Digital Europe:
Pushing the frontier, capturing the benefits

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Introduction

Digital Europe: Pushing the frontier, capturing the benefits

A collection of sector-specific insights from Digital McKinsey

There is no shortage of opinions about what the digital revolution is doing to companies, societies, and individuals. The sheer scope of change certainly is mind blowing. From self-driving cars to automated workforces to nanotech-driven healthcare to ever-more-powerful mobile devices, it can be easy to get caught up in the details and miss the scale of change that's upon us.

But beyond all the excitement, what's often missing is deep analysis and considered thought about the implications of these digital developments. For all the change we've already seen, we believe that we really haven't seen much yet. The change that's coming will be more dramatic than the change that's already here, which requires a more thoughtful approach to the implications of these changes. Those companies that thrive during this period will be those that are ready to truly reinvent themselves, not just make peripheral changes.

That's why we've put together this collection of articles examining the digital developments in Europe and their implications across an array of sectors. They examine changes to business models and innovations that are both threats and opportunities. Each short piece focuses on the main priorities to tackle in that sector in the next three to five years.

We hope these articles will be both informative and provocative. We look forward to continuing the conversation.

The battle for digital banking

Sébastien Lacroix, Pedro Rodeia, and Zubin Taraporevala

Banking will face major upheavals over the next five to ten years as technology raises customer expectations, reduces the cost of switching banks, increases price transparency, and cuts cost to serve. Digital attackers are undermining long-established business models and challenging incumbent banks in a high-stakes struggle for the customer.

Digital is increasingly dominant

The use of digital channels and services is already widespread in both retail and corporate banking. The Internet is the preferred channel for account and loan inquiries and money transfers, and product purchase is rapidly moving online, too. In the developed Asian markets of Hong Kong, Tokyo, South Korea, Taiwan, Singapore, and Australia, for example,

between 58 and 75 percent of retail customers have bought a financial product online.[1] As digital becomes dominant, traditional channels decline: in France, for instance, the number of customers visiting branches at least monthly has fallen by 30 percent in the past five years.[2]

As millennials become the next wave of banking customers, the shift to digital will accelerate. Meanwhile older customers—banking's bread and butter—are becoming more comfortable with digital channels. In the US, where customers 50 and older account for more than 60 percent of retail-banking revenues, people aged 45 to 65 are the fastest-growing group of smartphone users.[3]

Corporate clients seem equally keen on digital banking. Small and medium-sized companies in Europe are more than four times as likely to choose a bank with a good digital-banking platform than one with a nearby branch, for example. In capital markets, one asset class after another has gone electronic, a shift that new entrants have been quick to exploit. Consider cash equities, for instance, where a vast portion of trading is now done by firms that did not exist 15 years ago. It is hardly surprising that four-fifths of the leaders attending McKinsey's North American commercial-banking roundtable in April 2015 agreed that digital attackers will soon be a meaningful threat to their business.

Banks still rely on customer-facing activities

In the traditional business model, banks combine financing, investing, and transactions to serve all their customers' needs throughout a long—perhaps lifelong—relationship. They provide basic services such as personal accounts at low cost to capture customers, who then, partly through inertia, treat the bank as their default choice for other financial needs, enabling it to maintain healthy margins in products such as deposits. This web of activities is held together by the customer relationship, but a glance at the underlying economics of banks' business model shows that their grip on this relationship is now in jeopardy.

Almost 60 percent of banks' profits (but only 46 percent of revenues) come from their origination and sales activities. Banks' return on equity is far higher in these areas, at 22 percent, than in the balance-sheet provision businesses of loans, deposits, and current accounts, at 6 percent.[4] It is these lucrative origination and sales activities that are most threatened by new entrants and nimble incumbents alike.

Attackers are all around

Digital start-ups and technology giants in online retail, media, and other sectors are poised to exploit this imbalance in the banking business model. Technological advances and shifts in consumer behavior offer attackers a chance to weaken the heavy gravitational

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[1] Sonia Barquin and Vinayak HV, "Digital Banking in Asia: What do consumers really want?" March 2015.

[2] McKinsey Multichannel Survey, 2015.

[3] *The Fight for the Customer: McKinsey Global Banking Annual Review 2015*, McKinsey & Company, September 2015.

[4] McKinsey Panorama—Global Banking Pools, 2015 (proprietary database)

pull that banks have traditionally exerted on their customers. Many challengers seek to disintermediate these relationships, cherry-picking the most profitable origination and sales components in the value chain and leaving banks holding only the basics of asset and liability management and balance-sheet provision.

The attackers are numerous. Between 2013 and 2014, venture-capital investment in fintechs—highly focused tech start-ups offering consumer loans, mortgages, deposits, currency exchange, and other basic banking services—soared from $4 billion to $12.2 billion. As of August 2015, there were more than 12,000 fintechs moving rapidly into a wide range of banking activities.[5]

Fintechs are not the only challengers; other attackers are proliferating too. Some new digital platforms such as NerdWallet (in the United States) or India's BankBazaar.com aggregate the offerings of multiple banks in loans, credit cards, deposits, insurance, and more and receive payment from the banks for generating new business. Wealthfront targets millennials who prefer using automated software to interacting with personal advisers at lower cost; and Lending Home sets out to appeal to investment-property buyers looking for fast access to inexpensive mortgages. Starting out as a price-comparison site for mortgages, Moneysupermarket.com now offers information and a purchasing platform for a wide range of financial products as well as telecom services, travel deals, and energy supplies.

Finding growth difficult, giants from sectors such as technology, online retail, media, and entertainment are considering how they might claim a share of the tempting profits to be had in banking. Many of these companies have strong relationships with vast customer bases. Phone operators are entering electronic payments by turning smartphones into digital wallets through the use of SIM cards with embedded NFC chips. And retailers, including Rakuten, Tesco, Auchan, and Carrefour, are offering payment services, seeking to capture a significant share of revenues by breaking the link between account management and payment.
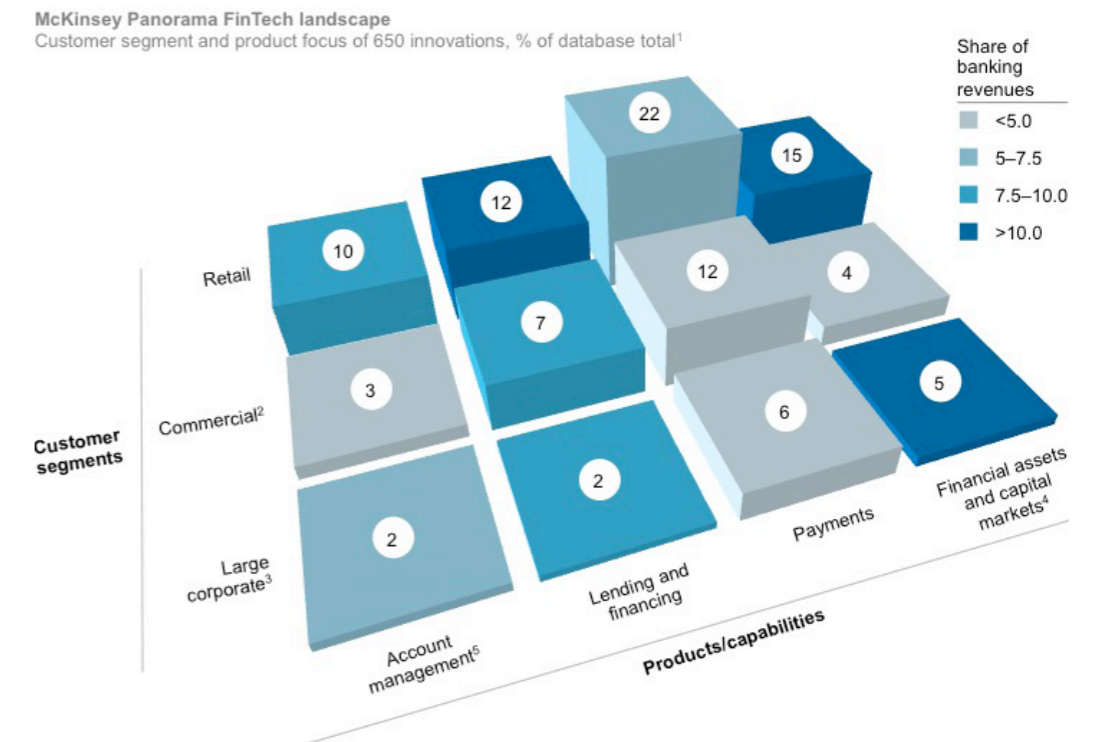
Retail banking is at risk

In the new competitive arena, retail banking is particularly at risk. Among 650 fintech businesses we analyzed, 59 percent target retail banking. Among them, 22 percent focus on payments, 15 percent on financial assets, 12 percent on lending and financing, and 10 percent on account management (Exhibit 1). From the banks' point of view, however, the retail segments most at risk are lending and financing and financial assets, which have the highest segment share of global banking revenues, at more than 10 percent.

[5] *The Fight for the Customer: McKinsey Global Banking Annual Review 2015*, McKinsey & Company, September 2015.

Fintechs are everywhere, especially in retail and payments

McKinsey Panorama FinTech landscape
Customer segment and product focus of 650 innovations, % of database total[1]

1 Includes innovations from both fintech start-ups (80%) and banks. Bar height and numbers represent distribution of innovations. Bar colors represent share of banking pools.
2 Includes small and medium-sized enterprises
3 Includes large corporate, public entities, and nonbanking financial institutions
4 Includes investment banking, sales and trading, securities services, retail investment, noncurrent account deposits, and asset-management factory
5 Revenue share includes current-account deposit revenue.
NOTE: Numbers may not sum due to rounding.

SOURCE: McKinsey Panorama FinTech database; McKinsey analysis

Start-ups are also creating more intuitive and compelling customer experiences to make online finance simpler and more intuitive. Some start-ups, for example, make a game of savings, comparing the user's returns with others', or make peer-to-peer transfers fun, by adding voice messages and emoticons.

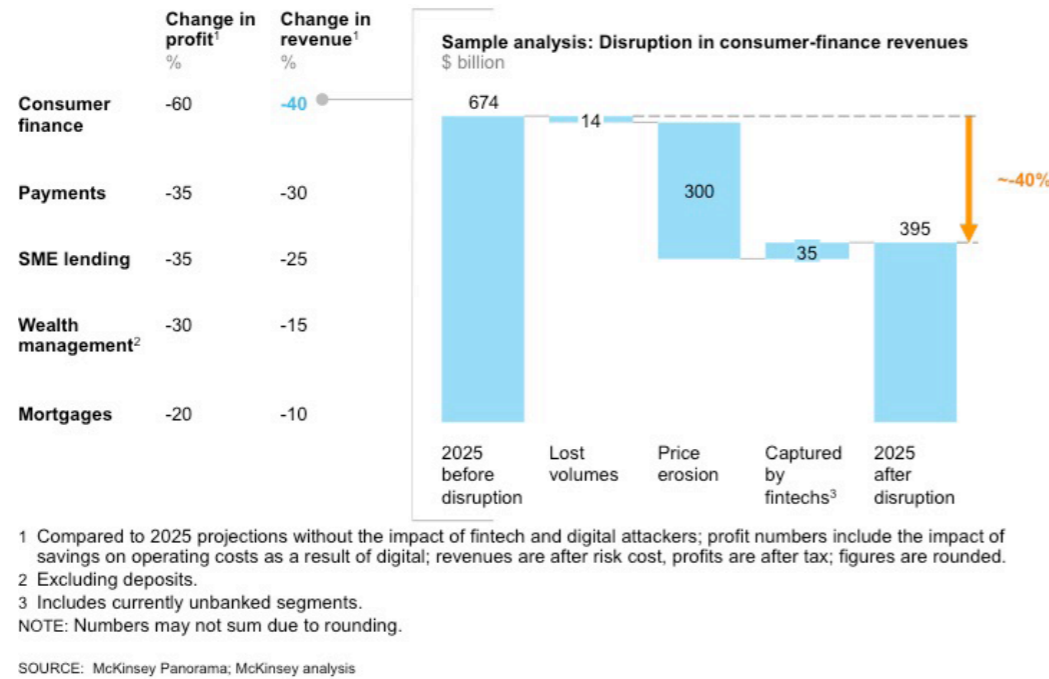Most fintechs do not fulfill the products they sell, but use a bank and its balance sheet to fulfill a loan or deposit, a card provider and its payments backbone to fulfill a credit card, a foreign-exchange broker for currency exchange, and so on.

The consequences for banks are dramatic: the substantial value they generate from distribution could be captured by others. Five retail businesses in particular have substantial

value at risk (Exhibit 2). Margins will come under pressure, and the customer relationship — a platform from which banks sell other products on a fee basis at higher margins — could be weakened or even destroyed.

Exhibit 2

Estimated impact of fintech disruption on five retail businesses, 2025

	Change in profit[1] %	Change in revenue[1] %
Consumer finance	-60	-40
Payments	-35	-30
SME lending	-35	-25
Wealth management[2]	-30	-15
Mortgages	-20	-10

Sample analysis: Disruption in consumer-finance revenues
$ billion

674 · 14 · 300 · 35 · 395 · ~-40%

2025 before disruption / Lost volumes / Price erosion / Captured by fintechs[3] / 2025 after disruption

1 Compared to 2025 projections without the impact of fintech and digital attackers; profit numbers include the impact of savings on operating costs as a result of digital; revenues are after risk cost, profits are after tax; figures are rounded.
2 Excluding deposits.
3 Includes currently unbanked segments.
NOTE: Numbers may not sum due to rounding.

SOURCE: McKinsey Panorama; McKinsey analysis

Payments have already been disrupted

Within the retail business, payments has already experienced significant disruption. Companies such as Apple and Square, a mobile payments and financial-services company, are creating new, phone-based payment systems and merchant-acceptance solutions. Transferwise and other start-ups are building new peer-to-peer money-transfer services. Perhaps most troubling of all for banks, Facebook, with its unequaled global customer base, has recently unveiled its own money-transfer system.
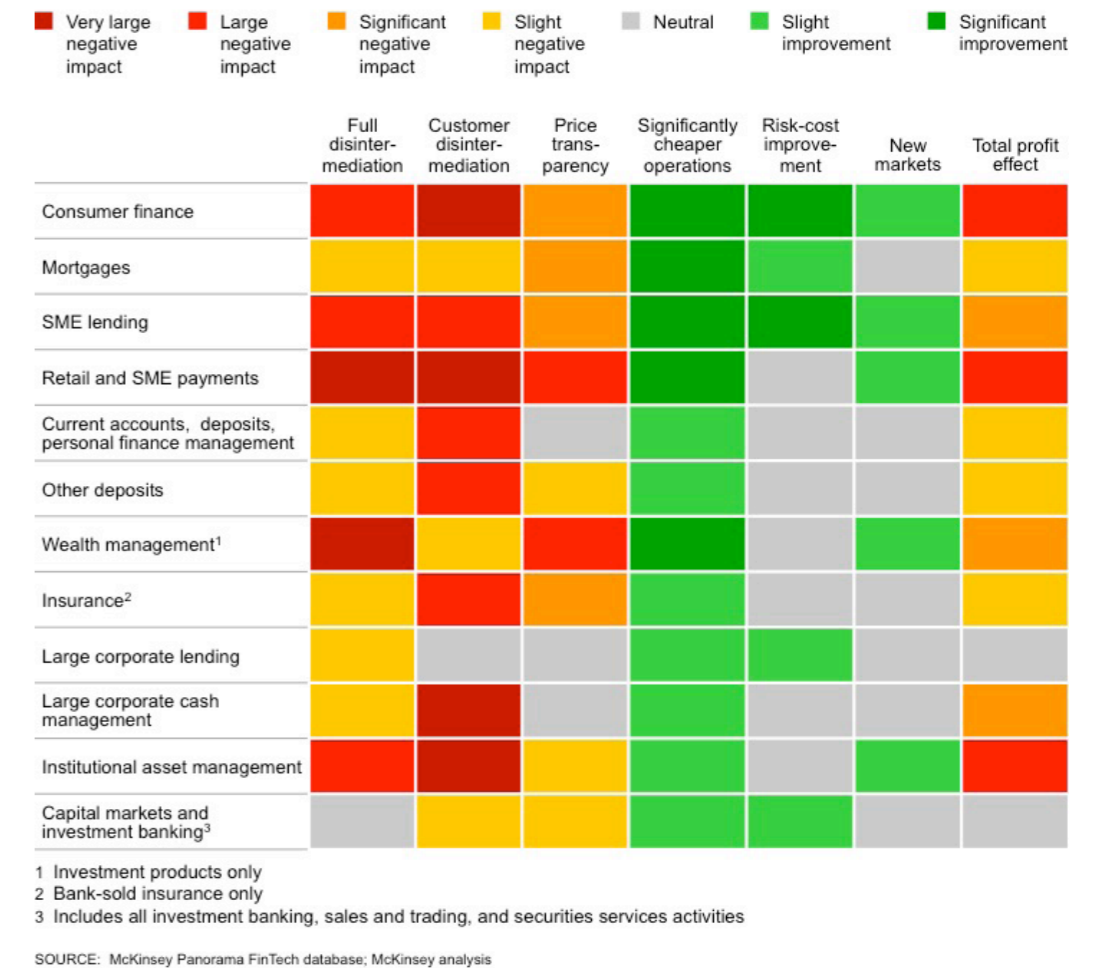
On the upside, these new services are likely to increase the size of the payments market as cash usage declines and better use of data opens up more opportunities for cross-selling. Banks may struggle to capture this growth, however, and could well see their margins shrink as payments bypass them and the credit cards they offer.

SME banking faces a similar situation: banks' costs are high, and their products and services are susceptible to automation and digitization. Corporate banking businesses such as trade finance are looking vulnerable. On the other hand, asset-based lending, syndicated lending, and other complex and custom businesses are more likely to stay with banks. Across the banking sector as a whole, the implications of digital disruption are best understood at the level of individual products (Exhibit 3).

In capital markets and investment banking, digitization is already well advanced. Sales and trading have gone electronic in many asset classes, and others are moving in the same direction. Margins have declined considerably in e-traded markets. Overall, though, capital

Exhibit 3

How digital threats and opportunities could affect key products

Legend: Very large negative impact · Large negative impact · Significant negative impact · Slight negative impact · Neutral · Slight improvement · Significant improvement

Columns: Full disinter-mediation · Customer disinter-mediation · Price trans-parency · Significantly cheaper operations · Risk-cost improve-ment · New markets · Total profit effect

Rows: Consumer finance; Mortgages; SME lending; Retail and SME payments; Current accounts, deposits, personal finance management; Other deposits; Wealth management[1]; Insurance[2]; Large corporate lending; Large corporate cash management; Institutional asset management; Capital markets and investment banking[3]

1 Investment products only
2 Bank-sold insurance only
3 Includes all investment banking, sales and trading, and securities services activities

SOURCE: McKinsey Panorama FinTech database; McKinsey analysis

markets and investment banking are less likely to undergo disruption in the medium term than other banking sectors, with businesses such as global custody and cash management looking relatively secure for the next few years.

But there are opportunities as well as threats

The story for banking is not all doom and gloom: digitization can also help incumbent banks cut costs, capture share, and boost profits. The digitization of IT and end-to-end processes could help banks improve their competitiveness and profitability considerably.

Banks could also learn from the attackers that are poaching their customers, squeezing their margins, and outperforming them on cost. Fintechs benefit from a culture of experimentation. Their small size and nimbleness enable them to take big chances and quickly pivot away from mistakes. In corporate and investment banking, and to a lesser extent in retail banking, some of them are finding ways to become partners in the banking ecosystem.[6] Because of their hefty cost advantages due to their highly automated software-based services and no expensive branches, they can offer far more attractive terms than banks do. They are also adept at using advanced data analytics to experiment with new credit-scoring approaches, improve their understanding of risk, and capture shifts in customer behavior.

Fintechs need not be seen only as adversaries and models, however. Some banks are forming arrangements with tech companies to gain access to technologies or platforms; others are forming broader partnerships and alliances with them; still others are setting up dedicated venture-capital funds and other vehicles to invest in fintechs; and some have bought fintechs outright.

Four ways to win the digital battle

Banks engaged in a digital transformation should pay attention to four areas in particular:

Building digital at scale. Few banks have all the skills and technology they need to create a compelling digital experience. Assessing their current competitive circumstances and skills should give them a good idea of where to focus. For most banks, this will include designing a new model for data governance and management, radically innovating their data technology and architecture, upgrading procedures for aggregating data and producing metrics, simplifying data assets by domain, and driving integration across silos.

Cutting costs. Banks cannot win the fight for the customer with their existing cost base. We estimate that incumbents' costs exceed attackers' by at least 25 to 30 per cent.[7] Incremental cost cuts will be insufficient; instead, banks must rethink the way they

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operate, especially in origination and distribution, where competition for customers is most intense. Digitization will be the biggest weapon in their arsenal, but there are others, such as simplifying the product portfolio; offshoring, outsourcing, and near-shoring; and transforming IT. In capital markets, banks can save by creating utilities for routine tasks, such as gathering "know your client" information.

Excelling at data-driven customer acquisition. Not only do attackers focus on distribution, they have clear advantages in cost and customer experience. To compete, banks must provide seamless multichannel connectivity, use technology and analytics to improve the customer experience, develop segment-specific pricing, and build emotional connections with customers. Some banks are using machine-learning techniques to understand what products customers might want to buy, and feeding the results to relationship managers to follow up. This has enabled some European banks to increase sales of new products by 10 percent, reduce capital expenditures by 20 percent, and cut churn by 20 percent.[8]

Developing ideas beyond the core. Banks can generate digital traffic from data-driven services that have nothing to do with their main business: virtual marketplaces, online courses and other education services, and even online dating. Customers of these new services can then be brought into the bank through cross-selling. A portfolio of unrelated digital ideas can provide access to millions of customers and tens of thousands of institutional and corporate clients. If banks could achieve a success rate between that of a venture-capital and a private-equity firm—20 to 30 percent—their distribution would be substantially improved.[9]

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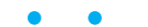
To come out on top in the digital battle for customers, banks need to radically redefine their value proposition. By taking a fresh look at who they are and what kind of customers they want to serve, they can start to carve out a powerful position in the new digital world. ❑

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[6] See Miklos Dietz, Philipp Härle, and Somesh Khanna, "A digital crack in banking's business model," *McKinsey Quarterly*, April 2016.

[7] *The Fight for the Customer: McKinsey Global Banking Annual Review 2015*, McKinsey & Company, September 2015.

[8] *Ibid*

[9] *Ibid*

The digital future of construction

Rajat Agarwal, Shankar Chandrasekaran, Mukund Sridhar, and Paul-Louis Caylar

The construction industry is ripe for disruption. Large projects typically take 20 percent longer to finish than scheduled and are up to 80 percent over budget (Exhibit 1). Construction productivity has actually declined in some markets since the 1990s (Exhibit 2), and financial returns for contractors are often relatively low—and volatile.

The construction sector has been slow to adopt process and technology innovations and has struggled to fix the basics. Project planning, for example, remains uncoordinated between the office and the field, and it is often done on paper. Contracts do not include incentives for risk sharing and innovation, performance management is inadequate, and supply-chain practices are still unsophisticated.

Exhibit 1

Cost and schedule overruns are the norm in the construction sector

Estimated overrun in capital expenditure
% of original quoted capital expenditure

Legend: Mining, Oil and gas, Infrastructure

Average = 80%

Average = 20 months

Delay beyond original schedule
Years

SOURCE: Global Projects Database, IHS Herold, November 19, 2013, herold.com; McKinsey analysis
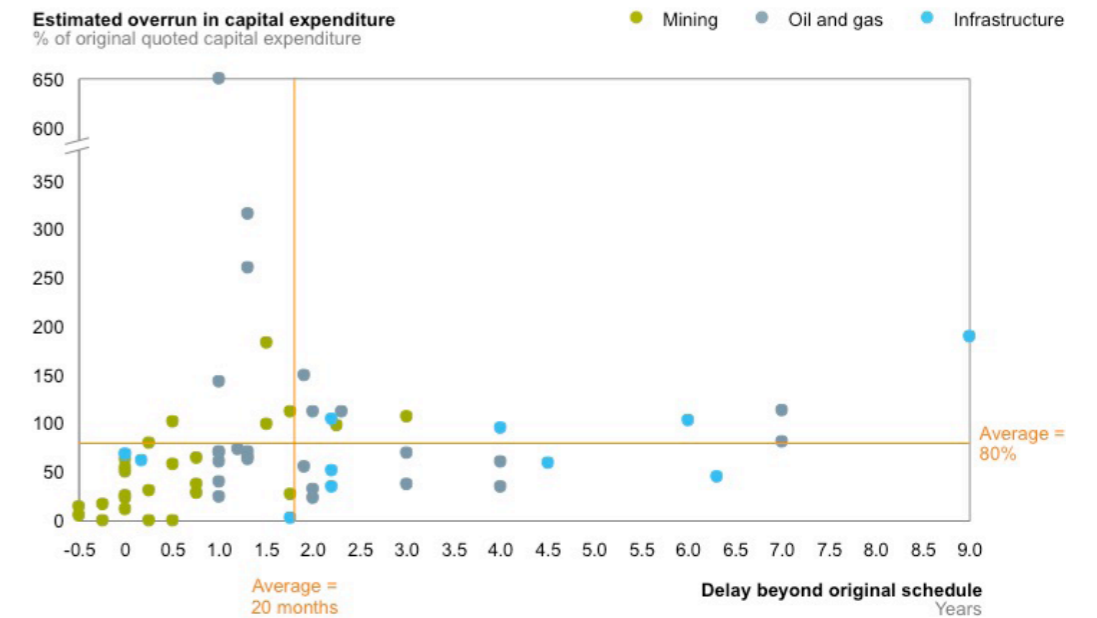
Exhibit 2

Construction labor productivity has not kept pace with overall economic productivity

Labor productivity, gross value added per hour worked, constant 2010 prices
Index: 100 = 1995

Legend: Germany, United Kingdom

Total economy

Construction

SOURCE: OECD; McKinsey analysis
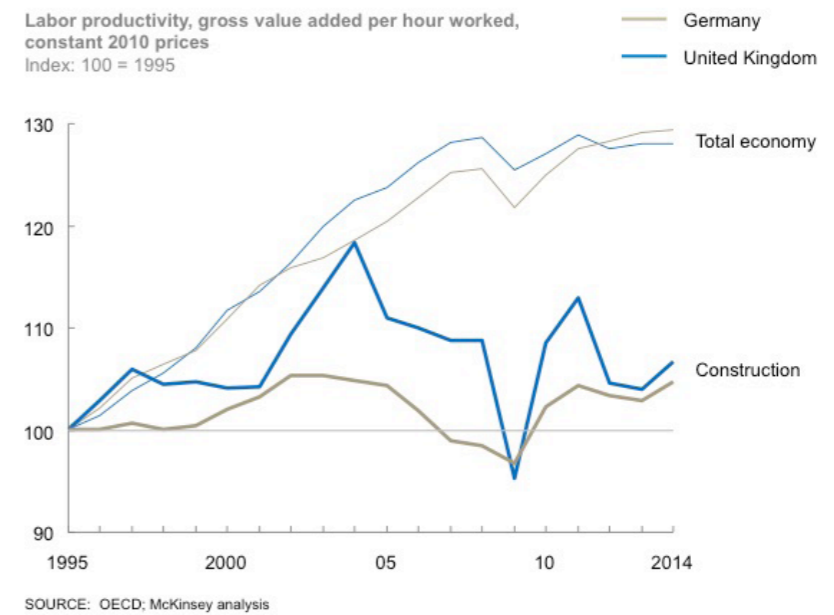
Nor has the industry yet invested up front in new digital technologies, even if the long-term benefits are significant. Information technology and R&D spending run well behind that of other industries, despite the emergence of new software solutions.

Technical challenges specific to construction play a role in the slow pace of digitization. Rolling out solutions across dissimilar, geographically dispersed construction sites—an oil pipeline and an airport, for example—is no easy task. The growing complexity and scale of projects, increasing demand for environmentally sensitive construction practices, and the shortage of skilled labor and supervisory staff magnify the challenges and demand new ways of thinking and working.
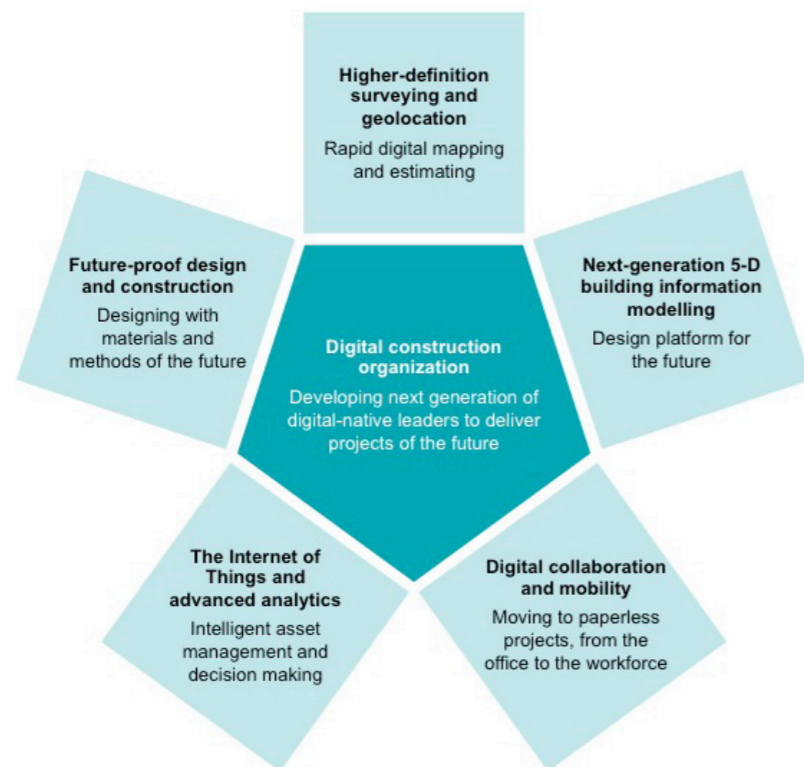
The McKinsey Global Institute estimates that the world will need to spend $57 trillion on infrastructure by 2030 to keep up with global GDP growth—a huge incentive for construction-industry players to embrace new technologies and improved practices.

In this report, we offer five ways the industry could transform itself over the next five years (Exhibit 3). They are all practical, relevant, and designed to work together for greater impact.

Disrupting construction: Five big ideas

Five trends will shape construction and capital projects

Higher-definition surveying and geolocation
Rapid digital mapping and estimating

Next-generation 5-D building information modelling
Design platform for the future

Future-proof design and construction
Designing with materials and methods of the future

Digital construction organization
Developing next generation of digital-native leaders to deliver projects of the future

The Internet of Things and advanced analytics
Intelligent asset management and decision making

Digital collaboration and mobility
Moving to paperless projects, from the office to the workforce

SOURCE: McKinsey analysis

Higher-definition surveying and geolocation

Geological surprises often cause project delays and budget overruns. New techniques that integrate high-definition photography, 3-D laser scanning, and geographic information systems, enabled by drone and unmanned-aerial-vehicle technology, can dramatically improve accuracy and speed. This is especially true when light-detection-and-ranging (lidar) technology, for example, is much faster than conventional technologies and provides high-quality 3-D images that can be integrated with project-planning tools. One such tool is building information modeling (BIM), complemented by geographic information systems that allow maps, images, distance measurements, and GPS positions to be overlaid. This information can then be uploaded to other analytical and visualization systems for use in project planning and construction. The costs of this new survey technology have come down substantially. Lidar and real-time kinematic GPS are now available for about $10,000, while high-resolution cameras are small and light enough to be mounted on standard industrial drones

Next-generation 5-D building information modeling

The construction industry has yet to adopt an integrated modeling platform that spans project planning, design, construction, operations, and maintenance. It relies instead on bespoke software tools. In addition, project owners and contractors often use incompatible platforms. As a result, there is no single source for an integrated, real-time view of project design, cost, and schedule.

Now there's a solution. Next-generation 5-D BIM is a five-dimensional representation of the physical and functional characteristics of any project. It considers the project's cost and schedule in addition to the standard spatial design parameters in 3-D. It also includes such details as geometry, specifications, aesthetics, and thermal and acoustic properties. A 5-D BIM platform allows owners and contractors to identify, analyze, and record the impact of changes on project costs and scheduling (Exhibit 4). The visual and intuitive nature of 5-D BIM gives contractors a better chance to identify risks earlier and thus make better decisions.

One study found that 75 percent of companies that adopted BIM reported a positive return on their investment. They also reported shorter project lifecycles and savings on paperwork and materials costs. In view of these benefits, a number of governments, including those in Britain, Finland, and Singapore, mandate the use of BIM for public infrastructure projects.

The use of 5-D BIM technology can be further enhanced through augmented-reality technology residing in tablets or wearable devices. For example, a wearable, self-contained device with a see-through, holographic display and advanced sensors can map the physical environment. Companies are developing BIM-like design and construction

Exhibit 4

5-D BIM integrates design, cost, and schedule in a 3-D output

Building information modelling (BIM) is a digital representation of the physical and functional characteristics of a project, forming a reliable basis for decisions during the project's life cycle

SOURCE: McKinsey analysis
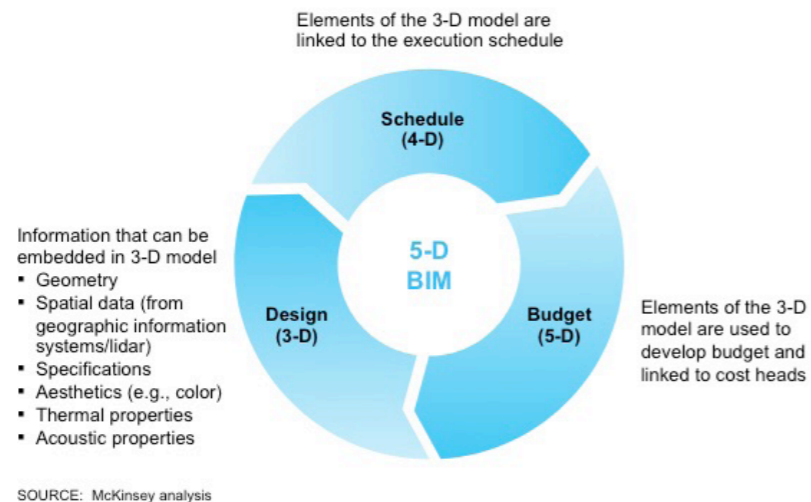
solutions for these platforms. In this "mixed reality" environment, users can pin holograms to physical objects and interact with data using gesture, gaze, and voice commands.

Combining 5-D BIM and augmented-reality devices could transform construction, maintenance, and operations. To get the full benefit of BIM technology, project owners and contractors need to incorporate its use right from the design stage, and all stakeholders need to adopt standardized data-reporting formats compatible with it. In addition, owners and contractors need to create an organization for BIM implementation and invest in capability building.

Digital collaboration and mobility

The industry still relies on paper to manage processes and deliverables, making it difficult to capture and analyze data and provoking disagreements among owners and contractors on such matters as construction progress, change orders, and claims management. Now, though, some owners and contractors are realizing substantial benefits by deploying digital-collaboration and field-mobility solutions. A large global construction firm recently announced a joint development agreement with a software provider to develop a cloud-based, mobile-enabled field-supervision platform that integrates project planning, engineering, physical control, budgeting, and document management for large projects. Several large-project developers have already successfully digitized their project-management work flows.

Digitizing work flows has substantial benefits. In the case of an American tunnel project that involved almost 600 vendors, the contractor developed a single-platform solution for bidding, tendering, and contract management that saved the team more than 20 hours

of staff time per week, cut down the time to generate reports by 75 percent, and sped up document transmittals by 90 percent.

Crew-mobility solutions can have a similar catalytic effect on productivity. It has long been difficult for central planning teams and on-site construction teams to connect and share information about progress in real time. Several problems have limited the adoption of such tools by field crews: compatibility issues between mobility solutions and central-planning solutions, a lack of reliable and high-speed broadband connectivity, and non-intuitive designs and user interfaces.

The availability of low-cost mobile connectivity via tablets and handheld devices has ushered in a new generation of "mobile-first," cloud-based crew-mobility apps. They can be deployed, even on remote construction sites, with real-time updates and are commercially viable for contractors and project owners of all sizes.

As front-line users such as project managers, tradespeople, and operators adopt real-time crew-mobility apps, they could change the way the industry handles work- and change-order management, time and materials tracking, dispatching, scheduling, productivity measurement, and incident reporting.

The Internet of Things and advanced analytics

On a construction site, the Internet of Things can enable construction machinery, equipment, materials, structures, and even formwork to "talk" to a central IT platform to capture critical performance parameters. Sensors, near-field-communication (NFC) devices, and other technologies can help monitor and repair equipment, do quality assessments, and improve energy efficiency and safety. Since the 1990s, construction has used radio-frequency identification (RFID) for applications such as tracking materials and equipment and developing automated time sheets. Soon, tags will also be able to include information on specifications, dates, defects, vendors, and original-equipment manufacturers, among other applications. Costs of RFID equipment are falling, and new applications are emerging. Furthermore, the greater use of digitization in construction is enabling firms to adopt advanced analytics, which can help improve efficiency, on-time performance, and risk management.

A large Middle Eastern construction firm, for example, worked with a software company to build a predictive analytics engine to prevent equipment breakdowns on-site for its fleet of construction vehicles. The engine saved millions of dollars in downtime, fuel costs, and maintenance expenses.

Future-proof design and construction

New building materials such as self-healing concrete, aerogels, and nanomaterials, as well as innovative construction approaches such as 3-D printing and preassembled modules, can lower costs and speed up construction while improving quality and safety.

In addition to self-healing concrete, which uses bacteria as a healing agent to close cracks, innovations in construction materials over the past few decades include top-mix permeable, a cement alternative that can absorb 4,000 liters of water a minute, and superstrong, ultralightweight nanomaterials that may eventually substitute for steel reinforcement in structures and foundations. Some of these "materials of the future" could redefine how projects are conceptualized, designed, and executed. However, adoption has been slow because of a lack of awareness and familiarity within the design and engineering community, a limited supply chain, and a lack of availability at scale—not to mention risk aversion among project owners and contractors.

As to construction techniques, many project developers and contractors are deploying new off-site approaches such as pre-assembly, in which relatively simple structures can be assembled in-factory or in-yard. This technique can be adapted for modular buildings such as hotels and budget condominiums.

Techniques such as prefabricated, prefinished volumetric construction (PPVC) integrate off-site capabilities to transform the construction site into a manufacturing system. Another technique, 3-D printing, enables contractors to print submodules or complete concrete structures before assembly and internal work, which could eventually transform the industry with respect to design, cost, and time. Finally, robots are now being selectively used for repetitive and predictable activities.

Recommendations for action

Given the construction industry's mixed track record on innovation and the adoption of new technologies, tools, and approaches, project owners and contractors need to adopt a new mind-set. For the industry to do better, it needs to embrace four principles:

- **Transparency and risk sharing in contracts.** Rather than adversarial opportunities to hand off risks, contracts need to be tools that allow fair sharing of risks and rewards, clearly outline responsibilities, and allow owners and contractors to share the benefits that arise from the adoption of innovations.

- **Return-on-investment orientation.** Measuring and communicating how new technology will improve construction is the surest way to build a compelling case for adoption. Demonstrating the positive financial impact of new technology will generate "pull" from other projects.

- **Simplicity and intuition in the design of new solutions.** At the front end, user interfaces need to be "foreman friendly" to encourage usage. At the back end, building in compatibility with existing enterprise solutions mitigates the need to spend more on upgrading existing platforms.

- **Investment in change management.** To move away from business as usual, top management must communicate a clear change story. Organizations that do not invest in change management will face the same resistance encountered during previous waves of technology deployment and are more likely to fail.

All major stakeholders share the responsibility for the transition to digital technology and innovation. Project owners and developers need to mandate and measure. That starts with mandating adoption of digital technologies in contracts. Owners should then measure and reward technology adoption across their projects. Engineering and construction contractors must develop digital and technology roadmaps and appoint a chief technology officer or chief innovation officer to lead the digital agenda, including the digitization of internal processes. Industry bodies and regulators should work with contractors, owners, and technology players to define new standards for emerging technologies, encourage the adoption of digital technologies such as 5-D BIM in public projects, and set productivity norms, such as the use of prefabricated components.

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Other industries have shown that first movers can build a sustainable competitive advantage. In the construction sector, this is also likely to be the case. Over the next decade, these winners of tomorrow will take the lead in technology innovation and digitization. Resisting change is no longer an option. ◻

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Enabling seamless lifelong learning journeys—the next frontier of digital education

Jan-Peter aus dem Moore and Stefano Martinotti

Unlike many other sectors, education has come a little late to the digital dance.[1] But after the initial hype and subsequent disillusionment of mostly modest learning outcomes in the early stages of educational technology in recent years, we now see the sector entering a new phase.

With the compound annual growth rate of education and training expenditure projected at 7 to 9 percent globally over the next few years, and with only 2 percent of overall education spend designated as digital, private companies have invested an estimated $4.5 billion in education-technology companies in 2015.
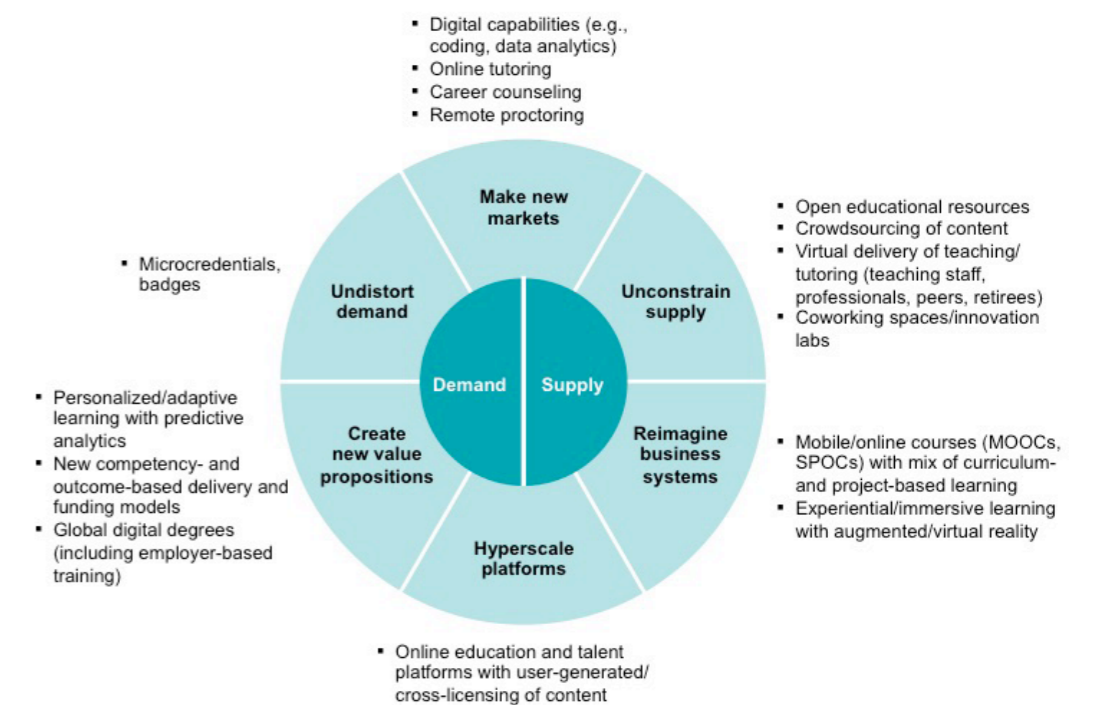
In response to massive demand for more affordable and modular education—fueled by the projection of one billion more digital-native millennial students worldwide over the next 20 years[2]—and pressure on funding sources, many disruptions in education have focused on creating lower-cost digital supply systems.

We believe, however, that digital's potential in the education and training sector is more far-reaching, and points to a transition to a digital lifelong learning and training ecosystem.

To understand that opportunity better, we've found it useful to examine the changing nature of both supply and demand in multiple education segments. Exhibit 1 depicts a simple framework identifying six dimensions of change. The upper half is linked to moderate degrees of change.

Exhibit 1

The digital disruption in education is pervasive

- Digital capabilities (e.g., coding, data analytics)
- Online tutoring
- Career counseling
- Remote proctoring

- Microcredentials, badges

- Open educational resources
- Crowdsourcing of content
- Virtual delivery of teaching/tutoring (teaching staff, professionals, peers, retirees)
- Coworking spaces/innovation labs

Make new markets · Unconstrain supply · Reimagine business systems · Hyperscale platforms · Create new value propositions · Undistort demand

Demand / Supply

- Personalized/adaptive learning with predictive analytics
- New competency- and outcome-based delivery and funding models
- Global digital degrees (including employer-based training)

- Mobile/online courses (MOOCs, SPOCs) with mix of curriculum- and project-based learning
- Experiential/immersive learning with augmented/virtual reality

- Online education and talent platforms with user-generated/cross-licensing of content

SOURCE: McKinsey analysis

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[1] For the sake of clarity, we loosely define *digital* as the confluence of multiple technologies, including social media and networking, mobile connectivity, order-of-magnitude increases in processing power, megadata and analytics, and deployment of cloud-based solutions.

[2] IBIS Capital / EdTech Global 2016.

Microcredentials and badges can undistort demand by allowing learners to assemble their own modular learning pathways rather than requiring them to rely on bundled certificates, diplomas, or degrees curated by educational institutions. Similarly, the unbundling of learning content through open educational resources, crowdsourcing of content, and virtual delivery of teaching and tutoring disintermediate the supply and thus reduce costs. The provision of physical learning spaces is also disrupted, with many inner-city coworking hubs and labs providing flexible access to infrastructure.

In addition, areas of previously unmet demand due to supply constraints—for digital capabilities, individual tutoring, career counseling, remote proctoring, and so on—see the emergence of new markets and specialized providers.

The lower half of the supply-demand framework highlights opportunities for extreme disruption. The setup of new value chains for the supply and cloud-based delivery of online courses and degrees is dramatically shifting supply-side economics. Digital solutions are starting to offer equal or improved learning outcomes at much reduced cost.[3]

At the same time, the power of big-data analytics enables the creation of new value propositions, not only for adaptive or personalized programming, but also for competency-based and customized delivery and funding models as well as global digital degree programs. Finally, the strong network effects, both on the demand side of users and the supply side of educational-content providers, boost the opportunity for hyperscale platforms that tie these innovations together.

Toward a lifelong digital education model

The prospect of a digitally transformed global education market potentially dominated by only a few hyperscaling platforms might seem more of a bane than a boon to many. These fears are understandable considering recent experiences with rapid digital disruptions in other sectors. In the music industry, for instance, the unbundling of albums into downloadable MP3 files and personalized music-streaming services has made music consumption more flexible and cost efficient. Yet some would deplore the commoditization of the artistic effort, with the customer relationship now handled by large-digital-platform players.

Still, we see three main reasons to be optimistic about the widespread adoption of digital education. First, we see digital education as the best opportunity to provide access to quality education and training to large, historically excluded populations around the globe. Second, modular digital education is establishing itself as the most suitable format for developing fluid digital skills at scale. Finally, an integration of digital learning across segments, institutions, and employers, combined with big data, predictive learning, and talent analytics, creates an opportunity to overcome existing stubborn drop-off points in lifelong learning and education-to-employment pathways.

Exhibit 2

The current phase of digital unbundling can pave the way to more flexible, lifelong learning journeys

	Educational institutions at the core	Digital unbundling	New frontiers of lifelong digital learning
Strategy	Digital education as informal complement to traditional delivery, with limited integration	Modular integration of "best of breed" formal and informal digital content, provision, and solutions along learning journey	E2E personalized lifelong learning journeys, with digital learning credentials/ID and talent analytics across systems[1]
Governance and organization	Educational institutions and publishing houses at the core, curating learning experiences and assets	New dedicated platforms shape open ecosystems of traditional players and new entrants	Outcome-based competition based on granular predictive analytics and insights
Leadership, talent, and culture	Limited dedicated capabilities, focused on internal needs/deployment	Centers of Excellence building and sharing capabilities across institutions, with emerging dedicated career pathways	Digital education and talent-management capabilities fully embedded in educational institutions and employers' HR/talent function
Technology and operations	Infrastructure and standards deployed and operated separately by institution, often hosted on premise	Adoption of scalable cloud solutions with Open API and LTI standards to integrate solutions	Seamless and secure integration of platforms and systems based on common standards

1 K-12 – Vocational – Higher Ed – Professional/Continuous; Formal – Informal; Local – Global

SOURCE: McKinsey analysis

The economic opportunity of this integration is large: online talent platforms could raise global GDP by up to $2.7 trillion and increase employment by 72 million full-time-equivalent positions.[4] Last year's LinkedIn acquisition of the online-learning company Lynda.com is emblematic of this trend. In addition, major educational platforms like Coursera, edX, and Udacity have recently expanded their networks to address critical education-to-employment gaps, especially related to 21st-century job skills in emerging markets.[5]

Five factors that will shape the future of digital education

For a variety of reasons, the education sector has been lagging behind other areas in fully embracing digital technologies. We see five key factors that will shape the look of the future and determine the speed of the digital transformation in education:

1. Common accreditation standards for digital curricula and credentials. Common standards will increase the efficiency of learning investments for individuals across formal and informal learning episodes and provide more reliable orientation for innovative digital solution providers.

2. Transparency around outcomes. The new generation of education users will expect clearer outcomes before investing in learning. Conversely, public and private funders should require more frequent, evidence-based insights on "what works."

3. Data privacy regulations and IP rights. Regulations will need to balance privacy rights with potential gains from broader adoption of personalized, predictive analytics. In addition, sustainable crowdsourcing of digital content creation will require clearer rules and enforcement of IP rights.

4. Building and strengthening digital capabilities at all levels. Managing the digital transformation successfully will require new skills and career pathways, which need to be embedded systematically across education-system entities and institutions.

5. Efficient setup and deployment of secure IT infrastructure and devices. Decisions on procurement and setup of IT infrastructure will need to migrate from the local institution level to centrally administered cloud solutions to drive efficiency and speed of adoption for new services and tools.

The digital transformation in education is gaining traction, and new solutions are emerging with enormous potential for economic and social benefits. In particular, the integration between new hyperscaling education and online talent platforms provides an opportunity for digital lifelong learning journeys across segments.

While many developed countries can build on the long tradition and reputation of their educational system and institutions, emerging markets are catching up fast in an era of digital globalization. Capturing this opportunity will require new forms of collaboration on key issues to bootstrap and speed up the benefits to all stakeholders. □

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How big data will revolutionize the global food chain

Clarisse Magnin

The way digital technologies are reshaping the relationship between consumers and brands has been hotly debated over the past few years, with much discussion of the reshaping of consumer decision journeys, the advent of multichannel marketing and sales, and the impact of smartphones and the mobile Internet on customer behavior. Yet an even bigger opportunity has been largely overlooked. By taking advantage of big data and advanced analytics at every link in the value chain from field to fork, food companies can harness digital's enormous potential for sustainable value creation. Digital can help them use resources in a more environmentally responsible manner, improve their sourcing decisions, and implement circular-economy solutions in the food chain.

Huge untapped potential

So far, most of the excitement about digital's potential in the consumer-packaged-goods industry has centered on marketing and sales. But for food producers, the opportunities begin higher upstream and end lower downstream. At the upstream end, the agricultural practices followed by dairy farmers, cacao and coffee producers, wheat and barley producers, cattle farmers, and so on result in enormous variations in commodity costs in an industry where raw materials represent easily 60 percent of the cost of goods sold (COGS) (Exhibit 1).

Exhibit 1

Big data and advanced analytics (BDAA) provide a real opportunity to tackle multiple challenges faced by the upstream steps of the value chain
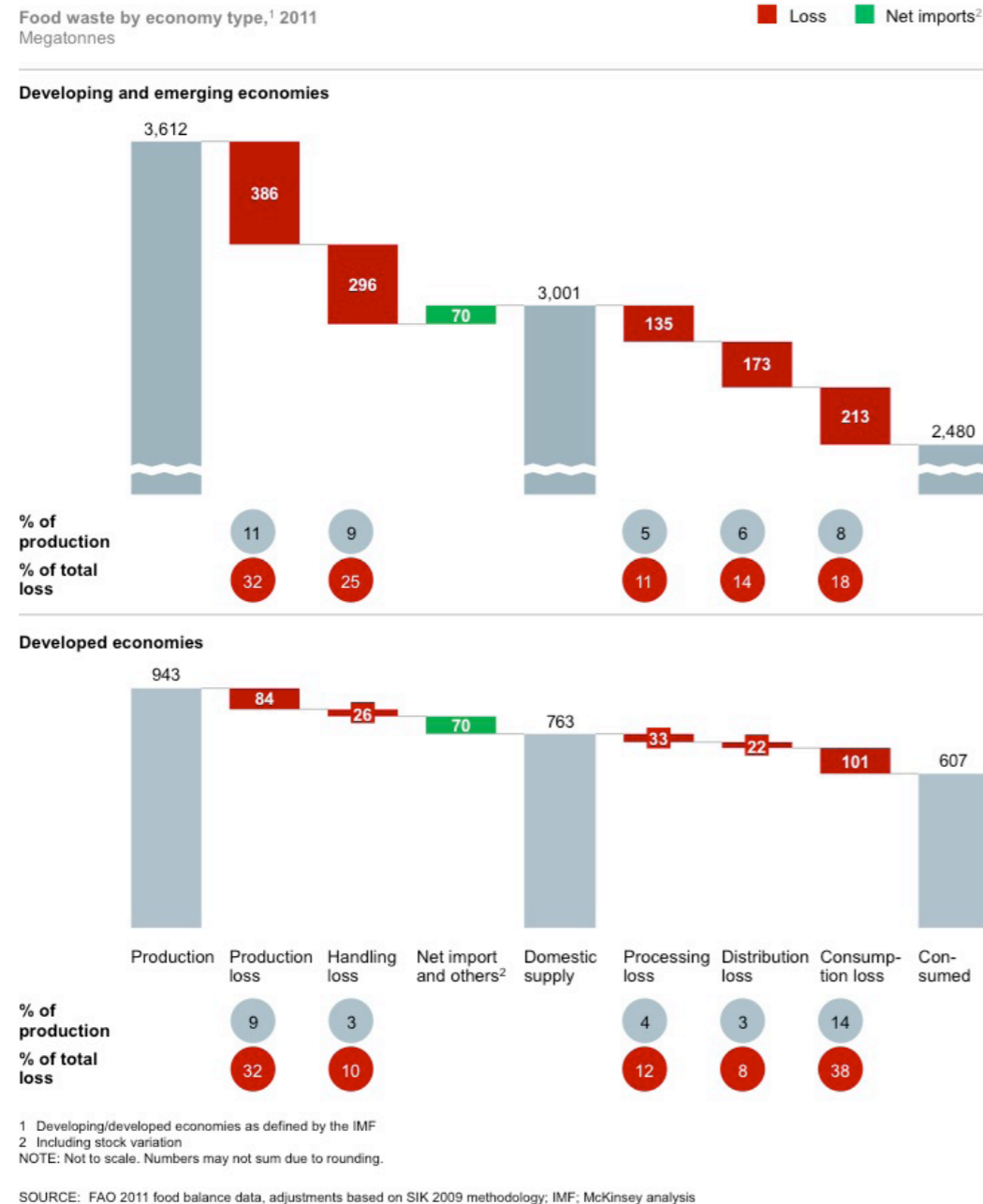
NOT EXHAUSTIVE

Opportunity	Industry challenge	How BDAA can help (examples)
Win the innovation game	• High need for innovation, particularly in inputs—at increasing speed	• Building a "data innovation engine" using insights from millions of trials to find the "product per P&L" • Holistic input optimization • Soil science
Optimize farming operations	• 50 percent more and better food needed over next 20 to 30 years	• "Precision agriculture" based on measuring and optimizing granular field operations
Increase supply-chain transparency	• Currently little foresight into crop volumes • High price volatility	• Increasing forecasting accuracy with real-time data collection and analysis • Integrated planning across the value chain for lowering response times, risks
Step up downstream operations	• Ag processing is a high-volume, huge business with low operational efficiency	• "Operations big data toolbox"—production optimization, e.g., holistic, simulation-based plant optimization, predictive maintenance
Tackle the infra-structure challenge	• Poor infrastructure in emerging markets, particularly Africa	• Advanced analytics to identify key bottlenecks in infrastructure (e.g., car/truck monitoring) • Infrastructure network optimization, e.g., warehouse location based on geospatial data/models
Embrace your customers	• Ag industry is "far from customers," but has high ambitions • Fragmented customer base	• "M&S big-data toolbox"—CRM, data-driven pricing, advanced upselling and cross-selling
Anticipate waste	• Enormous amounts of residential (food) waste (up to 30 percent of some crops)	• Granular data collection of waste streams in households, etc., as a basis for, e.g.. — Changed offerings in retail — Regulation and public services

SOURCE: BDAA in Ag initiative; expert interviews; McKinsey analysis

Manufacturing and packaging also represent a substantial share of COGS, as well as contributing to companies' environmental and social footprints and food-safety risks. At the other end of the food chain, big data and advanced analytics can be used to optimize downstream activities such as waste management. Food waste causes economic losses, harms natural resources, and exacerbates food-security issues. About a third of food produced for human consumption is lost or wasted every year in a world where 795 million people—a ninth of the population—go hungry (Exhibit 2).

Exhibit 2

In developing
and emerging
economies, 32
percent of total
loss occurs during
production;
in developed
economies, 38
percent of loss
occurs during
consumption

Food waste by economy type,[1] 2011
Megatonnes

■ Loss ■ Net imports[2]

Developing and emerging economies

3,612 → 386 → 296 → 70 → 3,001 → 135 → 173 → 213 → 2,480

% of production	11	9		5	6	8
% of total loss	32	25		11	14	18

Developed economies

943 → 84 → 26 → 70 → 763 → 33 → 22 → 101 → 607

	Production	Production loss	Handling loss	Net import and others[2]	Domestic supply	Processing loss	Distribution loss	Consumption loss	Consumed
% of production		9	3			4	3	14	
% of total loss		32	10			12	8	38	

1 Developing/developed economies as defined by the IMF
2 Including stock variation
NOTE: Not to scale. Numbers may not sum due to rounding.

SOURCE: FAO 2011 food balance data, adjustments based on SIK 2009 methodology; IMF; McKinsey analysis

Cutting postharvest losses in half would produce enough food to feed a billion more people. Global food waste and loss cost $940 billion a year, have a carbon footprint of 4.4 Gt CO_2-equivalent (more than 8 percent of global greenhouse-gas emissions), and a blue-water footprint of about 250 cubic km (3.6 times the annual consumption of the US).

In 2007, the amount of food wasted globally equated to 1.4 billion hectares—an area bigger than Canada—of agricultural production.

Using technology to improve areas such as climate forecasting, demand planning, and the management of end-of-life products could bring enormous social, economic, and environmental benefits. For example, the French start-up Phenix runs a web-based marketplace to connect supermarkets with end-of-life food stocks to NGOs and consumers who could use them. The platform enables the supermarkets to save the costs of disposal, gives consumable products a second life, and alleviates some of the social and environmental burden of waste.

The opportunities for digital innovation in the food chain are enormous and vary by context, with some well suited to emerging markets and others more appropriate to mature economies.

Efficiency opportunities for emerging economies

Emerging markets can tap the potential of digital in the food chain through innovations such as precision agriculture, supply-chain efficiencies, and agriculture-focused payment systems.

Precision agriculture is a technology-enabled approach to farming management that observes, measures, and analyzes the needs of individual fields and crops. By allowing farmers to apply tailored care and manage water more effectively, it boosts production, improves economic efficiency, and minimizes waste and environmental impact. Its development is being shaped by two technological trends: big-data and advanced-analytics capabilities on the one hand, and robotics—aerial imagery, sensors, sophisticated local weather forecasts—on the other. According to 2014 estimates, the global market for agricultural robotics is expected to grow from its current $1 billion to $14–18 billion by 2020.

New entrants and large companies alike are developing products and services for precision agriculture. The start-up CropX offers sensors to help farmers adjust irrigation to the needs of their soil, while Blue River uses computer vision and robotics to determine the needs of individual plants. At the opposite end of the scale, IBM has developed a highly precise weather-forecast technology, Deep Thunder, and an agriculture-specific cloud technology.

Supply-chain efficiencies can help optimize farming operations in less favorable locations. Prescriptive farming allows farmers to tailor inputs according to soil and land characteristics by fine-tuning the type, quantity, and timing of application to reduce dependency on artificial inputs and replace them with effective natural inputs.

Recommendations can be adjusted in real time to reflect changing weather conditions. Soil sensors and aerial images help farmers manage crop growth centrally, with automated detection systems providing early warnings of deviations from expected growth rates or quality.

Automated systems showing the status, performance, and potential bottlenecks of critical equipment in real time can be used to optimize fleet management, thus increasing delivery reliability and preventing spoilage. Transport times can be cut in half by using smart meters to improve routing. Coupling transport-management systems with agricultural sensors can allow unified hauling of inbound transportation, generating average savings of 10 to 20 percent.

Agriculture-specific payment systems and financial services can help farmers make their economic models more resilient. Some growers use insurance contracts to offset weather risk, for instance. Insurers calculate a premium on the basis of the likelihood of a particular weather event, such as frost, and the impact it would have on a crop at a specific point in its growth cycle. The premium is paid out when the number of occurrences surpasses a predefined threshold.

Payments is another area where digital solutions can make food chains more efficient. In Kenya, Sokopepe provides a trading platform for agricultural commodities that links small-scale producers to retailers and bulk purchasers via mobile-phone messaging. Another Kenyan initiative, MFarm, provides up-to-date market prices via an app or SMS and connects farmers with buyers, offering a group selling tool for those farmers too small to market to a large buyer by themselves.

Solutions to systemic challenges for mature economies

Developed countries can use digital tools and methods to tackle challenges such as improving the safety of food, the sustainability of sourcing decisions, and companies' environmental footprints.

Food safety could be improved through the adoption of innovative technologies such as consumer food scanners that analyze a dish using spectroscopy and give users immediate information on its composition (Exhibit 3). The European Commission recently launched a competition to develop a viable, affordable, and noninvasive food scanner, with a prize of €800,000 in funding for the winning team.

Two groups of people would derive particular benefit from these devices: sufferers from food-related illnesses such as obesity, allergies, and intolerance, and health-conscious individuals wishing to use food scanners as a complement to activity trackers. In view of the global epidemic in obesity and type-2 diabetes, estimates suggest that the market for personal food scanners could reach US $1 billion by 2020.

Exhibit 3

Food scanning—
initial actors

SCiO by Consumers Physics	GoBe by Healbe	Philips Design
• In 2014, the Israeli start-up Consumer Physics launched a pocket food scanner on the spectroscopy technology. It can scan food and send all Relevant information to a smartphone • It will probably be embedded in a smartphone in a close future • Different business models can be applied such as — pay high price for the device and access databases for free — pay low price for the device and pay subscription to access databases • Consumer physics has raised ~$ 5 M so far through crowdfunding and VC funds	• In 2014, Healbe launched the GoBe wrist device with the ambition of tracking calories directly through skin analysis by reading glucose in the cells • Precision or reliability of the device are still discussed but it could potentially replace activity trackers that always fail at tracking calories and therefore give a partial visibility on health • Healbe has raised ~ $ 5M so far through VC funds	• In 2009, Philips Design developed the concept of "Diagnostic Kitchen" in the context of its research project "Food Probe" • In this case, the approach was dual through: — a sensor that consumers would swallow and keep in their body to inform on current states and needs — a scanner that would define the impact of the new meal on the body in advance • This perfectly fits the trend towards more transparency for consumers

SOURCE: McKinsey analysis

Sourcing decisions could be made more sustainable by adding yield-forecasting and risk-assessment tools to agronomic modeling methods to assess the impact of hyperlocal weather forecasts on a particular plant's yield and soil conditions. This would allow global food manufacturers to not only choose the best regions and countries to source from, but also to adapt their sourcing routes to weather challenges. These tools could also be used to determine the ideal mix of commodities in a country's agricultural portfolio, taking into account productivity levels by region.

Given the unpredictability and volatility of raw-materials costs, global food companies could derive huge benefits from finding ways to mitigate these risks while maintaining a responsible sourcing strategy toward growers.

Environmental-footprint management is another challenge that digitization can help to address. For instance, Cisco's Internet of Everything will provide consumers with the means to trace a food product back along its entire chain of production, from farmer's field to supermarket shelf. A scannable code on packaging will take users to a website that provides a detailed analysis of every stage and process undergone by that product's specific production batch.

The technology could be used to provide consumers with a guarantee of a product's environmental credentials. One of the challenges of advanced environmental practices is the difficulty of demonstrating the reality behind marketing claims and overcoming consumer skepticism, particularly where price premiums are concerned. A robust method for tracing sourcing through to origins could support this practice and make it more economically viable for food manufacturers.

• • •

Digital methods and tools are opening up opportunities for leading food companies to improve their management not only of the "last mile" of marketing and sales, but the entire journey from field to fork. ☐

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Exhibit 1

Governments have a dual role in a country's digital transformation

Government digitization: Four pillars to accelerate				Government as a digital catalyst of social and economic transition	
Digital citizen interactions	Digital end-to-end processes	Digitally and data-enabled decisions	Data sharing and publishing	**Sectorial regulation** (competition, new data-based players)	**New business models** (e.g., collaborative economy)
				Transition to digital	**Digital human capital**
				New employment model	**Infrastructure** (technical infrastructure, financing models)

SOURCE: McKinsey analysis

Policy in the data age: Data enablement for the common good

Karim Tadjeddine and Martin Lundqvist

By virtue of their sheer size, visibility, and economic clout, national, state or provincial, and local governments are central to any societal transformation effort, in particular a digital transformation. Governments at all levels, which account for 30 to 50 percent of most countries' GDP, exert profound influence not only by executing their own digital transformations but also by catalyzing digital transformations in other societal sectors (Exhibit 1).

The tremendous impact that digital services have had on governments and society has been the subject of extensive research that has documented the rapid, extensive adoption of public-

sector digital services around the globe. We believe that the coming data revolution will be even more deeply transformational and that data enablement will produce a radical shift in the public sector's quality of service, empowering governments to deliver better constituent service, better policy outcomes, and more-productive operations.

The data revolution enables governments to radically improve quality of service

Government data initiatives are fueling a movement toward evidence-based policy making. Data enablement gives governments the tool they need to be more efficient, effective, and transparent while enabling a significant change in public-policy performance management across the entire spectrum of government activities. As Exhibit 2 shows, data applications can transform operations and service delivery in everything from tax compliance and collections to economic development to healthcare to education—and much more.

To raise quality of service, optimization applications are necessary but not sufficient in themselves. Governments also need to deploy a comprehensive and open performance-management system: data enablement provides a solid fact base for policy making while allowing transparency and public accountability. With this perspective in mind, governments need to launch data initiatives focused on:

Exhibit 2

Great digital
governments
combine the power
of digital with
advanced analytics,
big data, and IoT to
deliver smart and
integrated services

Use-case areas	Examples
Smart tax	• Improve tax compliance and collections • Reduce financial criminality (reduce fraud and money laundering, detect competition distortions)
Smart welfare and employment	• Improve targeting of benefits • Improve skills-based job matching, training-programs definition, identification of future hiring needs • Reduce Social Security fraud, detect irregular-attribution-of-welfare scheme
Smart defense	• Predictive maintenance, supply-chain optimization • Equipment, parts, and suppliers' performance evaluation • Geospatial analytics, field intelligence
Smart safety and security	• Crime-response and prevention: police force allocation optimization, individual criminal-behaviors prevention, detection of organized crime, corrections optimization • Border control and illegal-immigration prevention • Improve safety: crowd management, fire prevention and reaction
Smart economic development and agriculture	• Prioritize economic sectors at national/local level • Trace food sources to verify quality, prevent disease • Review pesticide and other chemical-substances usage
Smart transportation and logistics	• Optimize infrastructure maintenance, road safety (e.g., speed-bumps deployment, potholes, speed-limit positioning) • Optimize public transportation and road network (e.g., dynamic change of routes, traffic lights, parking-lot pricing, based on traffic/parking data)
Smart infrastructure and utilities	• Enable smart lighting, reduce energy and/or water-consumption overall levels and peaks • Optimize energy sourcing
Smart education	• Fine-tune "education journeys" for students • Enable teacher performance review benchmarked against peers
Digital patient and eHealth	• Support better health: detection of epidemics, identification of medicine-usage irregularities, international medication-price barometer
Smart budgeting and policy making	• Improve reliability of budgeting estimates and enable complex, real-time scenarios • Improve policy-making process, ex-ante and ex-post evaluation of policies and administrations
Smart government administration	• Help protect governmental and national assets and information • Analyze procurement performance • Enable better talent management for the civil service

SOURCE: McKinsey analysis

- better understanding public attitudes toward specific policies and identifying needed changes

- developing and using undisputed KPIs that reveal the drivers of policy performance and allow the assignment of targets to policies during the design phase

- measuring what is happening in the field by enabling civil servants, citizens, and business operators to provide fact-based information and feedback

- evaluating policy performance, reconciling quantitative and qualitative data, and allowing the implementation of a continuous-improvement approach to policy making and execution

- opening data in raw, crunched, and reusable formats.

The continuing and thoroughgoing evolution taking place in public service is supported by a true data revolution, fueled by two powerful trends.

First, the already low cost of computing power continues to plummet, as does the cost of data transportation, storage, and analysis. At the same time, software providers have rolled out analytics innovations such as machine learning, artificial intelligence, automated research, and visualization tools. These developments have made it possible for nearly every business and government to derive insights from large datasets.

Second, data volumes have increased exponentially. Every two years the volume of digitally generated data doubles, thanks to new sources of data and the adoption of digital tools. And a new explosion of data is on the horizon, thanks to the wide-scale deployment of connected devices, which are expected to increase from 10 billion in 2013 to 50 billion by 2020.[1] Many of those devices will be associated with smart-city programs, such as sensors embedded in streets and other public areas. By 2020, smart-city usage in European cities[2] will generate 100 e-bytes of data per day—four times more than the global data generated daily from all usages in 2015.

Even without the data generated by connected devices, data enablement is already making a difference. A few examples suggest just how big that difference is.

Smart defense. One large national-defense organization increased equipment and weapons-systems readiness and availability through a data-enabled redesign of spare-parts sourcing and supply strategy. Data-analytics engines provided full transparency on the performance and fully loaded costs of spare parts, while also allowing analysts to simulate the impact of modifications in sourcing and supply strategies. The redesign produced optimized expenditures equal to 10 to 12 percent of the country's overall military operations and maintenance budget.

Smart policing. An advanced-analytics engine has enabled several major cities to improve the quality of police services and prevent threats from organized crime and terrorists. One of the tools was analysis of factors suggesting imminent gang activity, such as four or more Twitter posts from gang members within ten minutes.

More broadly, these cities integrated and analyzed open-source data (such as social media) and traditional police data to monitor public sentiment in order to provide early warning of actual or potential criminal activity and enable targeted and appropriate intervention; continuously track city-specific threats from organized crime and terrorist organizations; and monitor and preempt the potential radicalization of local populations.

[1] World Economic Forum: Is this the future of Internet of Things? (https://www.weforum.org/agenda/2015/11/is-this-future-of-the-internet-of-things/)

[2] http://www.cisco.com/c/en/us/solutions/collateral/service-provider/global-cloud-index-gci/Cloud_Index_White_Paper.html

Smart corrections operations. One penitentiary system is experimenting with data-based allocations of inmates and corrections officers, with the aim of reducing violence by 20 to 40 percent. The system segments inmates according to their potential for violence, predicts toxic inmate combinations, and optimizes housing allocation and officer staffing by sorting inmates and staff according to language, experience, or certification.

Smart transportation. A major European city, responding to a spate of massive congestion episodes, has launched a multiyear program to eliminate road bottlenecks, reduce traffic jams, and optimize its mass-transportation network. Using analytics, city officials were able to design the program's strategy based on an accurate understanding of current and future patterns of urban transit. Their data tools enabled them to diagnose the root causes of bottlenecks, such as congestion caused by drivers looking for available parking spaces, and simulate the impact of different mitigation measures. The first measures implemented have produced an average speed increase of 8 percent and a reduction in parking occupancy from 100 percent to 65 percent.

Smart infrastructure and utilities. Barcelona's smart-city program has improved the city's environmental footprint and citizens' quality of life while creating 47,000 local jobs. Municipal authorities estimate that through smart-water and smart-lighting use cases, water consumption in municipal areas for parks irrigation and the like has been reduced by 25 percent, while electricity consumption for lighting has been reduced by 30 percent. These reductions have generated $95 million in annual savings. In addition, Barcelona has implemented many other use cases, including automated waste management that enables sanitation workers to optimize their collection routes by prioritizing locations with full bins; improved care of the elderly population; and optimized transportation routing and scheduling. The city has undertaken this effort in collaboration with start-ups and multinational companies that jointly developed the technical infrastructure and applications to support the program.

Four keys to capturing the full benefit of data

The examples above represent just a few of the ways that data and analytics can improve government operations and the lives of citizens. But to capture the full benefit of data, states need to deliver on four key imperatives:

1. Gain the confidence and buy-in of citizens and public leaders

2. Conduct a skills-and-competencies revolution

3. Fully redesign the way states operate

4. Deploy enabling technologies that ensure interoperability and the ability to handle massive data flows

Gain the confidence and buy-in of citizens and public leaders through the articulation of a set of principles formalized in a data vision, a data strategy, and regulatory frameworks. Those principles are:

- *To work for the common good.* Data services are viewed as public services and data as a public asset beneficial to the society as a whole. Scotland has enshrined this principle in its "Data Vision for Scotland" (see Deep-dive).

Deep-dive

Scotland's data vision

- Scotland is a leader in using data to enhance the delivery and management of public services. As part of the country's digital transformation, the government has published its data vision for Scotland, which might serve as a model for the data visions of other governments. It appears below in slightly edited form.

- Data is used to support the delivery of outstanding public services.

- Citizens feel confident that personal data is being shared responsibly to create better and more responsive services that meet their individual needs.

- Citizens readily know how to access personal information held about them, allowing them to confirm its accuracy and to choose if they wish to create their own personal-data store.

- When personal data is used in research, the safeguards to protect

privacy operate effectively and efficiently.

- Nonpersonal data held by the public sector is viewed as a societal good or resource that is readily available and accessible for reuse, in a format that supports that application.

- The government's capability is enhanced to address data challenges and opportunities so that data can inform public-service design and support economic growth.

- Collaboration between business, research, and the public sector will ensure that Scotland realizes its data vision and is internationally competitive.

- The public, private, and third sectors and civil society are continuously engaged in debate to ensure the continued effective use of data.

Source: Scotland's government website (http://www.gov.scot/Topics/Economy/digital/digitalservices/datamanagement/dmbvfs/dmbvfspdf)

- *To strive for inclusiveness.* States need to close the digital gap to eliminate the biases in data collection that result from lower usage of digital tools by some population segments. Estonia's Digital Divide program and Look@World public-private partnership increased Internet usage from 32 percent of the population in 2001 to 77 percent as of 2011.

- *To ensure citizen integrity and data protection.* States should establish rules that govern what can and can't be done with personal data. In particular, they should work to balance openness—across agencies, sectors or borders—and individual data privacy, confidentiality, and intellectual property rights.

- *To embrace data-based decision support.* This principle recognizes that while data greatly enhances decision support, it cannot supplant public leaders' and citizens' roles in decision making, moral judgment, and social change.

- *To achieve transparency and accountability.* Transparency allows for cross-benchmark execution, not in order to fix blame and enforce sanctions but to further the goal of continuous improvement. Both the French and UK governments have explicitly stated in law or policy that data should be open by default.

Lead a skills-and-competencies revolution. Governments need to identify and attract talent into data-specific jobs and positions, such as data scientists, data architects, UX designers, agile-development project managers, and analysts. The UK's Government Digital Service has developed a comprehensive talent-management strategy for digital and data skills. Its recruitment hub helps all departments recruit digital and data talent and organize rotational programs.

Because data-specific skills are scarce, governments need to draw on their internal capabilities to advance this revolution. Civil servants are intimately familiar with their department's or agency's challenges and idiosyncrasies, and they are ideally positioned to drive improvements—provided they are equipped with the necessary digital and analytical skills. These can be developed through rotational, training, and coaching programs, with content targeted to different populations. The US is building the capabilities of its employees through its DigitalGov University, which every year trains 10,000 federal civil servants from across the government in digital and data skills.

More generally, governments should train and incentivize civil servants to embed data discovery and analytics processes in their workplaces. That means that all civil servants' end-user computing platforms must feature data discovery and analytics tools.

Fully redesign the way states operate. States should install a dedicated data-governance model, led by a senior civil servant (possibly designated as chief data officer) positioned at a transversal level to supervise data centers of excellence (CoE). A CoE could, for

example, develop technologies to mine data from social networks to produce insights into public sentiment or gain better knowledge of citizens and businesses through the application of geospatial analytics.

France has pioneered such an effort, appointing a governmental chief data officer in 2014. That officer heads Etalab, the government's CoE, and is armed with a mandate that gives the center access to data from across the government. Meanwhile, the Singapore government's InfoComm Development Authority manages data and runs analytics programs for the entire government.

If such efforts are to reach their full potential, governments must carry out a major cultural shift in order to break down silos and barriers. Such a transformed culture is characterized by a "test and learn" mind-set that believes "good enough is good to go."

The state of North Carolina is instigating cultural change through its iCenter, a lab for digital and data innovation where innovators offer their products and ideas to various agencies for testing. Testing enables the agencies to model the outcomes of these products and ideas and then invest in the most promising tools.

Cultures that facilitate governments' data transformations are also characterized by open, collaborative, and inclusive operating models for data generation and data usage. They facilitate the participation of public agencies, private-sector companies, start-ups, and society as a whole. One example of such a model is New York City's Open 311 platform, which enables New Yorkers to report potholes, missed garbage collections, unsafe construction sites, and other neighborhood issues. In the UK, meanwhile, the government's Open Data Institute, funded by the government and the Omidyar Institute, serves as an incubator for start-ups that create apps that draw on the government's open data. In 2015, the ODI was expanded to the entire EU, with funding from the EU Commission. Barcelona's @22 is using public funding to develop an ecosystem of private-sector players (including both start-ups and established companies) to develop smart-city use cases.

Deploy enabling technologies that ensure interoperability and the ability to handle massive data flows. The digital government of the future must act today to consolidate, make secure, and distribute interoperable data from public and private operators in reusable formats. Barcelona is a leader in this effort, having funded the development of Sentilo, a technology that enables communication among the more than 13,000 sensors, apps, and systems of the entire smart-city ecosystem. Estonia has undertaken a similar effort with its X-Road, which enables the sharing and reuse of data across both public and private sectors. In addition, this initiative enables advanced data-security services such as a data-integrity blockchain service, which will be available to all in 2016.

Governments also need to develop a reusable, undisputed, and universal authentication service for people and things so that service providers can know who and what is providing and using data. Estonia's eID scheme—featuring chip-bearing cards that can be used on- and offline—allows online authentication. The cards also serve as mass-transportation passes and parking permits.

To support this technology, national and local governments will need to develop data centers, cloud computing, and network capacity, especially for data generated by IoT devices. Sweden is a leader in building this capacity. Launched in 2009, its "Broadband strategy for Sweden" aims to deliver 100-mbps broadband speeds to 90 percent of the country's homes and businesses. As of 2015, 40 percent of businesses and residences had such coverage, earning Sweden first place in Europe (and third globally) on the Global Connectivity Index. New Zealand is also building its capacity, with its "cloud first" cloud-computing strategy.

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The examples and recommendations in this article are inclusive but far from comprehensive. New and as yet unimagined opportunities to digitize government services are sure to emerge. We believe that in ten years, the data revolution will bring about radically different public policies for the benefit of public agencies and citizens alike. ☐

Sincere thanks go to Dimitri Obolensky, specialist based in Paris, for his contribution to this article.

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Health systems: Achieving sustainability and improving quality through digital transformation

Thomas London and Penelope Dash

Health systems in developed countries face a twofold challenge: ensuring financial sustainability and improving quality. Digitization can help health systems achieve both these objectives and unlock substantial value through lower spending and superior healthcare delivery.

Rising costs, uneven quality

Healthcare is claiming an ever-increasing share of national wealth. In recent years, healthcare expenditure in Organization for European Cooperation and Development (OECD) countries has been rising at a rate one to two percentage points faster than GDP. If this trend were to continue, healthcare would represent more than 25 percent of France's GDP—and more than 35 percent of the US's—by 2050. Clearly, action is needed to bring costs under control.

Moreover, medical errors and other safety lapses persist even in the strongest health systems and are often caused by inconsistencies in care and lack of adherence to good practices. Outcomes vary enormously across healthcare systems and among the care providers within them. For instance, maternal mortality is four per 100,000 births in Italy, but more than three times higher in the US, at 14.[1] Postoperative pulmonary embolisms and thrombosis affect 865 of every 100,000 patients leaving a hospital in France, but just 107 in Belgium, a difference of 706 percent.[2] Regular albumin screening to prevent complications is provided annually for 88 percent of diabetics in the Netherlands, but for fewer than 30 percent of those in France.[3]

A recent study revealed that medical errors are the third-most-common cause of death in the US after cancer and heart disease, accounting for more than 250,000 deaths every year.[4] Addressing these issues and the variations in care practices and quality that cause them is another priority for all countries.

Addressing the challenges through digital innovation

Digitization offers benefits in both costs and quality. One large OECD country estimated that by implementing existing digital technologies, it could reduce its healthcare expenditure between 7 and 11.5 percent (see Exhibit). At the same time, it could improve quality through measures such as monitoring chronic conditions more effectively to avoid acute events, increasing adherence to best practices, improving clinical decisions, and promoting healthier behaviors.

Digital innovation can transform healthcare in three main ways:

By improving care-delivery models through seamless data and information exchange.
The rise of chronic conditions is making it more important to integrate patient care pathways across care settings. Digital solutions can greatly facilitate the seamless exchange of patient and other information and data between providers. Telehealth

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[1] OECD health statistics 2013, Institute for Health Metrics and Evaluation, WHO Neonatal and Perinatal Mortality, Country, Regional and Global Estimates, 2006.
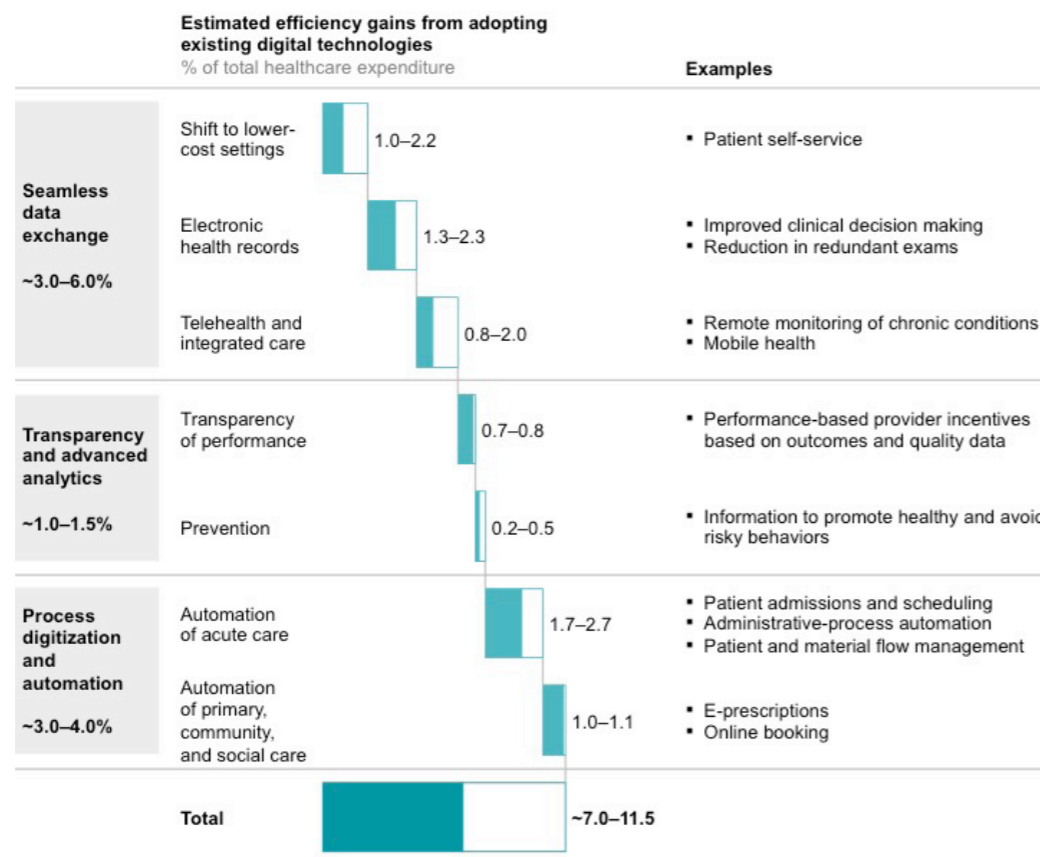
[2] OECD health statistics 2013

[3] CNAMTS; J. N. Struijs, J. T. van Til, and C. A. Baan, "Experimenting with a bundled payment system for diabetes care in the Netherlands," Institute for Public Health and the Environment (RIVM), 29 October 2010.

[4] Martin A. Makary and Michael Daniel, "Medical error—the third leading cause of death in the US," *British Medical Journal*, 3 May 2016.

Estimated impact of digital interventions on healthcare in one OECD country

Estimated efficiency gains from adopting existing digital technologies
% of total healthcare expenditure

		% of total healthcare expenditure	Examples
Seamless data exchange ~3.0–6.0%	Shift to lower-cost settings	1.0–2.2	• Patient self-service
	Electronic health records	1.3–2.3	• Improved clinical decision making • Reduction in redundant exams
	Telehealth and integrated care	0.8–2.0	• Remote monitoring of chronic conditions • Mobile health
Transparency and advanced analytics ~1.0–1.5%	Transparency of performance	0.7–0.8	• Performance-based provider incentives based on outcomes and quality data
	Prevention	0.2–0.5	• Information to promote healthy and avoid risky behaviors
Process digitization and automation ~3.0–4.0%	Automation of acute care	1.7–2.7	• Patient admissions and scheduling • Administrative-process automation • Patient and material flow management
	Automation of primary, community, and social care	1.0–1.1	• E-prescriptions • Online booking
Total		~7.0–11.5	

NOTE: Numbers may not sum due to rounding.

and mobile health solutions can improve the effectiveness and efficiency of maintaining patients at home, thereby avoiding unnecessary hospital stays, improving clinical outcomes, and reducing the costs of care. Finally, the use of digital tools to enhance clinical decision making and the monitoring of treatment protocols— as Kaiser Permanente does through the use of its eHR (electronic medical record) system—can significantly reduce variability and increase adherence to good clinical practice.

By harnessing the power of data through advanced analytics and transparency. More and more applications that rely on healthcare data analytics are available to support patients in understanding and managing their medical condition and influencing their medical care. New data-enriched tools and algorithms are constantly emerging, including decision-support tools, online services, and smartphone apps. Examples are Indigo's Archimedes, which helps care providers influence patients' lifestyle and behavior choices, and www.drugs.com, a website helping patients identify potential contraindications and drug-interaction risks.

Providers making crucial clinical decisions about diagnosis and treatment will increasingly be supported by tools such as algorithms that compare a patient's clinical and other data with large datasets and draw on the full body of scientific literature. As the number of diagnostic tools (such as imaging and "omics" sciences) continues to expand, and as the sum of biomedical scientific literature doubles every five to seven years, more initiatives supporting medical decisions and patient care, such as IBM's Watson, Syapse, and Flatiron Health, will emerge and mature.

Analytics also promises to support drug and device developers in many ways, such as by helping them identify the patients likely to respond best to a particular drug. In addition, the use of medico-administrative databases can in some cases provide a more effective way to address requirements for real-life drug evaluation and monitoring.

Finally, the collection and publishing of data on outcomes and quality of care can also allow healthcare systems to modulate tariffs and orchestrate competition among providers based on their quality of care, and should be a major lever for raising the overall standard of care across healthcare systems.

Through process automation. Many healthcare processes can be digitized, including appointments, logistics, patient records, admissions, human resources and rotation management, and billing. In addition to providing efficiency gains, automation can also improve patient care: for instance, remote monitoring of intensive-care units via patient sensors and a central control room led in one case to a 22-percent reduction in mortality rates and a 23-percent reduction in the average length of hospital stays. Digitization can also bring significant benefits in the area of clinical trials, such as improving the efficiency and reliability of clinical data collection and trial monitoring and optimizing trial design through the use of modeling tools.

Three ways to accelerate digitization

Although there are clear benefits from extending the digitization of healthcare, obstacles remain. Healthcare systems often struggle with a range of issues including limitations and constraints on data collection, access, and sharing; resistant mind-sets; an excessive focus on risks to the detriment of potential benefits; and misaligned incentives.

To help overcome these obstacles and accelerate digitization, healthcare systems should seek to:

1. *Enhance data and modernize data infrastructure, management, and access.*
   To capture the full benefits of data analytics, healthcare systems will require ready access to a hugely expanded array of data. They should consider investing both to enhance the data collected (for instance, through the development of patient cohorts

and registries and the collection of data on patient-reported outcomes) and to develop their data-analytics capabilities, as value will reside as much in algorithms as in the data itself.

Legacy systems are unlikely to be able to cope with these demands, so a new, modern data infrastructure will be needed. One possible model could be an open cloud-based platform aggregating data from different sources, with an operator who manages the infrastructure and data access, promotes data collection and quality, and provides a means for patients to manage their informed consent. The operator would have to collaborate closely with regulators, understand healthcare delivery, appreciate the need to protect sensitive patient data, and be trusted by patients. If a national health system or a national payor in each country were to take on this role, a step-change in mind-set and capabilities would be needed, as it involves acting as an ecosystem manager and attracting, certifying, and managing a community of innovators as well as operating a technical platform loaded with sensitive data.

2. *Create incentives to support new practices and mind-sets.* Digitization involves a shift toward a more data-driven culture with continuous and transparent evaluation of professional practices, that in turn requires changes in the mind-sets of healthcare professionals. To achieve such a shift, providers need to develop and communicate a clear change story that outlines the benefits as well as the risks of a digital transformation. They also need to adopt funding mechanisms that provide incentives to adopt new behaviors, such as episode-based payments, outcomes-driven performance payments, or even capitation-based models as adopted in Alzira, Spain, in which a private provider takes responsibility for providing care for a given population in return for a fixed per-capita payment. Current approaches such as fee-for-service models reward the volume rather than the value or quality of care provided, and seldom provide incentives for robust clinical data collection and collaboration across care settings.

In addition, digitization will require changes in professional training and medical education as well as training, funding, and other forms of support for healthcare professionals and institutions as they implement new digital tools and methods.

3. *Adjust legal and regulatory frameworks to improve data exchange.* The sensitive nature of healthcare data requires its usage to be regulated to protect patients' privacy, but scope remains to enhance data exchange. Today's fragmented country regulations often leave health data in silos, impeding projects that rely on diverse sources of information. For example, one EU country may permit the use of historical clinical data while another prohibits it, and yet another allows it under a specific license—a complex situation that reduces the range of information on which researchers can draw for their studies.

Establishing a common European framework to harmonize the collection, processing, and use of patient and healthcare data would be an important improvement. Another option would be to move toward a more open approach that relies on a risk/benefit assessment of individual cases and a robust tracking and monitoring of each permitted usage of the data, as at Kaiser Permanente, which provides access internally to clinical and claims data for specific uses, with tight monitoring to flag and address any potential misuses.

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Harnessing the full potential of digital innovations in healthcare could have a profound impact on the quality and financial sustainability of health systems. It would also involve profound changes for care providers and healthcare professionals. To shift mind-sets, healthcare authorities will require a clear and compelling vision and ambitious action. But the benefits for both quality and economics will be well worth it. ☐

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Digital in industry: From buzzword to value creation

Paul-Louis Caylar, Olivier Noterdaeme, and Kedar Naik

In the past few years, we have seen digitization bring its first benefits to the industrial sector, particularly in processing and manufacturing, yet enormous untapped potential remains. Digital capabilities such as e-commerce platforms can significantly improve traditional customer-supplier experiences. Additional advances in automation, big data and analytics, and the Internet of Things create additional opportunities for substantial gains along the entire industry value chain.

Another industrial revolution

Early signs of the digital revolution are already here. Amazon Business, a B2B e-commerce platform launched in April 2015, turned over $1 billion in sales in its first year, growing at an impressive 20 percent per month. B2B buyers increasingly prefer digital, with 94 percent conducting some form of online research before purchase.

Further changing the rules of the game are the decreasing costs of new processing technologies such as additive manufacturing and advanced robotics. For example, 3-D printing costs came down by 60 percent between 1990 and 2014, and industrial robot costs decreased 5 percent annually between 2000 and 2012.

Put concretely, what does digital bring in terms of performance jump across functions? Let's start by looking at operations, where our experts have recently shown that the impact potential is significant across all functions (Exhibit 1).

And this is not science fiction! Pockets of excellence exist across industrial sectors that have proven it can be done (see also Deep-dive 1):

- In the oil and gas industry, predictive maintenance is eradicating unplanned downtime and costly repairs. Connected plants use remote sensors to forecast and report on the condition and performance of machinery. Early signs of problems are detected and corrected, maintenance resources are directed at the areas of greatest need, and machinery availability is maximized.

Deep-dive 1

Complex operations' optimization

Advanced modeling techniques for optimizing complex manufacturing sites and supply chains

Working with a basic-chemicals manufacturer with complex operations, we designed an end-to-end advanced model that generates a holistic optimization of the entire supply chain from procurement to commercial. By incorporating detailed price and cost curves into this model and leveraging the latest advanced optimization engines, we developed a systematic optimization tool that was embedded into the company business process. The company saw a recurring EBITDA margin increase of roughly 5 percent, equal to approximately 6 percent of overall manufacturing, logistic, and raw-material costs. Application of these techniques on more than ten other cases in the process industry suggests a recurring EBITDA margin increase in the range of two to five percentage points, with value creation being proportional to supply-chain complexity.

Exhibit 1

The McKinsey Digital Compass maps Industry 4.0 levers to the 8 main value drivers

10 to 40% reduction of maintenance costs

Productivity increase of **3 to 5%**

20 to 50% reduction in time to market

30 to 50% reduction of total machine downtime

Industry 4.0 levers

- Predictive maintenance
- Remote maintenance
- Virtually guided self-service

- Smart energy consumption
- Intelligent lots
- Real-time yield optimization

- Customer co-creation/open innovation
- Concurrent engineering
- Rapid experimentation and simulation

- Routing flexibility
- Machine flexibility
- Remote monitoring and control
- Predictive maintenance
- Augmented reality for MRO[1]

- Data-driven demand prediction
- Data-driven design to value

- Human-robot collaboration
- Remote monitoring and control
- Digital performance management
- Automation of knowledge work

- Statistical process control
- Advanced process control
- Digital quality management

- In-situ 3-D printing
- Real-time supply-chain optimization
- Batch size 1

Service/aftersales — Resources/processes — Time to market — Asset utilization — Supply/demand matching — Labor — Quality — Inventories

Value drivers

Forecasting accuracy increased to **85%+**

Costs for quality reduced by **10 to 20%**

Costs for inventory holding decreased by **20 to 50%**

45 to 55% increased productivity in technical professions through automation of knowledge work

1 Maintenance, repair, and operations.

SOURCE: "Industry 4.0: How to navigate digitization of the manufacturing sector," McKinsey Digital, 2015

- The pulp and paper industry has seen significant increases in productivity through the use of remote temperature monitoring. Kiln sensors monitor lime mud temperature, a leading indicator of calcination. Sophisticated tools aggregate and analyze the temperature readings and automatically optimize the shape and intensity of the flame driving heat through the kiln. The process has resulted in fuel savings as high as 6 percent and a lime throughput increase of 16 percent.

- In manufacturing, repetitive, strenuous, and complex tasks are performed by robots working alongside operators on the shop floor. The operators themselves spend less time waiting for goods or processes or filling in routine documentation, because information systems optimize materials flows and track key performance indicators. Real-time analytics and advanced process control enable errors and quality lapses to be picked up immediately, minimizing rework and scrap, and automated inventory systems—such as wireless-connected boxes with cameras that automatically reorder when their fill level drops below a certain limit—ensure that inventories are accurate, goods can be easily located, and safety stocks are adequate but not excessive (Exhibit 2).

Let's not forget the customer: digital has the potential to profoundly reshape the way industrial companies interact with and serve their customers. Let's have a closer look:

- Where customer access was once constrained by minimum order sizes and the cost to serve in a particular market, e-commerce and web shops allow companies to reach customers they could never have reached before; hence cost to serve can be cut by 50 to 70 percent. Online marketplaces such as Amazon Business and Alibaba virtually connect unlimited buyers and sellers, and established players like Grainger are leading the way with their own platforms, capitalizing on 2015's estimated $1 trillion in B2B digital commerce sales in the United States.

- Suppliers who once relied on subjective analysis and historical knowledge to determine prices can now use faster, data-driven tools to optimize pricing. For example, a leading technical gases company with a large and highly fragmented product portfolio used advanced data analytics and modeling to design a more strategic and logical approach to pricing. The newly developed value-based pricing led to an increased return on sales of 5 percentage points (see Deep-dive 2).

Deep-dive 2

Pricing

Impact of value-based pricing

For a leading technical-gases client with a large and highly fragmented product portfolio, we deployed an innovative B2B value-based pricing approach to replace its existing method of setting prices according to customer size. We scanned the entire portfolio of more than 450 SKUs and over 1,300,000 transactions using a value-based pricing tool that sets price bands. We also performed a risk assessment for 183,000 product-customer combinations. With this more data-driven strategy, we reset 100,000 product-customer prices, covering 150 SKUs and addressing 92 percent of sales. As a result, the client saw an increased return on sales of five percentage points.

Exhibit 2

Smart automated
plant illustration

1. Full process and
end-to-end material-
flows automation

2. Data collection across the
supply chain; full M2M and
M2Cloud communication

3. Called by the machines,
maintenance uses
augmented reality tools

4. Operators working safely with
robots on the shop floor

5. Real-time monitoring and
adjustment of all plant operations

6. Remote controlling and management
based on full visibility of operations

7. Finished products going to the mass market,
semi-finished going to a customer-centric plant

SOURCE: "Industry 4.0: How to navigate digitization of the manufacturing sector," McKinsey Digital, 2015

- Sales directors can make smarter resource-allocation decisions based on timely inputs from sales reps, individual performance data, and automated recommendations from tools. Reps making sales recommendations no longer have to rely on hunches about what their customers want, but instead make use of targeted insights about products to sell, customers' success stories, and simulations run with the customer during the sales visit. The ability to attract new customers, improve

cross-selling, and reduce leakage can increase revenues by 5 to 15 percent, while customer satisfaction can be increased by 20 to 30 percent.

Digital's disruptive power

But digital is not only a means to optimize a company's existing operations. It also gives both attackers and incumbents the power to disrupt value chains, enter new sectors, and create innovative business models. Established companies face threats from new competitors like Amazon Business, which offers millions of products, from automotive components, industrial lifts, and ramps to lab products, protective gear, and electrical equipment.

To get ahead of threats like this, industrial companies can use digital to transform and extend their own business models before change is imposed on them by attackers reshaping their industry. Some incumbents are joining digital platforms and B2B marketplaces to aggregate demand and sell direct to end users. BASF, for example, was the first chemicals company to sell products online through Alibaba. Other businesses, such as the 3-D printing start-up Sculpteo, are selling services rather than products. Still others are offering their manufacturing capacity as a service to third parties.

But are companies ready?

Compelling though the opportunities are, our analysis indicates that industrial sectors in general are lagging behind other sectors in terms of digitization: the MGI Industry Digitization Index[1] shows that while advanced manufacturing and the oil and gas sectors have already gone some way in their digitization journeys, basic goods manufacturing and chemicals and pharmaceuticals are still in the early stages.[2]

Moreover, the McKinsey Industry 4.0 survey of more than 300 manufacturing experts in Germany, Japan, and the United States from January 2016 shows that only 16 percent of manufacturers have an overall Industry 4.0 strategy in place, and just 24 percent have assigned clear responsibilities to implement it.

Five ways to win

Companies that want to get ahead of the digital pack would be wise to take five key steps:

- **Prioritize and scale up.** Use structural assessments to determine priorities, avoiding the temptation to focus on flashy concepts that may not move the needle. Determine the customer appetite versus willingness to pay by using mockups to conduct

[1] "Digital Europe: Pushing the frontier, capturing the benefits," McKinsey Global Institute, June 2016; "Digital America: A tale of the haves and have-mores," McKinsey Global Institute, December 2015.

[2] "Industry 4.0 after the initial hype: Where manufacturers are finding value and how they can best capture it," Digital McKinsey, April 2016.

interviews with potential customers and external experts. In addition, weigh the potential impact against the ease of implementation by assessing the degree of innovation or disruption (Is it a substitute? an extension? a breakthrough?), defining the scalability, studying the feasibility of the pilot and full solution, and ascertaining the fit with existing assets and capabilities.

- **Adopt a test-and-learn approach.** As technology-driven change accelerates, forecasting and planning are becoming less relevant and reliable. Agility—remaining open to learning and experimentation—is key. And it is crucial when investing in digital solutions to adopt the mind-set of a venture capitalist. This includes trying out ideas quickly with target customers as soon as they exist to check market interest and price points. It also means being ruthless: if the idea isn't worth it, kill it immediately. In addition, successful ventures think about monetization potential as soon as interactions with potential customers start, and they proudly copy from other sectors. A focus on scale is also essential, with the ambition being a tenfold increase.

- **Put foundations in place.** To maintain the efficiency and stability of existing operations while providing the processing capacity and speed required by new data-driven activities, smart companies move to a two-speed IT infrastructure—overlaying a fast, next-generation cloud-based IT system on their secure, robust, resilient legacy systems. New talent is another priority, especially data and process experts who can connect up various functions, systems, and levels of management; draw insights from all the information generated across the enterprise; and use their knowledge of the whole production chain to help design new products. Meanwhile, job profiles must be rethought to meet new needs, such as maintenance staff who oversee predictive maintenance rather than acting as troubleshooters, and quality specialists who intercept quality issues online rather than detecting faulty parts after production (Exhibit 3).

- **Treat data as a competitive advantage.** Data fuels the algorithms that provide insights into markets, customers, and business processes, so ensure that data management has a clear structure and governance. And considering that even tech giants such as Google have been vulnerable to malicious attacks, be sure to put cybersecurity high on your management agenda. Physical targets such as connected machinery and systems installed for remote access could also be highly susceptible to sabotage by hackers and other attacks.

- **Work across functions, and manage change in the organization.** Digitization requires that all departments work together to capture joint benefits for the whole business. Moreover, because these innovations have a major impact on how people work, it is essential to anticipate concerns and build a persuasive case for the employees. When thinking about digital priorities, identify the technologies and applications that

Exhibit 3

Example of required shifts in job profiles for connected factory

	From…	…To
Worker (production)	Carries out production tasks, large share of manual tasks	Exception handler in production line, operator in automated environment
Maintenance expert	Troubleshooter and exception handler	Oversees predictive maintenance, plans and steers based on data-driven analysis
Quality specialist	Inspects parts and controls quality standards after the fact	Smart engineering of process to online control for quality issues
Production planner	Top-down planning and steering of linear processes (50 percent build-to-stock)	Supply-chain planner • Develops flexible self-steering value stream (100 percent build-to-order)
Logistics planner	Plans supply in segmented approach (inbound, line delivery, outbound)	• Becomes a planner on a fully integrated supply chain from order to delivery
Team leader	Focus on leading people based on visible waste on shop floor	Leads team based on identified digital waste, brings insights to action

SOURCE: McKinsey analysis

would have the greatest potential impact. But also make sure not to ignore possible barriers to adoption: devise a plan for helping employees use the new technologies and the related new methodologies most effectively. Remember that no organization achieves a successful digital transformation without taking a thoughtful approach to change management, and that it's the people applying the technology in their daily jobs who will create the additional value.

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Digital's potential in industry is massive, not only in operations, but across all functions of the sector, and the levers that make the most difference to a company's bottom line vary—from e-commerce to automation to advanced analytics. But industrial companies must begin taking advantage of digital opportunities in order to avoid losing the value to others. A commitment to digitization from top management is critical to succeeding, as is a systematic method of defining priorities and the ability to leverage early success to drive change. ▫

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Making digital strategy a reality in insurance

Tanguy Catlin, Somesh Khanna, Johannes-Tobiaz Lorenz, and Sandra Sancier-Sultan

The nature of competition in property and casualty (P&C) insurance is shifting as new entrants, changing consumer behaviors, and technological innovations threaten to disrupt established business models. Though the traditional insurance business model has proved remarkably resilient, digital has the power to reshape this industry as it has many others. Innovations from mobile banking to video and audio streaming to e-books have upended value chains and redistributed value pools in industries as diverse as financial services, travel, film, music, and publishing. As new opportunities emerge, those insurers that evolve fast enough to keep up with them will gain enormous value; the laggards will fall further behind. To succeed in this new landscape, insurers need to take a

structured approach to digital strategy, capabilities, culture, talent, organization, and their transformation roadmap.

Disruption at the gates

Though the P&C insurance business has long been insulated against disruption thanks to regulation, product complexity, in-force books, intermediated distribution networks, and large capital requirements, this is changing. Sources of disruption are emerging across the value chain to reshape:

- **Products.** Semi-autonomous and autonomous vehicles from Google, Tesla, Volvo, and other companies are altering the nature of auto insurance; connected homes could transform home insurance; new risks such as cybersecurity and drones will create demand for new forms of coverage; and Uber, Airbnb, and other leaders in the sharing economy are changing the underlying need for insurance.

- **Marketing.** Evolving consumer behavior is threatening traditional growth levers such as TV advertising and necessitating a shift to personalized mobile and online channels.

- **Pricing.** The combination of rich customer data, telematics, and enhanced computing power is opening the door to usage- and behavior-based pricing that could reduce barriers to entry for attackers that lack the loss experience formerly needed for accurate pricing.

- **Distribution.** New consumer behaviors and entrants are threatening traditional distribution channels. Policyholders increasingly demand digital-first distribution models in personal and small commercial lines, while aggregators continue to pilot direct-to-consumer insurance sales. Armed with venture capital, start-ups like Lemonade—which raised $13 million in seed funding from well-known investors including Sequoia Capital—are exploring peer-to-peer insurance models.

- **Service.** Consumers expect personalized, self-directed interactions with companies via any device at any hour, much as they do with online retail leaders like Amazon.

- **Claims.** Automation, analytics, and consumer preferences are transforming claims processes, enabling insurers to improve fraud detection, cut loss-adjustment costs, and eliminate many human interactions. Connected technologies could allow policyholders and even smart cars and networked homes to diagnose their own problems and report incidents. Self-service claims reporting such as "estimate by photo" can create fast, seamless customer experiences. Drones can be used to assess damage quickly, safely, and cheaply after catastrophes.

All these disruptions are being driven and enabled by digital advances, as Exhibit 1 illustrates with examples from auto insurance. No single competitor or innovation poses a threat across the entire value chain, but taken together, they could lead to the proverbial death by a thousand cuts: many small disruptions combining to fell a giant.

Digital affects every part of the insurance value chain

Example: Auto insurance

Trend	Product	Marketing	Underwriting/ pricing	Distribution	Claims	Service
Trend	Product becomes more personalized and usage based	Digital drives more effective marketing via better targeting and conversion	Availability of new data drives the next S-curve in pricing accuracy	Policies bound digitally become the norm (e.g., 50% of auto policies)	Claims adjustment done digitally via integration with connected car sensors	Higher portion of service transactions completed digitally (online, mobile, social)
Examples from today	▪ Metromile insures ride-sharing drivers (e.g., reaching ~150,000 Uber drivers)	▪ >65% of consumers get auto quotes on-line; 40% on mobile ▪ 65% of European insurers plan to profession-alize their online marketing	▪ Select carriers' programs have pre-dicted rise in claims frequency and severity as car usage rose post-recession	▪ Direct channel growing at 2x rate of other channels ▪ 70% of European insurers plan to install multi-access training program for their physical sales channel	▪ Guidewire claims platform is becoming the industry standard	▪ +50% of service trans-actions completed digitally at leading carriers

SOURCE: McKinsey Global Institute analysis

Tremendous value at stake

The P&C industry lags in digital sophistication, so examples of the full benefits of digital are scarce. Our analysis suggests that the top 20 or 30 processes can account for up to 40 percent of costs and 80 to 90 percent of customer activity. Digitizing these processes can take out 30 to 50 percent of the human service costs while delivering a much better customer experience. And the benefits do not end there: Exhibit 2 shows how P&C insurers in the top quartile for digital performance are achieving twice the growth rate of their less digitally advanced peers and delivering better profitability at the same time.

A few carriers are experimenting with corporate venture capital, innovation labs, and other approaches as they explore untapped sources of value and new business models. Areas of early focus include connected cars and homes, the sharing economy, and the move from insurance as a product to protection as a service.

Exhibit 2

Top digital performers in P&C have outperformed the market

2010–14

Growing twice as fast as their less digital competitors …

Revenue growth
Compound annual growth rate (%)

6.2   +1.8X   P&C industry: 4.2   3.5

Top-quartile digital insurers[1]   Rest

… while delivering substantially better profitability[2]

Combined ratio
%

96   102   -6%

Loss ratio   70   70
Expense ratio   26   32

Top-quartile digital insurers[1]   Rest

1 P&C carriers in the top quartile of all North American companies (across sectors) by total digital quotient.
2 Primarily through their lower expense ratios.

SOURCE: SNL; McKinsey Global Institute analysis

Many industry leaders are concerned about the costs and difficulty of transforming their business. To be sure, sizable investments are needed, but the penalty for doing nothing or moving too slowly could be far greater. Imagine the risk to incumbents if:

■ Existing competitors slashed their costs and lowered their prices by half.

■ Amazon or another digital giant with deep customer relationships moved into selling insurance, increasing price transparency and poaching the most profitable policyholders.

■ A data aggregator drew on new sources of data to develop much more accurate underwriting and pricing models and partnered with a third-party investor to launch a new insurer that outperformed incumbents in profitable growth.

■ A small commercial competitor offered cybersecurity insurance in a bundle with business-owner policies.

■ A critical mass of autonomous vehicles eliminated many road accidents and injuries.

Exhibit 3

The next digital
wave will transform
insurance still further

Digital trends transforming business models

Big data's next frontier	Growing ability to model ever larger and more complex datasets to derive nuanced insights from customer micro-segmentation to genomics pattern recognition
Megarisk management	Basic risks are reduced as core products get safer (e.g., self-driving cars), yet long-tail risks are growing (e.g., natural catastrophe disrupting operations)
Telematics/ Industry 4.0	Cars and property are increasingly connected and able to communicate on a massive scale, enabling insurers to dynamically adjust insurance premiums based on risk
Digital-led growth in emerging markets	Emerging markets with 3 billion mobile owners using smartphones to search for, purchase, and pay for insurance
Personalization and ecosystems	As customers choose service providers to personalize their experience, service subscriptions become a greater share of revenues

Tech startups are disrupting the insurance industry and attracting record funding
Global investment in insurance-related startup products[1]
$ million

Year	Value
2010	136
2011	179
2012	361
2013	324
2014	904
2015	2,600

1 Including angel and venture-capital funding, private-equity investments, and funding from initial public offerings; rough estimates based on data available. Includes robo-advisory and insurance.

SOURCE: CBInsights; Crunchbase; McKinsey Panorama; McKinsey Global Institute analysis

How would these disruptions affect premiums and profitability? How quickly would insurers feel the impact? How could they respond? And what other digital innovations lie in store (Exhibit 3)?

A structured approach to capturing value

Insurers are experimenting with many different approaches to digital, but all are grappling with the same challenge: deciding where and how to focus in order to establish or maintain a competitive edge. A successful digital transformation calls for a structured approach with action on five levels:

- **Strategy.** Align on a long-term vision to overhaul operations and generate new sources of value based on clearly articulated, shared priorities.

- **Value capture.** Build the mechanisms to execute the strategy by improving today's business and processes through digitization while simultaneously launching efforts to build tomorrow's digital business through innovation.

- **Capabilities.** Invest in the core technical competencies needed to support digitization and innovation, such as flexible modular IT architecture, deep data access and analytics, user-centric experience design, and digital operations.

- **Culture, talent, and organization.** Build agile test-and-learn capabilities at the front line to encourage experimentation and shift to a digital-first mind-set; recruit and develop new types of talent such as data scientists and design thinkers; and revise formal organization structures to encourage collaboration between functions and reflect the importance of digital.

- **Roadmap.** Build an integrated transformation roadmap that addresses all the elements above and takes into account the organization's digital maturity and readiness to embark on a multiyear digital journey as well as the value digital can bring to its specific markets and products.

To chart a successful path, it helps to understand common pitfalls. Digital strategies most frequently fall short when they lack a clear vision of the sources of value in digitization and digital innovation. To develop digital capabilities, insurers need to be prepared to commit adequate time and money. Lapses in digital culture, talent, and organization typically stem from insufficient investment in installing new types of talent and ways of working in the business, or a failure to adjust organization structures to reflect digital's importance. Some insurers struggle to go it alone as they strike out on their journey, when they might move faster or capture more value by partnering with third parties or buying them outright. Whether it is better to build, buy, or partner will depend on a company's starting point, aspirations, and time horizon.

What all successful digital transformations share is a sustained commitment from senior management, a shared long-term vision, a willingness to transform the culture and operating model, and the tenacity to persist through the difficulties that accompany any organizational effort of this magnitude.

• • •

Undertaking a digital transformation is undoubtedly challenging, especially since insurers have to carry it out while managing their everyday business operations effectively as well. But the question is not "Do we have the appetite to undertake a digital transformation?" but "Can we afford not to?" □

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How telecom companies can win in the digital revolution

Paul-Louis Caylar and Alexandre Ménard

Telecom companies face increasingly tough times as digitization reshapes the industry landscape. In fact, telecoms come second only to media in the ranks of sectors expecting moderate or massive digital disruption over the next 12 months, according to a 2015 cross-industry survey of senior industry leaders.[1]

In the past five years, the telecom business has entered a period of slow decline, with revenue growth down from 4.5 percent to 4 percent, EBITDA margins down from 25 percent to 17 percent, and cash-flow margins down from 15.6 percent to 8 percent.[2] Competitive boundaries are shifting as core voice and messaging businesses

continue to shrink, partly under regulatory pressures, but also because social media is opening up new communications channels. Among US telecom companies, for instance, landline and mobile voice now account for less than a third of total access, down from 55 percent in 2010, while data revenue has risen from 25 percent of total revenues in 2010 to 65 percent today.

But digitization is not just a threat; it also offers telecom companies an opportunity to rebuild their market positions, reimagine their business systems, and create innovative offerings for customers. Not surprisingly, most executives consider digitization to be one of their top priorities,[3] but few companies are close to capturing its full potential. We calculate that digitization could enable telecom operators to improve their profits by as much as 35 percent, yet the average improvement achieved is just 9 percent.

So how can companies bridge this gap? We have identified five ways to come out on top of the digital revolution.

1. Reinvent the core

Digitization touches almost every aspect of a telecom operator's business:

Omnichannel sales. Today's consumers engage with multiple channels during their customer journey. Customers increasingly visit stores to look at products before buying online, but even more do the opposite, researching products online before completing their purchase in a store. Great customer journeys call for excellence in every interaction, clear cross-channel pathways, and a seamless customer experience. Stores need radical reform, too, not just to reduce their footprint but to transform the customer experience they offer. Investing in digital sales has enabled some leaders to increase revenues by 30 percent and reduce commercial costs by a similar proportion.
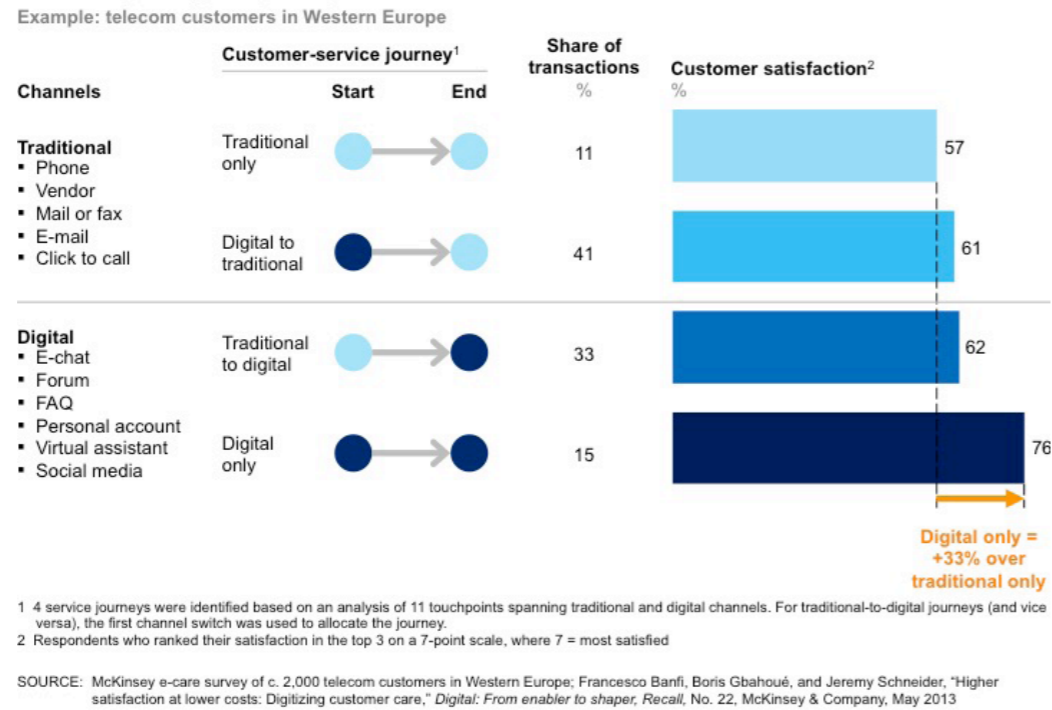
E-care. Digital is now the leading channel in many customer-service transactions, too. Among a sample of telecom companies in Western Europe, 89 percent of service journeys occurred partly or entirely online (Exhibit 1). Customers prefer digital service, with 76 percent of telecom customers satisfied with digital-only journeys, compared with 57 percent for traditional channels. However, few service journeys are entirely digital as yet: just 15 percent are digital from start to finish, while 41 percent begin on an e-care platform and then switch to traditional channels. For telecom operators, migrating to e-care can reduce call volumes and operating expenses by 25 to 30 percent. One company that launched an e-care effort as part of a broader digital sales transformation saw a 40 percent reduction in customer-care costs as well as a rise in customer satisfaction.

Digital processes. Today's customers expect an easy-to-use interface across all channels, an exciting in-store experience, and fast service 24/7. Yet many operators, especially incumbents, struggle to meet these expectations because of slow design processes,

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[1] In a survey of more than 2,000 C-level executives from 15 industries, 64 percent of telecom executives (and 72 percent of media executives) expected to see moderate or massive digital disruption in the next 12 months. See Rhys Grossman, "The industries that are being disrupted the most by digital," *Harvard Business Review*, 21 March 2016.

[2] Figures for 2010 and 2014.

[3] According to McKinsey's TMT Extranet Survey of more than 250 respondents from telecom, high-tech, media, cable, and Internet companies worldwide, conducted in November and December 2014.

Exhibit 1

The more digital the journey, the higher the satisfaction

Example: telecom customers in Western Europe

Channels	Customer-service journey[1]		Share of transactions %	Customer satisfaction[2] %
	Start	End		
Traditional • Phone • Vendor • Mail or fax • E-mail • Click to call	Traditional only		11	57
	Digital to traditional		41	61
Digital • E-chat • Forum • FAQ • Personal account • Virtual assistant • Social media	Traditional to digital		33	62
	Digital only		15	76

Digital only = +33% over traditional only

1 4 service journeys were identified based on an analysis of 11 touchpoints spanning traditional and digital channels. For traditional-to-digital journeys (and vice versa), the first channel switch was used to allocate the journey.
2 Respondents who ranked their satisfaction in the top 3 on a 7-point scale, where 7 = most satisfied

SOURCE: McKinsey e-care survey of c. 2,000 telecom customers in Western Europe; Francesco Banfi, Boris Gbahoué, and Jeremy Schneider, "Higher satisfaction at lower costs: Digitizing customer care," *Digital: From enabler to shaper, Recall*, No. 22, McKinsey & Company, May 2013
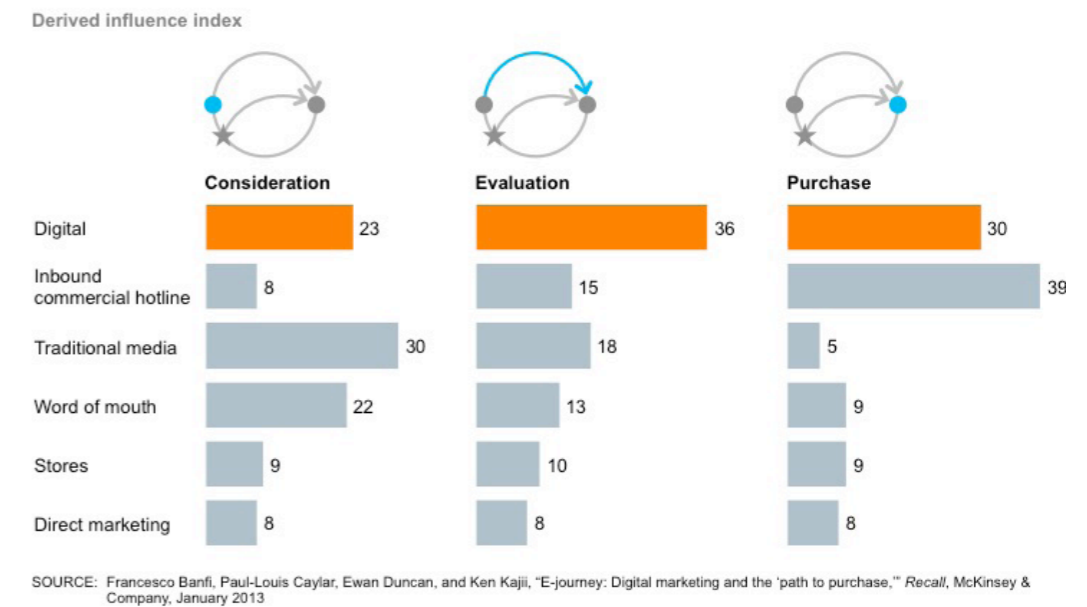
limited customer input, and rigid legacy IT systems. They need to overcome these barriers and invest in effective customer-relationship-management systems to track customers' digital footprints, reduce costs, boost customer satisfaction, and improve brand advocacy and differentiation. Digital touchpoints now influence customers' preferences across the whole decision journey (Exhibit 2). Among these touchpoints, websites have by far the most influence on customers' brand preferences, with mobile apps a distant second because of their limited reach (only about 10 percent of the target population). Social media play a part only when negative coverage harms customer acquisition. In the near future, telcos will be able to use real-time 360-degree data on individual customers to personalize promotions, campaigns, and service interventions along the entire customer journey.

Analytics. Network operators can use analytics to reduce customer churn, make better marketing-spend decisions, improve collections, and optimize network design. For instance, customers at risk of defecting can be identified even before they consider doing so, enabling operators to target their retention efforts, reduce spending, and maximize impact. One company raised its telephone-outreach hit rate from 60 to 480 at-risk customers out of every 1,000 calls, and reduced its attrition rate from 24 percent to 20 percent a year. At the same time, network operators can optimize their marketing spending by using advanced analytics tools, such as forecast simulators

and econometric models, to predict acquisition and retention at the level of individual advertising channels instead of relying on predefined percentages or gut instinct to allocate their ad budget and ceding the details to an agency. In collections, meanwhile, operators can use analytics to identify customers at risk of default and optimize outreach for those they wish to retain. One company created an algorithm that sorted late-paying customers into three groups—self-cure, in need of reminders, and bad payers—and targeted each group with different measures. The new approach cut churn among these customers by 90 percent. In network design, clustering customers according to their daily travel patterns has enabled some operators to fine-tune their geographical networks to optimize customer service and investment. One company increased the ROI of network deployment by 10 percentage points and reduced capital spending by 38 percent.

Exhibit 2

The customer decision journey has radically shifted toward digital touchpoints

Derived influence index

	Consideration	Evaluation	Purchase
Digital	23	36	30
Inbound commercial hotline	8	15	39
Traditional media	30	18	5
Word of mouth	22	13	9
Stores	9	10	9
Direct marketing	8	8	8

SOURCE: Francesco Banfi, Paul-Louis Caylar, Ewan Duncan, and Ken Kajii, "E-journey: Digital marketing and the 'path to purchase'," *Recall*, McKinsey & Company, January 2013
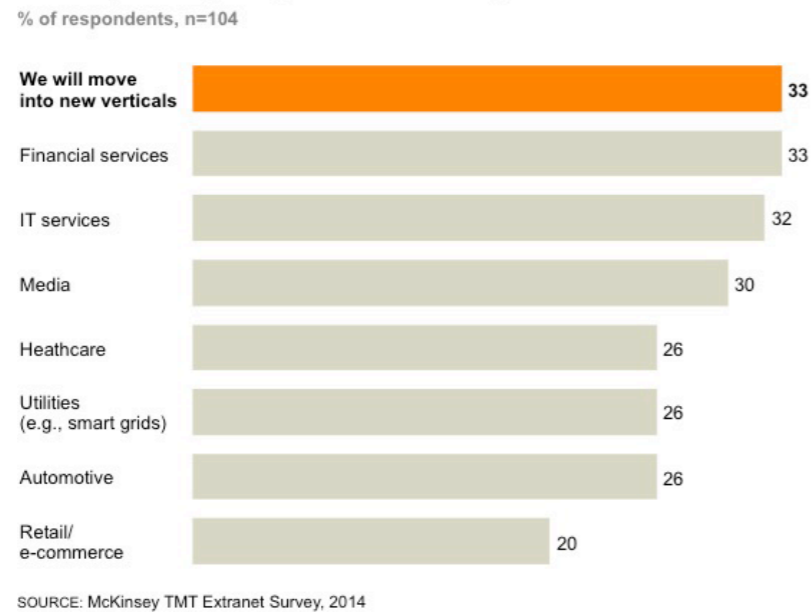
2. Pursue adjacencies

A third of the respondents to our TMT Extranet Survey were preparing to move into adjacent businesses such as financial services, IT services, media, or utilities in search of new opportunities and revenue streams (Exhibit 3). Some top-tier telecom companies have set up dedicated digital business units with funding for internal R&D to create new services. Most companies are in the early stages of developing their digital-services portfolios, though some have offered a limited set of services for years. Such offerings usually involve partnership with third parties that bring specialist expertise to complement

Exhibit 3

Some companies
are planning an
imminent move into
adjacent businesses

% of respondents, n=104

We will move into new verticals	33
Financial services	33
IT services	32
Media	30
Heathcare	26
Utilities (e.g., smart grids)	26
Automotive	26
Retail/ e-commerce	20

SOURCE: McKinsey TMT Extranet Survey, 2014

the telcos' strong customer relationships and broad reach. A notable example is in media, through partnerships with companies such as Netflix, Deezer, and Spotify.

To become a successful multiservice provider, telecom companies should seek to:

Create a focused offering for promising adjacent opportunities, with clear positioning, a well-defined value proposition, and a carefully targeted customer segment. Such an offering should rely on standardized IT products and services and existing platforms where possible.

Develop platform-based solutions in disruptive technology areas that are close to the core business but provide additional growth potential. Telecom companies should also consider how to derive additional value from their existing assets and competitive advantages.

Minimize costs in production and delivery by using automated and "low-touch" processes to avoid building in extensive personnel requirements and increasing speed to market with a product that is not fully integrated in existing legacy systems and potentially running on a separate infrastructure.

Drive sales by starting with a basic portfolio of services to gain traction and then developing one or two solutions with demonstrable advantages for a particular business. As customer demand increases, telcos can improve their responsiveness by implementing lean approaches and speeding up processes though multiskilling and dedicated presales and
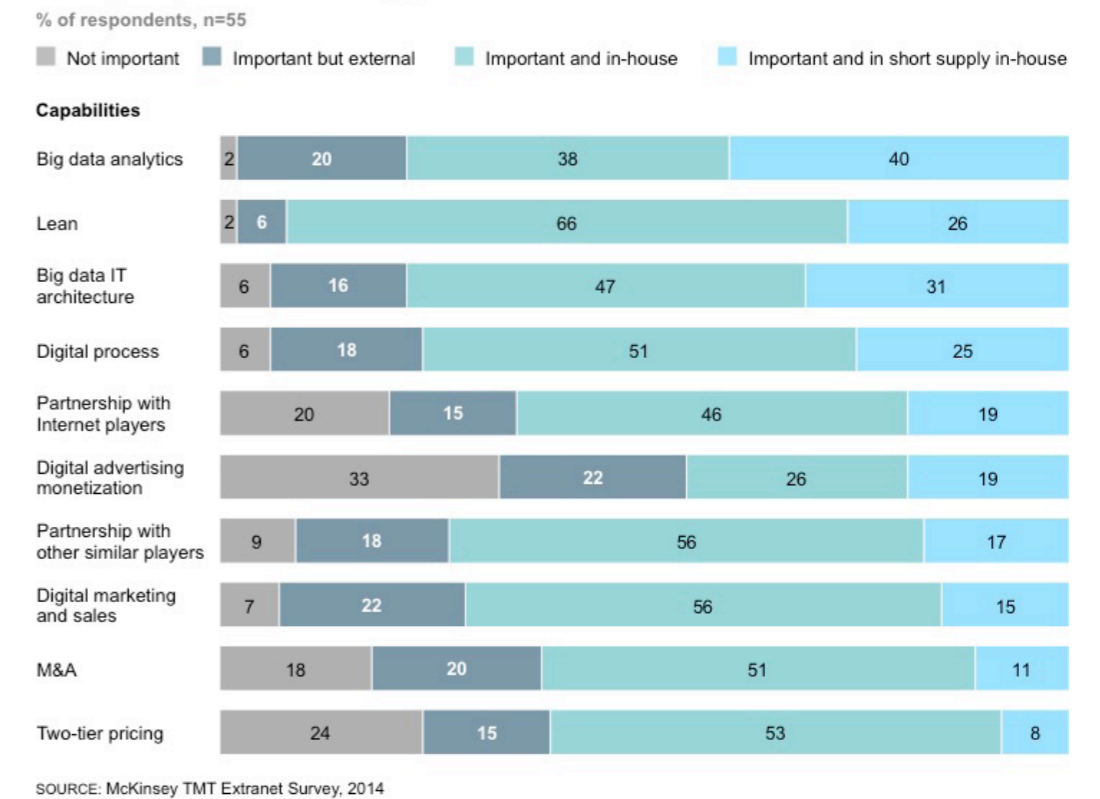
sales support. They should also capture synergies with their core business in areas such as local presence, customer access, and industry knowledge.

3. Build talent and capabilities

Many operators realize they need to work on building essential digital capabilities (Exhibit 4).

Exhibit 4

Some digital
capabilities are in
short supply

% of respondents, n=55

Capabilities	Not important	Important but external	Important and in-house	Important and in short supply in-house
Big data analytics	2	20	38	40
Lean	2	6	66	26
Big data IT architecture	6	16	47	31
Digital process	6	18	51	25
Partnership with Internet players	20	15	46	19
Digital advertising monetization	33	22	26	19
Partnership with other similar players	9	18	56	17
Digital marketing and sales	7	22	56	15
M&A	18	20	51	11
Two-tier pricing	24	15	53	8

SOURCE: McKinsey TMT Extranet Survey, 2014

We recommend they focus more on agility and learning than on forecasting and planning, which become less relevant and reliable as technology-driven change continues to accelerate. They also need to foster a mind-set geared to learning, experimentation, and iterating with the customer. That means going to target customers at an early stage to test their appetite and price sensitivity, and then scaling up promising options fast.

4. Revamp IT

For most operators, streamlining their application landscape and standardizing and automating their IT infrastructure will be a priority. Aging and complex legacy IT applications

are a major hindrance in competing against nimble digital rivals. A recent McKinsey IT benchmarking study of 80 telecom companies worldwide found that top performers had removed redundant platforms, automated core processes, and consolidated overlapping capabilities. Such an effort enabled one South American telecom to free up the equivalent of 31 percent of its full-time employees, gain a unified view of customer billing, resolve customer issues faster, and reduce service errors. Inefficient IT processes are another obstacle.

The top-performing companies in our benchmarking study have simplified and automated backbone IT processes and systems such as server deployment, load balancing, and service-ticket management, saving costs and enhancing their ability to adjust capacity and load volumes. In emerging markets, where some telecom operators are adding as many as one or two million subscribers per month, the ability to automate capacity, server throughput, and storage has allowed senior managers to focus on business growth instead of scrambling to augment their IT infrastructure.

5. Start with the customer and work back

Most operators think of the customer experience as a series of touchpoints — individual interactions between the customer and different parts of the business, such as products, customer service, sales staff, and marketing materials. But this misses the crucial part of the picture: the customer's whole experience of the company. Only by walking in the customer's shoes along the entire customer journey from beginning to end can operators truly understand how to improve their performance. What would an ideal journey feel like for the customer? What processes would support it? How would they intersect with social, mobile, and cloud technologies? The goal is not to digitize multiple elements but to deliver a superior customer experience. Companies that excel at this focus on singling out the handful of customer journeys that matter most to key segments, mapping how these journeys flow across functions, channels, and devices, and identifying and eliminating the biggest pain points.

●   ●   ●

Making smart use of digital technologies across the whole business is an imperative for telecom operators that want not only to combat the declining growth, shrinking margins, and intensifying competition of recent years, but also to seize opportunities that could make them stronger and more profitable than before. Getting it right will involve a wholesale digital transformation that starts with full commitment and strong leadership from the top. ❑

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The digital utility: New opportunities and challenges

Adrian Booth, Niko Mohr, Peter Peters, and Sébastien Léger

Today's headlines about the digital revolution tend to focus on consumer sectors, but the changes are just as profound, if a little more slow moving, in the power industry. Renewables, distributed generation, and smart grids are demanding new capabilities and triggering new business models and regulatory frameworks as entrants from the digital economy disrupt the industry landscape. As data collection and exchange grow exponentially, new opportunities and threats are emerging. Competition for customers is shifting online, while the Internet of Things promises new products and management options. Meanwhile governments and regulators seek to encourage smarter measuring systems and greener standards for generation and consumption.

All this is happening against a perfect storm of macroeconomic and industry-specific factors that have created overcapacity and depressed prices. Since 2008, Europe's large publicly traded utilities have lost, on average, half their market capitalization, with the destruction of around €500 billion of shareholder value. Business models are being undermined as structural and asset-related competitive advantages disappear. To drive recovery, utilities need to restructure their portfolios, achieve operational excellence, develop new skills, improve innovation, and pursue financial engineering.

To thrive amid these challenges, the utility of the future will be fully digital — meaning that today's utilities face a digital transformation of their whole business. It begins with discovering new sources of value, then designing strategies to capture them, and delivering relevant products and services to the customer. The best companies will be able to de-risk the process by focusing on quick wins that can fund the transformation and greatly improve the chances for success.

Capturing potential at every level

Digital opportunities are present throughout the value chain from power generation to customer-relationship management (Exhibit 1). Many utilities have launched mobile applications for bill notification, presentment, and payment, and for outage management. But the big change coming is in smart homes and connected buildings, where digitized processes will unlock new sources of value. Digital management of distributed energy resources has begun, and many utility projects have a digital focus and use digital techniques.

Even so, the benefits of digitization are often underestimated. Experience from other industries suggests that utilities should set ambitious goals to transform their productivity, reliability, safety, customer experience, compliance, and revenue management. The opportunities can be captured in three waves:

Wave 1: Improving productivity and efficiency

Conservative estimates and analysis of real-life cases suggest that digitally optimized operations can boost profitability by 20 to 30 percent (Exhibit 2). This potential can be captured through three means:

Smart meters and the smart grid. These two sources supply the massive data flows that are the lifeblood of a digital utility and inform analyses, planning, and diagnostics. Smart grids are more efficient and require less capital, allowing for predictive maintenance and better asset health. Smart meters allow utilities to use advanced credit and collections algorithms to identify customers who need help to avoid default. With the right analytic tools, utilities can optimize staffing at power plants and manage the intricacies of multiple energy sources, trading options, and patterns in demand.

Exhibit 1

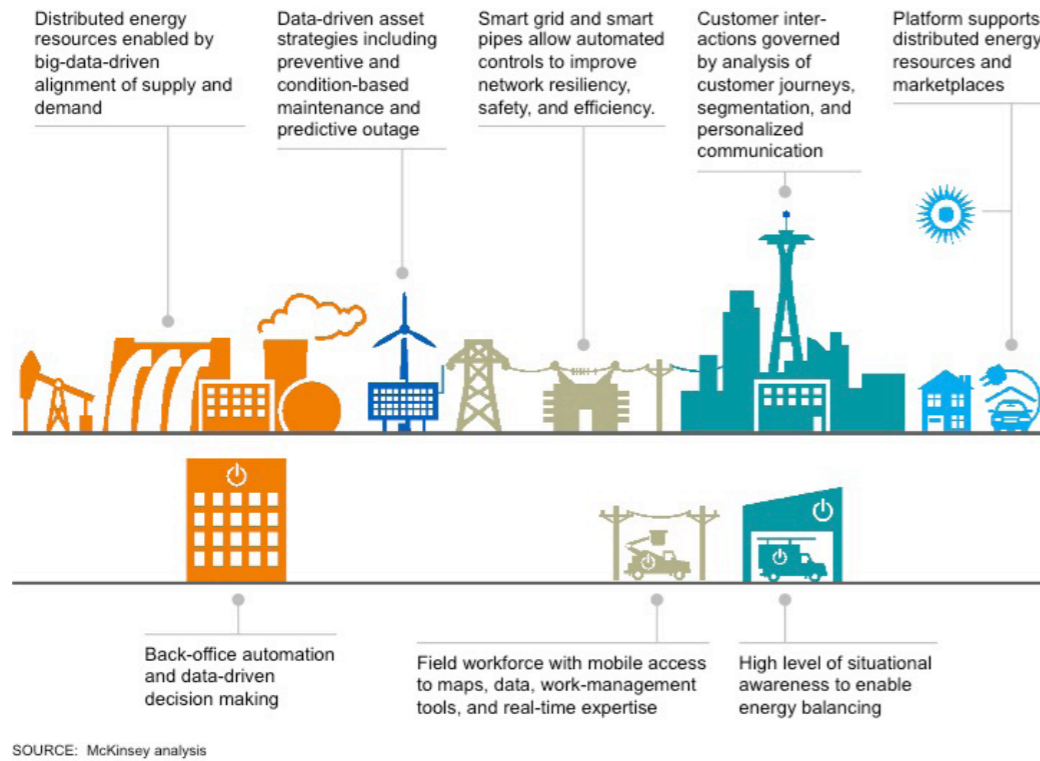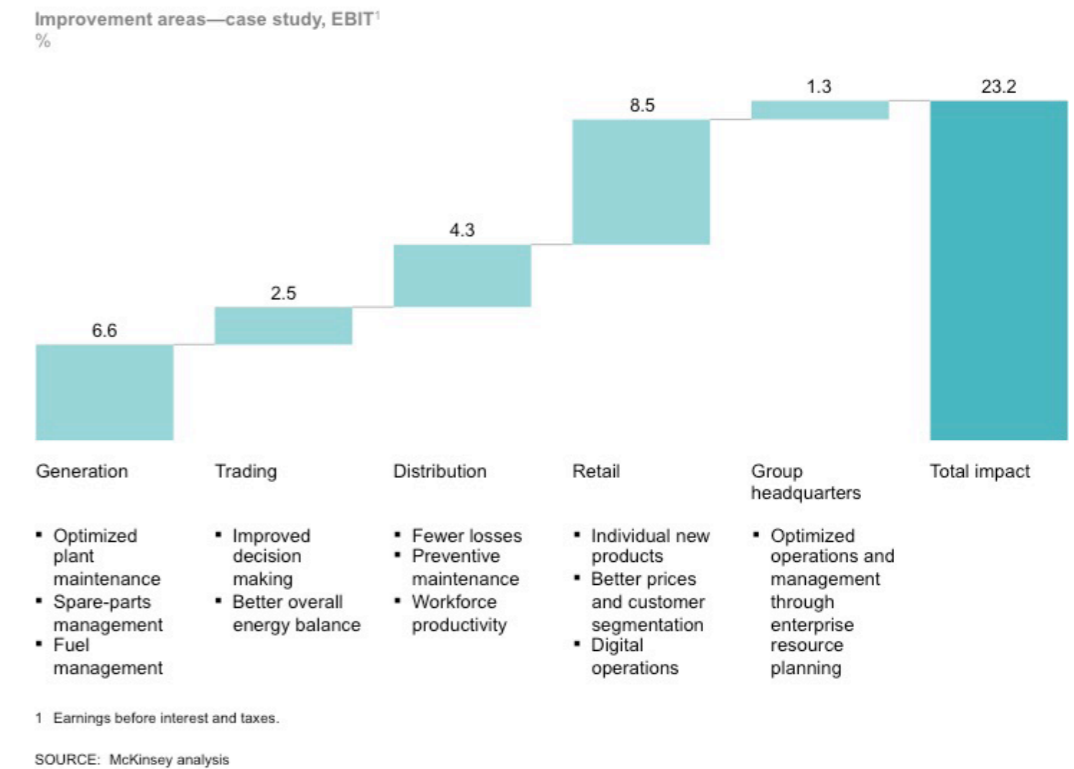The digital utility of the future captures opportunities all along the value chain

Distributed energy resources enabled by big-data-driven alignment of supply and demand

Data-driven asset strategies including preventive and condition-based maintenance and predictive outage

Smart grid and smart pipes allow automated controls to improve network resiliency, safety, and efficiency.

Customer inter-actions governed by analysis of customer journeys, segmentation, and personalized communication

Platform supports distributed energy resources and marketplaces

Back-office automation and data-driven decision making

Field workforce with mobile access to maps, data, work-management tools, and real-time expertise

High level of situational awareness to enable energy balancing

SOURCE: McKinsey analysis

Exhibit 2

Impact of digitization on utilities' profits

Improvement areas—case study, EBIT[1]
%

6.6   2.5   4.3   8.5   1.3   23.2

Generation | Trading | Distribution | Retail | Group headquarters | Total impact

- Optimized plant maintenance
- Spare-parts management
- Fuel management

- Improved decision making
- Better overall energy balance

- Fewer losses
- Preventive maintenance
- Workforce productivity

- Individual new products
- Better prices and customer segmentation
- Digital operations

- Optimized operations and management through enterprise resource planning

1 Earnings before interest and taxes.

SOURCE: McKinsey analysis

Productivity tools for employees. Using smartphones, grid companies can digitize core processes to improve asset management, engineering, planning, scheduling, dispatch, execution, and job closeout. One German energy supplier increased productive hours by 15 percent by adding GPS and traffic information to its route-planning toolkit. All employees carry a diagnostic tool that provides access to reference samples, root-cause analysis, and stocks of replacement parts, and allows contact with experts if more complex error patterns are detected.

Automation of back-office processes. The benefits of automation are growing as distributed generation and multichannel delivery make processes more numerous, convoluted, and error-prone. Variations between providers in cost per customer, cost of error resolution, and billing inquiries indicate the scope for efficiency improvements. By digitizing a single core process, one company cut its cost by 20 percent in the first year, while also improving customer satisfaction.

Wave 2: Improving the customer journey with advanced analytics

Utilities in competitive retail and traditional regulated environments are struggling to keep customers and fend off new threats. Digitizing the customer experience can help improve satisfaction and cut costs and often improves revenue. Most customers prize a platform

that seamlessly connects their interactions across online, mobile, call-center, and local sales channels. Such a platform allows utilities to analyze customer behavior across the customer journey and use advanced analytics to enhance service quality, reduce costs, and deepen customer relationships. One Northern European energy supplier used customer-data analytics to improve processes and saw an increase in upselling, cross-selling, and digital-channel usage.

Many companies have begun using machine learning to analyze customer information. Some are using customer attributes and behaviors to define segments by predictive criteria such as susceptibility to switching, allowing companies to personalize offers and communications more precisely.

Wave 3: New frontiers

Digital capabilities allow utilities to enter new business arenas:

Distributed generation. Smart meters provide data on each customer's generation and consumption, enabling energy suppliers to develop demand-response programs that award discounts and rebates to customers who allow them to control their heating and

cooling. Utilities are also using data analysis to offer improved maintenance services to distributed facilities, and could eventually own these facilities and sell optimized hours to facility operators and other customers. In such models, customer proximity, technological competence, and digital capabilities combine to create a powerful competitive advantage.

Efficiencies in energy and facility maintenance. The cost and effort required to identify energy-efficiency opportunities and install solutions have confined the economic advantages mainly to large, energy-intensive industrial companies. As smart-meter usage expands and detailed information on consumption and generation by commercial and residential customers becomes readily available, these costs could plummet. Utilities could form partnerships with real-estate companies and plant manufacturers to gain access to data and help design solutions.

Smart homes, connected buildings, smart cities. Many utilities already offer networked solutions for managing energy, such as remote control for buildings. They could use information from smart meters to pursue additional business applications in this area. Local, regional, and national governments are launching smart-city initiatives to promote technical innovation in an urban setting. As municipal energy and environmental planning become more closely integrated, utilities are partnering with cities and builders to introduce sensing technology and data analytics in "self-learning" buildings.

Guidelines for a Digital Transformation

To realize these opportunities, utilities should identify points in the value chain where digitization could make the largest revenue contribution in the next year or two (Exhibit 3), then act with these priorities in mind:

Prioritize design. Any successful digital transformation depends on adoption and usage, so simple design and user-friendly products are critical. Customers should be involved in designing the customer experience and providing continuous input into a proposal's usability and usefulness, so that their needs are addressed from the outset.

Adopt an agile approach. Utilities should set up agile cross-functional teams that use an iterative test-and-learn approach to understand end users more deeply and respond to their needs more effectively. Leaders should give these teams maximum freedom and visible support and nurture a culture of sharing and open communication.

Start with the end user. The best way to digitize a business process is to begin with the journey the customer takes to complete a given task and work backward. Once utilities

Exhibit 3

Digital transformations focus on key action areas

New frontiers		
Emerging themes		
• Smart grid • Smart homes • Connected buildings • Distributed generation		• Energy services • Preventive maintenance • Digital billing • Digital ecommerce

Core of the transformation		
Customer-experience design	**Digitized products & components**	**Value chain**
• Digital front-end processes • Multichannel commerce • Digital marketing and social media • Integrated digital and physical experience • Customer life-cycle management • Customer experience management	• Open innovation • Digital innovation • Intelligent products and components	• Automated back-end processes • Automated analytics and intelligence • End-to-end digitization • Workforce productivity

Technical and organizational principles	
Technology	**Organization and culture**
• System and data architecture (two-speed IT) • Mobile interactive devices • Connectivity • Big data and advanced analytics • Data security	• Project culture • Cross-functional cooperation • Flat hierarchies • Digital talent • Agility

SOURCE: McKinsey analysis

understand how customers interact with them at each touchpoint, they can shift their focus from functions or products to customer journeys. By doing so, one company streamlined its product portfolio by 30 percent, established a customer-friendly digital channel for its core products, and improved customer satisfaction by 10 percent.

Establish two-speed IT. A digital transformation must preserve the IT architecture and processes that support day-to-day business operations while introducing a flexible new environment that can respond to changes in portals, mobile apps, and other aspects of the end-user interface. Creating a two-speed IT infrastructure involves setting up a team, articulating the agile philosophy, and deciding on mobile platforms, development tools, and talent recruitment.

Define targets and link budgets to progress. Leading companies set clear targets and concrete budgets for their digitization efforts and measure short-term progress by defining and monitoring performance indicators such as customer growth. They give successful projects additional funding and modify or terminate lagging projects.

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Daunting though a digital transformation may seem, the opportunity is worth many times the cost and risk. Transformations can yield productivity improvements, revenue gains, better network reliability and safety, enhanced customer acquisition and retention, and entry into new business areas. They also offer a rare opportunity to rebuild strategies, structures, and processes from the ground up, helping to prepare an organization for future market challenges. ☐

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