CLOUDS AND BIG DATA: TEN IT-ENABLED BUSINESS TRENDS FOR THE DECADE AHEAD

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Abstract- Advancing technologies and their swift adoption are upending traditional business models. Senior executives need to think strategically about how to prepare their organizations for the challenging new environment. As technological change accelerates and adoption rates soar, ten pivotal trends loom large on the top-management agenda. Their implications have only grown since we last reviewed the IT landscape in 2010 .

Key words- Clouds, Big data, IT-enabled, Business trends.

I. INTRODUCTION

Three years ago, we described ten information technology–enabled business trends that were profoundly altering the business landscape. The pace of technology change, innovation, and business adoption since then has been stunning. Consider that the world's stock of data is now doubling every 20 months; the number of Internet-connected devices has reached 12 billion; and payments by mobile phone are hurtling toward the $1 trillion mark.

This progress both reflects the trends we described three years ago and is influencing their shape. The article that follows updates our 2010 list. (For a more detailed treatment, from the McKinsey Global Institute.) In addition to describing how several trends have grown in importance, we have added a few that are rapidly gathering momentum, while removing those that have entered the mainstream.

The dramatic pace at which two trends have been advancing is transforming them into 21st-century business "antes": competitive necessities for most if not all companies. Big data and advanced analytics have swiftly moved from the frontier of our trends to a set of capabilities that need to be deeply embedded across functions and operations, enabling managers to have a better basis for understanding markets and making business decisions. Meanwhile, social technologies are becoming a powerful social matrix—a key piece of organizational infrastructure that links and engages employees, customers, and suppliers as never before.[1]

Implicit in our earlier work, and explicit in this update, is a focus on information and communication technologies. Other forms of technology are changing, too, of course, and as we've been updating this list, we've also been conducting new research on the most disruptive technologies of all types. Four of the trends described here reflect IT disruptions elaborated in that separate but related research, which encompasses fields as wide-ranging as genomics and energy and materials science.[2] The Internet of All Things, the linking of physical objects with embedded sensors, is being exploited at breakneck pace, simultaneously creating massive network effects and opportunities. "The cloud," with its ability to deliver digital power at low cost and in small increments, is not only changing the profile of corporate IT departments but also helping to spawn a range of new business models by shifting the economics of "rent versus buy" trade-offs for companies and consumers. The result is an acceleration of a trend we identified in 2010: the delivery of anything as a service. The creeping automation of knowledge work, which affects the fastest-growing employee segment worldwide, promises a new phase of corporate productivity. Finally, up to three billion new consumers, mostly in emerging markets, could soon become fully digital players, thanks chiefly to mobile technologies. Our research suggests that the collective economic impact (in the applications that we examined) of information technologies underlying these four trends could range from $10 trillion to $20 trillion annually in 2025.[3]

The next three trends will be most familiar to digital marketers, but their relevance is expanding across the enterprise, starting with customer-experience, product, and channel management. The integration of digital and physical experiences is creating new ways for businesses to interact with customers, by using digital information to augment individual experiences with products and services. Consumer demand is rising for products that are free, intuitive, and radically user oriented. And the rapid evolution of IT-enabled commerce is reducing entry barriers and opening new revenue streams to a range of individuals and companies.

Finally, consider the extent to which government, education, and health care—which often seem outside the purview of business leaders—could benefit from adopting digital technologies at the same level as many industries have. Productivity gains could help address the imperative (created by aging populations) to do more with less, while technological innovation

could improve the quality and reach of many services. The embrace of digital technologies by these sectors is thus a trend of immense importance to business, which indirectly finances many services and would benefit greatly from the rising skills and improved health of citizens everywhere.

II. JOINING THE SOCIAL MATRIX

Social technologies are much more than a consumer phenomenon: they connect many organizations internally and increasingly reach outside their borders. The social matrix also extends beyond the cocreation of products and the organizational networks we examined in our 2010 article. Now it has become the environment in which more and more business is conducted. Many organizations rely on distributed problem solving, tapping the brain power of customers and experts from within and outside the company for breakthrough thinking. Pharmaceutical player BoehringerIngelheim sponsored a competition on Kaggle (a platform for data-analysis contests) to predict the likelihood that a new drug molecule would cause genetic mutations. The winning team, from among nearly 9,000 competitors, combined experience in insurance, physics, and neuroscience, and its analysis beat existing predictive methods by more than 25 percent. In other research, we have described how searching for information, reading and responding to e-mails, and collaborating with colleagues take up about 60 percent of typical knowledge workers' time—and how they could become up to 25 percent more productive through the use of social technologies.[4] Global IT-services supplier Atos has pledged to become a "zero e-mail" company by 2014, aiming to boost employee productivity by replacing internal e-mail with a collaborative social-networking platform.

Companies also are becoming more porous, able to reach across units speedily and to assemble teams with specialized knowledge. Kraft Foods, for example, has invested in a more powerful social-technology platform that supports micro bogging, content tagging, and the creation and maintenance of communities of practice (such as pricing experts). Benefits include accelerated knowledge sharing, shorter product-development cycles, and faster competitive response times. Companies still have ample running room, though: just 10 percent of the executives we surveyed last year said their organizations were realizing substantial value from the use of social technologies to connect all stakeholders: customers, employees, and business partners.[5] Social features, meanwhile, can become part of any digital communication or transaction—embedded in products, markets, and business systems. Users can "like" things and may soon be able to register what they "want," facilitating new levels of commercial engagement. Department-store chain Macy's has used Facebook likes to decide on colors for upcoming apparel lines, while Wal-Mart Stores chooses its weekly toy specials through input from user panels. In broadcasting, Europe's RTL Group is using social media to create viewer feedback loops for popular shows such as the X Factor. A steady stream of reactions from avid fans allows RTL to fine-tune episode plots.

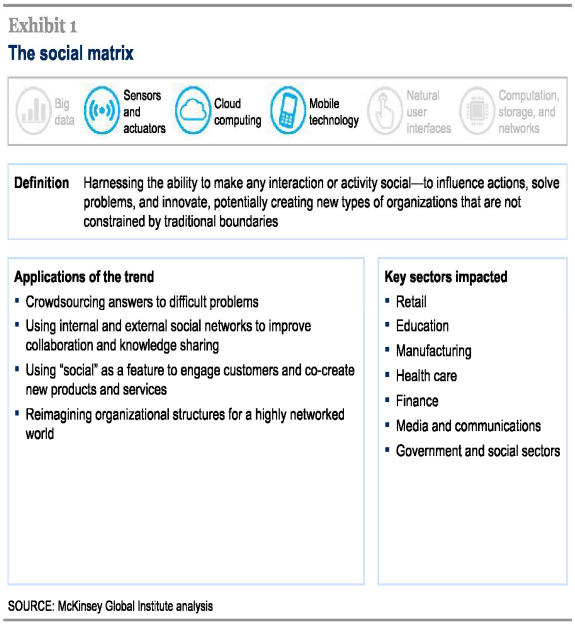
Indeed, our research suggests that when social perceptions and user experiences (both individual and collective) matter in product selection and satisfaction, the potential impact of social technologies on revenue streams can be pronounced.[6] We are starting to see these effects in sectors ranging from automobiles to retailing as innovative companies mine social experiences to shape their products and services.

Social technology is a massive technological and social phenomenon-but its power as a business tool is still being discovered.[7] Never before has a communications medium been adopted as quickly or as widely as social media.

It took commercial television 13 years to reach 50 million households and Internet service providers three years to sign their 50 millionth subscriber. But it took Facebook just a year and Twitter even less time to reach the same milestone.

Socially enabled applications will become ubiquitous, allowing liking, commenting, and information sharing across a large array of activities. We will live and

conduct business in a social matrix, where virtually all resources can be found collaborators, talent, customers, founders. The social matrix will enable new forms of organization that are only just becoming apparent (Exhibit 1).



Even now, however, the potential for value creation from the use of social technology remains largely untapped. A McKinsey global survey of more than 3,500 executives across industries in 2012 found that while more than 80 percent of respondents use social technologies, only 10 percent are truly networked and

derive substantial value across all stakeholder groups.3 The 2012 McKinsey Global Institute report on the social economy concluded that two-thirds of the value available from the use of social technologies can be found through improving collaboration and coordination within and across organizations-uses that are far less developed than social-based marketing and sales applications and which will require significant organizational change.

III. COMPETING WITH 'BIG DATA' AND ADVANCED ANALYTICS

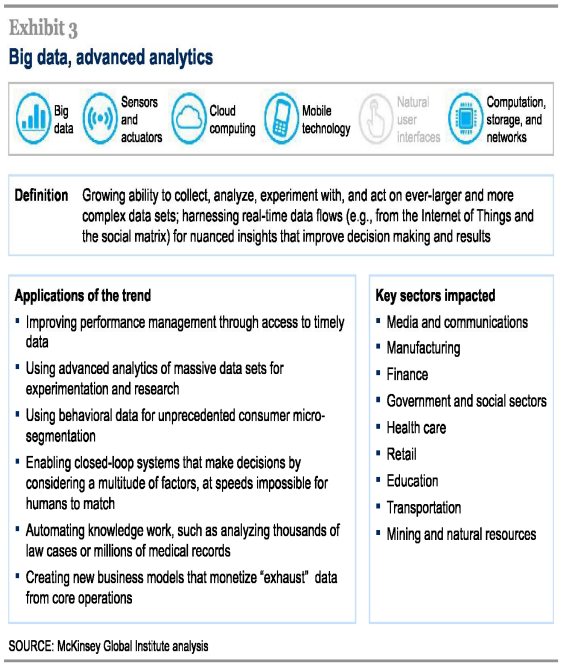
Three years ago, we described new opportunities to experiment with and segment consumer markets using big data. As with the social matrix, we now see data and analytics as part of a new foundation for competitiveness. Global data volumes—surging from social Web sites, sensors, smart phones, and more—are doubling faster than every two years.[7] The power of analytics is rising while costs are falling. Data visualization, wireless communications, and cloud infrastructure are extending the power and reach of information. With abundant data from multiple touch points and new analytic tools, companies are getting better and better at customizing products and services through the creation of ever-finer consumer micro segments. US-based Acxiom offers clients, from banks to auto companies, profiles of 500 million customers—each profile enriched by more than 1,500 data points gleaned from the analysis of up to 50 trillion transactions. Companies are learning to test and experiment using this type of data. They are borrowing from the pioneering efforts of companies such as Amazon.com or Google, continuously using what's known as A/B testing not only to improve Web-site designs and experiences but also to raise real-world corporate performance. Many advanced marketing organizations are assembling data from real-time monitoring of blogs, news reports, and Tweets to detect subtle shifts in sentiment that can affect product and pricing strategy.

Advanced analytic software allows machines to identify patterns hidden in massive data flows or documents. This machine "intelligence" means that a wider range of knowledge tasks may be automated at lower cost (see the fifth trend, below, for details). And as companies collect more data from operations, they may gain additional new revenue streams by selling sanitized information on spending patterns or physical activities to third parties ranging from economic forecasters to health-care companies.

Despite the widespread recognition of big data's potential, organizational and technological complexities, as well as the desire for perfection, often slow progress. Gaps between leaders and laggards are opening up as the former find new ways to test, learn, organize, and compete. For companies trying to keep pace, developing a big-data plan is becoming a critical new priority—one whose importance our colleagues likened, in a recent article, to the birth of strategic planning 40 years ago.[10]

Planning must extend beyond data strategy to encompass needed changes in organization and culture, the design of analytic and visualization tools frontline managers can use effectively, and the recruitment of scarce data scientists (which may require creative approaches, such as partnering with universities). Decisions about where corporate capabilities should reside, how external data will be merged with propriety information, and how to instill a culture of data-driven experimentation are becoming major leadership issues.

"Big data" is everywhere. With frequent media coverage, it has become well known in business. As our world becomes more networked and our activities more digital, data is more abundant, more diverse, and more available in real time. Organizations are harnessing big data to develop insights to fine-tune systems, inform decision making, and develop products that were previously impossible. However, many organizations still struggle to adopt big data and fully capture its potential. At the same time, the capabilities to analyze big data to drive deep insight are growing rapidly, raising the stakes for everyone (Exhibit 2).



Despite the fame of big data, its potential is far from being fully realized. According to survey data, 85 percent of organizations plan to use big data, but only 17 percent believe they have adequate capabilities to make full use of the technology.'? This has provided an advantage for data-driven companies that have been early adopters; another study found that the companies that have embraced big data are 4 percent more productive than their peers and have 6 percent higher profitability."

Meanwhile, the need for big data capabilities continues to grow as the amount of data in the world doubles every two years.[11]A growing number of

activitiescommunications, trade and commerce, media consumption and work-generate extensive digital data. The proliferation of networked sensors through the Internet of Things and smartphones is leading to more activities having a digital footprint and consequently, more data. Matching step with growth in data is the increasing power of advanced analytics. As predicted by Moore's law, computational capacity continues to double every 18 months. Combined with cloud computing and advances in user interfaces and visualization techniques, this progress is increasing the power to rapidly analyze data and deliver insight. It is also raising new challenges and requiring new skill sets. The potential of big data is huge, fast growing, and challenging to capture. We believe leaders of every organization face a growing imperative to harness big data and advanced analytics. This involves building the necessary capabilities in their organizations and embracing innovative uses of data in core activities.

IV. DEPLOYING THE INTERNET OF ALL THINGS

Tiny sensors and actuators, proliferating at astounding rates, are expected to explode in number over the next decade, potentially linking over 50 billion physical entities as costs plummet and networks become more pervasive. What we described as nascent three years ago is fast becoming ubiquitous, which gives managers unimagined possibilities to fine-tune processes and manage operations.

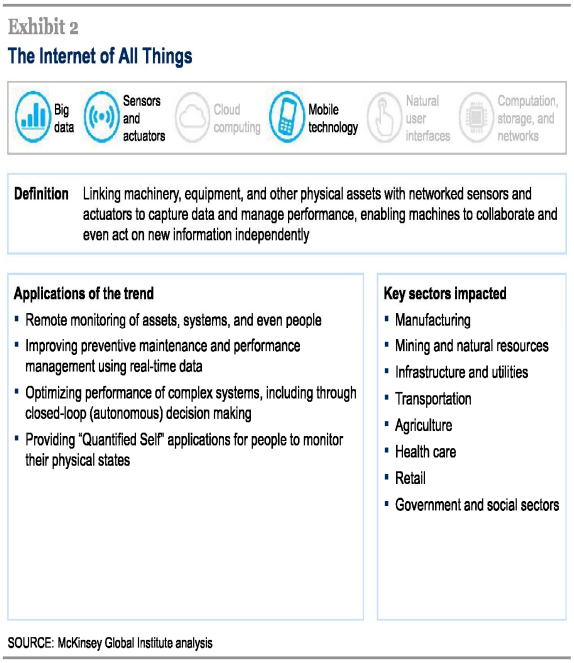
Through FedEx's Sense Awarex program, for example, customers place a small device the size of a mobile phone into packages. The device includes a global positioning system, as well as sensors to monitor temperature, light, humidity, barometric pressure, and more—critical to some biological products and sensitive electronics. The customer knows continuously not only where a product is but also whether ambient conditions have changed. These new data-rich renditions of radio-frequency-identification (RFID) tags have major implications for companies managing complex supply chains.

Companies are starting to use such technologies to run—not just monitor—complex operations, so that systems make autonomous decisions based on data the sensors report. Smart networks now use sensors to monitor vehicle flows and reprogram traffic signals accordingly or to confirm whether repairs have been made effectively in electric-power grids.

New technologies are leading to what's known as the "quantified self" movement, allowing people to become highly involved with their health care by using devices that monitor blood pressure and activity—even sleep patterns. Leading-edge ingestible sensors take this approach further, relaying information via smart phones to physicians, thereby providing new opportunities to manage health and disease.

Sensors, actuators, and other means of connecting things in the physical world to networks are proliferating at astounding rates. More than 12 billion devices around the world, including computers and smartphones, are connected to the Internet. And the number of devices connected to networks is expected to increase dramatically within the next decade, with estimates ranging from more than 50 billion devices to more than a trillion.6 This has the potential to transform activities such as manufacturing, building infrastructure, providing health care, and managing supply chains by monitoring and optimizing activities and assets at a very granular level. Any activity that "touches" multiple things or people across the value chain is a candidate for remaining with the help of networked sensors and actuators.

The proliferation of devices and applications is so rapid that this trend, which in 2010 we called the Internet of Things (lot), we have expanded to call the Internet of All Things (Exhibit 3).[12] According to one survey, some 15 percent of companies say they have implemented some kind of lot solution and 67 percent say they plan to do so within five years.[13] The rapid adoption of lot is driven by a rapid decline in the cost of sensors and actuators (devices that act in the physical world) and an increasing ability to connect to these sensors, often wirelessly, as well as the ability to analyze the huge amount of data generated (see Trend 3: "Big data, advanced analytics"). This has led to a number of new useeverything from monitoring the performance of truck drivers to tracking packages to measuring your daily activity.



V. OFFERING ANYTHING AS A SERVICE

The buying and selling of services derived from physical products is a business-model shift that's gaining steam. An attraction for buyers is the opportunity to replace big blocks of capital investment with more flexible and granular operating expenditures. A prominent example of this shift is the embrace of cloud-based IT services. Cosmetics maker Revlon, for example, now operates more than 500 of its IT applications in a private cloud built and operated by its IT team. It saved $70 million over two years, and when an entire factory, including a data center in Venezuela, was destroyed by a fire, the company was able to shift operations to New Jersey in under two hours. Moves like this, which suggest that cloud-delivered IT can be reliable and resilient, create new possibilities for the provision of mission-critical IT through internal or external assets and suppliers.

This model is spreading beyond IT as a range of companies test ways to monetize underused assets by transforming them into services, benefiting corporate buyers that can sidestep owning them. Companies with trucking fleets, for instance, are creating new B2B businesses renting out idle vehicles by the day or the hour. And a growing number of companies with excess office space are finding that they can generate revenue by offering space for short-term uses. The Los Angeles Times has rented space to film crews, for example. Cloud-based online services are feeding the trend both by facilitating remote-work patterns that free up space and by connecting that space with organizations which need it.

Other companies are seizing opportunities in consumer markets. Online services now allow rentals of everything from designer clothing and handbags to college textbooks. Home Depot rents out products from household tools to trucks. IT that can track usage and bill for services is what makes these models possible.

While we and others have written about the importance of cloud-based IT services for some time, the potential impact of this trend is in its early stages. Companies have much to discover about the efficiencies and flexibility possible through re envisioning their assets, whether that entails shifting from capital ownership to "expensed" services or assembling assets to play in this arena, as Amazon.com has done by offering server capacity to a range of businesses. Moreover, an understanding of what's most amenable to being delivered as a service is still evolving—as are the attitudes and appetites of buyers. Thus, much of the disruption lies ahead.

VI. UTOMATING KNOWLEDGE WORK

Physical labor and transactional tasks have been widely automated over the last three decades. Now advances in data analytics, low-cost computer power, machine learning, and interfaces that "understand" humans are moving the automation frontier rapidly toward the world's more than 200 million knowledge workers.

Powerful productivity-enhancing technologies already are taking root. Developments in how machines process language and understand context are allowing computers to search for information and find patterns of meaning at superhuman speed. At Clear well Systems, a Silicon Valley company that analyzes legal documents for pretrial discovery, machines recently scanned more than a half million documents and pinpointed the 0.5 percent of them that were relevant for an upcoming trial. What would have taken a large team of lawyers several weeks took only three days. Machines also are becoming adept at structuring basic content for reports, automatically generating marketing and financial materials by scanning documents and data.

Signaling a new milepost in the quest for artificial intelligence, IBM's Jeopardy-winning computer Watson has turned its attention to cancer research. Watson "trained" for the work by reading more than 600,000 medical-evidence reports, 1.5 million patient records, and 2.0 million pages of clinical-trial reports and medical-journal articles. Now it is the backbone of a decision-support application for oncologists at Memorial Sloan-Kettering Cancer Center, in New York.

At information-intensive companies, the culture and structure of the organization could change if machines start occupying positions along the knowledge-work value chain. Now is the time to begin planning for an era when the employee base might consist both of low-cost Watsons and of higher-priced workers with the judgment and technical skills to manage the new knowledge "workforce." At the same time, business and government leaders will be jointly responsible for mitigating the destabilization caused by the displacement of knowledge workers and their reallocation to new roles. Retraining workers, redesigning education, and redefining the nature of work will all be important elements of this effort.[14]

VII. ENGAGING THE NEXT THREE BILLION DIGITAL CITIZENS

As incomes rise in developing nations, their citizens are becoming wired, connected by mobile computing devices, particularly smart phones that will only increase in power and versatility. Although several emerging markets have experienced double-digit growth in Internet adoption, enormous growth potential remains: India's digital penetration is only 10 percent and China's is around 40 percent. Rising levels of connectivity will stimulate financial inclusion, local entrepreneurship, and enormous opportunities for business.

As Internet-enabled smart phones and other mobile devices move rapidly down the cost curve, they will enable vast new applications and sources of value. A

harbinger of the value to come is the success of mobile-payment services across a number of developing economies. Dutch–Bangla Bank Limited (DBBL), in Bangladesh, for example, garnered over a million mobile-payment subscribers in ten months. Standard Bank of South Africa reduced its origination costs for new customers by 80 percent using mobile devices.

Another source of value is local matching services that connect supply with demand. Kenya's Google-backed iHub project uses technology services to identify and finance entrepreneurs. Technology also helps multinationals adapt products and business models to local conditions. In India, Unilever provides mobile devices to rural distributors, including traditional mom-and-pop stores. The devices relay information (such as stock levels and pricing) back to the company, so Unilever can improve its demand forecasts, inventory management, and marketing strategy—raising sales in rural stores by a third.

VIII. CHARTING EXPERIENCES WHERE DIGITAL MEETS PHYSICAL

The borders of the digital and physical world have been blurring for many years as consumers learned to shop in virtual stores and to meet in virtual spaces. In those cases, the online world mirrors experiences of the physical world. Increasingly, we're seeing an inversion as real-life activities, from shopping to factory work, become rich with digital information and as the mobile Internet and advances in natural user interfaces give the physical world digital characteristics.

Today's clever apps use smart phone technology to sense our locations and those of our friends or even allow us to point to foreign street signs for quick translations. Augmented reality will go further with next-generation wearable devices such as Google Glass, which deploys cameras and wireless connections to project information, on demand, through eyeglasses. Other wearable technologies are also gathering steam, from "intelligent textiles" to wristwatch computers that can not only display e-mails and texts but also run mobile apps. Technologies pioneered in game consoles allow us to use physical movements and gestures to interact with digital devices.

Companies are applying these technologies to experiences that have remained resolutely physical, creating a new domain of customer interaction. Food retailers Tesco and Delhaize have deployed life-size store displays at South Korean and Belgian subway stations, respectively. The screens allow commuters waiting for trains to use smart phones to order groceries, which are then shipped to their homes or available for pickup at a physical store location. Other retailers are using similar displays in their physical stores so consumers can easily order out-of-stock products. Macy's has installed "magic mirrors" in store dressing rooms: a 72-inch display that allows shoppers to "try on" clothes virtually to help them make their selection.

Businesses are also integrating the digital world into physical work activities, thereby boosting their productivity and effectiveness. Boeing uses virtual-reality glasses so that factory workers assembling its 747 aircraft need to consult manuals less frequently. Annotated pop-ups point to drilling locations and display proper wire connections.

Executives need to examine their businesses to find areas where immersive experiences or interactive touch points can stimulate engagement with "always on" customers. And they should reflect on the potential for interactive digital platforms to play roles in product design and marketing or in gathering customer feedback. These possibilities will grow in importance as customers and employees come to expect interaction between heightened digital and physical offerings.

IX. 'FREEING' YOUR BUSINESS MODEL THROUGH INTERNET-INSPIRED PERSONALIZATION AND SIMPLIFICATION

After nearly two decades of shopping, reading, watching, seeking information, and interacting on the Internet, customers expect services to be free, personalized, and easy to use without instructions. This ethos presents a challenge for business, since customers expect instant results, as well as superb and transparent customer service, for all interactions—from Web sites to brick-and-mortar stores. Fail to deliver, and competitors' offerings are only an app download away.[15]

A number of businesses have battled in the free-services arena against tough digital competitors such as Craigslist, peer-to-peer music services, and Wikipedia. In 2012, Electronic Arts lost 400,000 players when it began charging for its online Star Wars game. Players came back when the company designed a "freemium" offer: users paid only after the first 50 levels. Additional challenges to traditional pricing power appear each day with comparative price apps that allow consumers to "showroom" at physical stores and then buy online at lower prices.

Indeed, users will probably never pay for many valuable technology-enabled services, such as search—and the list seems to be growing rapidly. Providers of these "free" services will need to innovate with alternative business models. The most successful are likely to be multisided ones, which tap large profit pools that can be generated from information gathered by an adjacent free activity that's commercially relevant. A familiar example is Google's policy of offering its search services free of charge while garnering revenues at the other side of the platform by selling advertising or insights into customer behavior. In a world of free, the hunt is on

for such monetization ideas. More and more companies, for example, are exploring opportunities to sell to third parties or to create new services based on sanitized information ("exhaust data").

Consumers, meanwhile, expect to be valued by companies and treated as individuals. In the online world, Spotify and Netflix analyze their customers' histories to create "for me" experiences when recommending music and movies. Services are becoming even more hassle free online: new Web and mobile apps are designed to be so easy to use that instructions are no longer needed. The demand for "quick and easy" is compelling companies to modify how they deliver real-world offerings—for example, by allowing customers to photograph checks and deposit them using smart phone apps. A world of digitized instant gratification and low switching costs could force many businesses to seek innovative business models that provide more products and services free of charge or at lower cost. They'll also have to think about offering more personalization in their products and services: customization at a mass level. This approach could require changes to back-end systems, which are often designed for mass production. Businesses will need new ways to collect information that furthers personalization, to embed experimentation into product-development efforts, and to ensure that offerings are easy to use—and even fun.

X. BUYING AND SELLING AS DIGITAL COMMERCE LEAPS AHEAD

The rise of the mobile Internet and the evolution of core technologies that cut costs and vastly simplify the process of completing transactions online are reducing barriers to entry across a wide swath of economic activity. Amped-up technology platforms are enabling peer-to-peer commerce to replace activities traditionally carried out by companies and giving birth to new kinds of payment systems and monetization models.

Entry costs have fallen to the point where people who knit sweaters, for example, can tap into a global market of customers. Airbnb brokers deals between travelers and people with spare rooms to rent in their homes or apartments. It booked more than ten million overnight stays in 2012 and could soon be selling more room nights than major international hotel chains do. Similar marketplaces are springing up for bicycles, cars,[12] labor,[13] and more.

Mobile-payment networks, sometimes augmented with services that extend beyond pure transactions, are a second area of evolution for e-commerce as costs fall. Starbucks envisions extending its pioneering use of smartphones for payments to include instant photo verification of buyers. New mobile-commerce platforms that manage transactions can offer customers the option of paying with credit credentials they established for other merchants. The mobile-payments provider Square offers customers using its service access to their sales data from any transaction and allows them to set up customer-loyalty programs easily.

This trend will become more striking over the next decade or so: 600 cities, most in emerging markets, will account for roughly two-thirds of the world's GDP growth. One likely consequence for fast-growing cities will be the rapid development of dense, digitally enabled commerce—new, highly evolved ecosystems combining devices, payment systems, digital and technology infrastructure, and logistics.[14]

XI. TRANSFORMING GOVERNMENT, HEALTH CARE, AND EDUCATION

The private sector has a big stake in the successful transformation of government, health care, and education, which together account for a third of global GDP. They have lagged behind in productivity growth at least in part because they have been slow to adopt Web-based platforms, big-data analytics, and other IT innovations. Technology-enabled productivity growth could help reduce the cost burden while improving the quality of services and outcomes, as well as boosting long-term global-growth prospects.

Many governments are already using the Web to improve services and reduce waste. India has enrolled 380 million citizens in the world's largest biometric-identity program, Aadhaar, and plans to use the system to make over $50 billion in cash transfers to poor citizens, saving $6 billion in fraudulent payments. In 2011, the US government introduced a Cloud First policy, which laid out a vision to shift a quarter of the $80 billion in annual federal spending to the cloud from in-house data centers, thus saving 20 to 30 percent on the cost of the shifted work. Governments can also use IT to better engage citizens, as South Korea has done with its e-People site, which helps citizens send online civil petitions for policy changes or reports of corruption.

Technology also is opening new opportunities to contain rising health-care costs and improve access. In rural Bangladesh, 90 percent of births occur outside hospitals. A mobile-notification system alerts clinics to dispatch nurse–midwife teams, who are now present in 89 percent of births. In China, a public–private partnership created a cardiovascular-monitoring system that allows patients to self-administer electrocardiograms and transmit data to specialists in Beijing, who can suggest treatments by phone. At New York's Mount Sinai Hospital, a venture with General Electric uses smart tags to track the flow of hundreds of patients, treatments, and medical assets in real time. The hospital estimates it could potentially treat 10,000 more patients each year as a result and generate $120 million in savings and revenues over several years.

Finally, there's education, which represents 4.5 percent of global GDP. Technology is starting to change the equation. Using game technologies and immersive math courseware, DreamBox makes learning more fun, while algorithms adapt the learning experience to each student's needs. Brilliant.org allows talented mathematicians and physics students around the world to learn at their own pace. Global massive online open courses (MOOCs) offer university-level "classes" using social networks, videos, and community interactions.

Smart phones and tablets are entering classrooms en masse to deliver personalized content. India is running trials of the sub-$50 Aakash tablet to link more than 25,000 colleges in an e-learning program. Other technologies are improving teachers' skills and performance through online collaboration, access to best-in-class pedagogies, and better tracking of student achievement, which facilitates targeted interventions.

What does all this mean for busy senior executives—beyond the obvious that there's no escaping these trends, that they will continue to evolve, and that their implications, which will vary for different types of organizations, merit serious attention? We'd suggest that the era of pervasive connectedness underlying these trends also implies a need for more focused attention on issues such as the following:

Transparent and innovative business models. Real-time information, instant price discovery, and quick problem resolution are becoming basic expectations of consumers, citizens, and business customers in the digital realm. Collectively, they will force many companies to rethink elements of their business models. Leaders will need to make their companies more transparent and elevate rapid responsiveness to the level of a core competency. Business models built on transparency and responsiveness will not only satisfy customers but also help companies become more nimble, innovative, and credible with all their stakeholders.[21]

Talent. The rising economic and business impact of information technology means that competition will heat up for graduates in science, technology, engineering, and mathematics—the STEM fields, where job growth is likely to be about 1.7 times faster than it will be in other areas. As the automation of knowledge work gains momentum, and computers start handling a growing number of tasks now performed by knowledge workers, some midlevel ones will probably be displaced and people with higher-level skills will become more important. Providing new forms of training to upgrade knowledge workers' capabilities and rethinking the nature of public education will be critical priorities for business and government leaders.[22]

Organization. The Internet's model and values, particularly connectivity and nonhierarchical interactions, have significant organizational implications. The flowering of many of these trends could imply decentralization, along with changing relationships among managers, employees, suppliers, and customers. These shifts aren't always comfortable for leaders, but they hold the potential for boosting innovation, loyalty, business reach, productivity, and marketing effectiveness, while reducing costs.[23]

Privacy and security. Billions of people soon will be socializing, sharing information, and conducting transactions on the Internet. As businesses and governments use the Web to monitor assets, manage payments, and store data, they will be tracking moves individuals make on the Internet.[24] Navigating the issues associated with generating economic utility while managing privacy will require organizations to examine trade-offs and address tensions in a clear, thoughtful way as rules of the road are established. Meanwhile, the value of the massive stores of digital information will only increase, giving criminals, terrorists, and even rogue states bigger incentives to breach firewalls and making the protection of data an imperative for top management.[25] Keeping up with state-of-the-art encryption standards and security-management practices, for example, is moving from an arcane corner of data management to a core customer expectation, which, if not met, could severely damage a business's reputation. [26]

CONCLUSIONS

The pace of technology and business change will only accelerate, and the impact of the trends above will broaden and deepen. For some organizations, they will unlock significant competitive advantages; for others, dealing with the disruption they bring will be a major challenge. Our broad message is that organizations should incorporate an understanding of the trends into their strategic thinking to help identify new market opportunities, invent new ways of doing business, and compete with an ever-growing number of innovative rivals.

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