkreis Freising, a district in northwestern Bavaria, Germany, allows visitors to select development options on interactive city maps.

Public officials are increasingly using mobile communications to keep in touch with constituents. For example, G. S. Hanssen in 2008 analyzed how local politicians use digital communications to engage citizens and industry stakeholders in policymaking.³¹ A national survey of municipal politicians and mayors in Norway he undertook showed that e-mail is the most important communications channel between local politicians and citizens. His study also found that mayors employ e-mail in work-related communications more than other public officials do.

H. Rojas and E. Puig-i-Abril in 2009 examined the impact of digital communication technologies on political mobilization and civic participation in Colombia.³² Using data from a random public opinion sample of Colombia’s adult urban population, they documented how broadband Internet and mobile telephony aided “expressive participation” in online protests. They undertook a survey of online information usage and found a relationship between digital information acquisition and political engagement. Those who sought information from the Internet were more politically active and expressive than those who did not use the Internet. Rojas and Puig-i-Abril conclude that in developing societies

with high levels of political, economic, and social conflict, digital communications represent a valuable pathway toward democratic political engagement.

Public Safety and Emergency Preparedness

Mobile devices are especially helpful for public safety and during various types of disasters. In natural emergencies, fixed-line communications often are not available, and people must depend on mobile telephony. Landlines get destroyed and telephone and electric wires go down in major storms.

For example, during Hurricane Katrina, emergency personnel relied on smartphones and handheld devices to communicate with one another and with individuals needing assistance. Businesses were closed and office buildings were submerged under water. With people at risk from crime or lack of proper medical care, mobile communications were vital to personal well-being and to getting the community back on its feet.

Conclusion

Mobile technology, especially broadband technology, is reshaping many different aspects of social, economic, and political life. Through invention and innovation, new products and services are transforming education, health care, and governance. Patients are being empowered to take responsibility for their own health, and students have tools with which they can learn 24/7. However, it is important for countries to reap the benefits of mobile technology by investing in wireless infrastructure and promoting innovation. Creating a strong ecosystem for innovation and invention should be a top priority for leaders in every country.