Digital/McKinsey: Insights

Winning in digital ecosystems

Features

Winning in digital ecosystems

To meet customers' rising expectations, companies are extending their range of products and services as never before. They are also making alliances with other companies, even competitors, to create complementary networks of offerings and services. The resulting ecosystems of businesses may come to define the global economy. In this issue of *Digital McKinsey Insights*, we look at how companies can adapt.

Staking out a position in ecosystems is important, because enormous value could be up for grabs. McKinsey experts believe that by 2025, some $60 trillion in annual revenue could be redistributed across the economy—one-third of that year's total. This dynamic is playing out in the high tech, media, and telecom sector, where tech giants have built platforms on which entire ecosystems run.

Not every company will succeed by orchestrating ecosystems. For many, joining existing ecosystems will be more effective. Whichever approach they choose, companies will need to start developing new capabilities, from "ecosystem IT" systems that link enterprises to platforms and innovative third-party services to new management skills that can handle the scale and complexity of ecosystem relationships. To explore what this kind of cooperation actually means, we take a deeper look at what is happening in the automotive and healthcare sectors, where incumbents and digital natives are sharing data and merging solutions.

The industry landscape is going through an upheaval as digital ecosystems take shape. To win, companies will need to embrace new relationships and ways of collaborating.

Competing in a world of sectors without borders

Venkat Atluri, Miklós Dietz, and Nicolaus Henke

Digitization is causing a radical reordering of traditional industry boundaries. What will it take to play offense and defense in tomorrow's ecosystems?

Rakuten Ichiba is Japan's single largest online retail marketplace. It also provides loyalty points and e-money usable at hundreds of thousands of stores, virtual and real. It issues credit cards to tens of millions of members. It offers financial products and services that range from mortgages to securities brokerage. And the company runs one of Japan's largest online travel portals—plus an instant-messaging app, Viber, which has some 800 million users worldwide. Retailer? Financial company? Rakuten Ichiba is all that and more— just as Amazon and China's Tencent are tough to categorize as the former engages in e-commerce, cloud computing, logistics, and consumer electronics, while the latter provides services ranging from social media to gaming to finance and beyond.

Organizations such as these—digital natives that are not defined or constrained by any one industry—may seem like outliers.

How applicable to traditional industries is the notion of simultaneously competing in multiple sectors, let alone reimagining sector boundaries? We would be the first to acknowledge that opportunities to attack and to win across sectors vary considerably and that industry definitions have always been fluid: technological developments cause sectors to appear, disappear, and merge. Banking, for example, was born from the merger of money exchange, merchant banking, savings banking, and safety-deposit services, among others. Supermarkets unified previously separate retail subsectors into one big "grocery" category. Changes such as these created new competitors, shifted vast amounts of wealth, and reshaped significant parts of the economy. Before the term was in vogue, one could even say the shifts were "disruptive."

Yet there does appear to be something new happening here. The ongoing digital revolution, which has been reducing frictional, transactional costs for years, has accelerated recently with tremendous increases in electronic data, the ubiquity of mobile interfaces, and the growing power of artificial intelligence. Together, these forces are reshaping customer expectations and creating the potential for virtually every sector with a distribution component to have its borders redrawn or redefined, at a more rapid pace than we have previously experienced.

Consider first how customer expectations are shifting. As Steve Jobs famously observed, "A lot of times, people don't know what they want until you show it to them." By creating a customer-centric, unified value proposition that extends beyond what end users could previously obtain (or, at least, could obtain almost instantly from one interface), digital

pioneers are bridging the openings along the value chain, reducing customers' costs, providing them with new experiences, and whetting their appetites for more.

We've all experienced businesses that once seemed disconnected fitting together seamlessly and unleashing surprising synergies: look no further than the phone in your pocket, your music and video in the cloud, the smart watch on your wrist, and the TV in your living room. Or consider the 89 million customers now accessing Ping An Good Doctor, where on a single platform run by the trusted Ping An insurance company they can connect with doctors not only for online bookings but to receive diagnoses and suggested treatments, often by exchanging pictures and videos. What used to take many weeks and multiple providers can now be done in minutes on one app.

Now nondigital natives are starting to think seriously about their cross-sector opportunities and existential threats that may lurk across boundaries. One example: We recently interviewed 300 CEOs world-wide, across 37 sectors, about advanced data analytics. Fully one-third of them had cross-sector dynamics at top of mind. Many worried, for instance, that "companies from other industries have clearer insight into my customers than I do." We've also seen conglomerates that until recently had thought of themselves as little more than holding companies taking the first steps to set up enterprise-wide consumer data lakes, integrate databases, and optimize the products, services, and insights they provide to their customers. Although these companies must of course abide by privacy laws—and even more, meet their users' expectations of

trust—data sets and sources are becoming great unifiers and creating new, cross-sectoral competitive dynamics.

Do these dynamics portend a sea change for every company? Of course not. People will still stroll impromptu into neighborhood stores, heavy industry (with the benefit of technological advances, to be sure) will go on extracting and processing the materials essential to our daily lives, and countless other enterprises beyond the digital space will continue to channel the ingenuity of their founders and employees to serve a world of incredibly varied preferences and needs. It's obvious that digital will not—and cannot—change everything.

But it's just as apparent that its effects on the competitive landscape are already profound and that the stakes are getting higher. As boundaries between industry sectors continue to blur, CEOs—many of whose companies have long commanded large revenue pools within traditional industry lines—will face off against companies and industries they never previously viewed as competitors. This new environment will play out by new rules, require different capabilities, and rely to an extraordinary extent upon data. Defending your position will be mission critical, but so too will be attacking and capturing the opportunities across sectors before others get there first. To put it another way: within a decade, companies will define their business models not by how they play against traditional industry peers but by how effective they are in competing within rapidly emerging "ecosystems" that comprise a variety of businesses from dimensionally different sectors.

A world of digital ecosystems
As the approaching contest plays out, we believe an increasing number of industries will converge under newer, broader, and more dynamic alignments: digital ecosystems. A world of ecosystems will be a highly customer-centric model, where users can enjoy an end-to-end experience for a wide range of products and services through a single access gateway, without leaving the ecosystem. Ecosystems will comprise diverse players that provide digitally accessed, multi-industry solutions. The relationship among these participants will be commercial and contractual, and the contracts (whether written, digital, or both) will formally regulate the payments or other considerations trading hands, the services provided, and the rules governing the provision of and access to ecosystem data.

Beyond just defining relationships among ecosystem participants, the digitization of many such arrangements is changing the boundaries of the company by reducing frictional costs associated with activities such as trading, measurement, and maintaining trust. More than 80 years ago, Nobel laureate Ronald Coase argued that companies establish their boundaries on the basis of transaction costs like these: when the cost of transacting for a product or service on the open market exceeds the cost of managing and coordinating the incremental activity needed to create that product or service internally, the company will perform the activity in-house. As digitization reduces transaction costs, it becomes economical for companies to contract out more activities, and a richer set of more specialized ecosystem relationships is facilitated.

Rising expectations
Those ecosystem relationships, in turn, are making it possible to better meet rising customer expectations. The mobile Internet,

As boundaries between industry sectors continue to blur, CEOs will face off against companies and industries they never previously viewed as competitors.

the data-crunching power of advanced analytics, and the maturation of artificial intelligence (AI) have led consumers to expect fully personalized solutions, delivered in milliseconds. Ecosystem orchestrators use data to connect the dots—by, for example, linking all possible producers with all possible customers, and, increasingly, by predicting the needs of customers before they are articulated. The more a company knows about its customers, the better able it is to offer a truly integrated, end-to-end digital experience and the more services in its ecosystem it can connect to those customers, learning ever more in the process. Amazon, among digital natives, and Centrica, the British utility whose Hive offering seeks to become a digital hub for controlling the home from any device, are early examples of how pivotal players can become embedded in the everyday life of customers.

For all of the speed with which sector boundaries will shift and even disappear, courting deep customer relationships is not a one-step dance. Becoming part of an individual's day-to-day experience takes time and, because digitization lowers switching costs and heightens price transparency, sustaining trust takes even longer. Over that

time frame, significant surplus may shift to consumers—a phenomenon already underway, as digital players are destroying billions to create millions. It's also a process that will require deploying newer tools and technologies, such as using bots in multidevice environments and exploiting AI to build machine-to-machine capabilities. Paradoxically, sustaining customer relationships will depend as well on factors that defy analytical formulas: the power of a brand, the tone of one's message, and the emotions your products and services can inspire.

Strategic moves

The growing importance of customer-centricity and the appreciation that consumers will expect a more seamless user experience are reflected in the flurry of recent strategic moves of leading companies across the world. Witness Apple Pay; Tencent's and Alibaba's service expansions; Amazon's decisions to (among other things) launch Amazon Go, acquire Whole Foods, and provide online vehicle searches in Europe; and the wave of announcements from other digital leaders heralding service expansion across emerging ecosystems. Innovative financial players such as CBA (housing and B2B services), mBank

(B2C marketplace), and Ping An (for health, housing, and autos) are mobilizing. So are telcos, including Telstra and Telus (each playing in the health ecosystem), and retailers such as Starbucks (with digital content, as well as seamless mobile payments and preordering). Not to be left out are industrial companies such as GE (seeking to make analytics the new "core to the company") and Ford (which has started to redefine itself as "a mobility company and not just as a car and truck manufacturer").[1] We've also seen ecosystem-minded combinations such as Google's acquisition of Waze and Microsoft's purchase of LinkedIn.

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[1] See Nicolaus Henke, Ari Libarikian, and Bill Wiseman, "Straight talk about big data," *McKinsey Quarterly,* October 2016; and "Bill Ford charts a course for the future," *McKinsey Quarterly,* October 2014, both available on McKinsey.com.

EXHIBIT 1

New ecosystems are likely to emerge in place of many traditional industries by 2025.

Ecosystem illustration, estimated total sales in 2025,[1] $ trillion
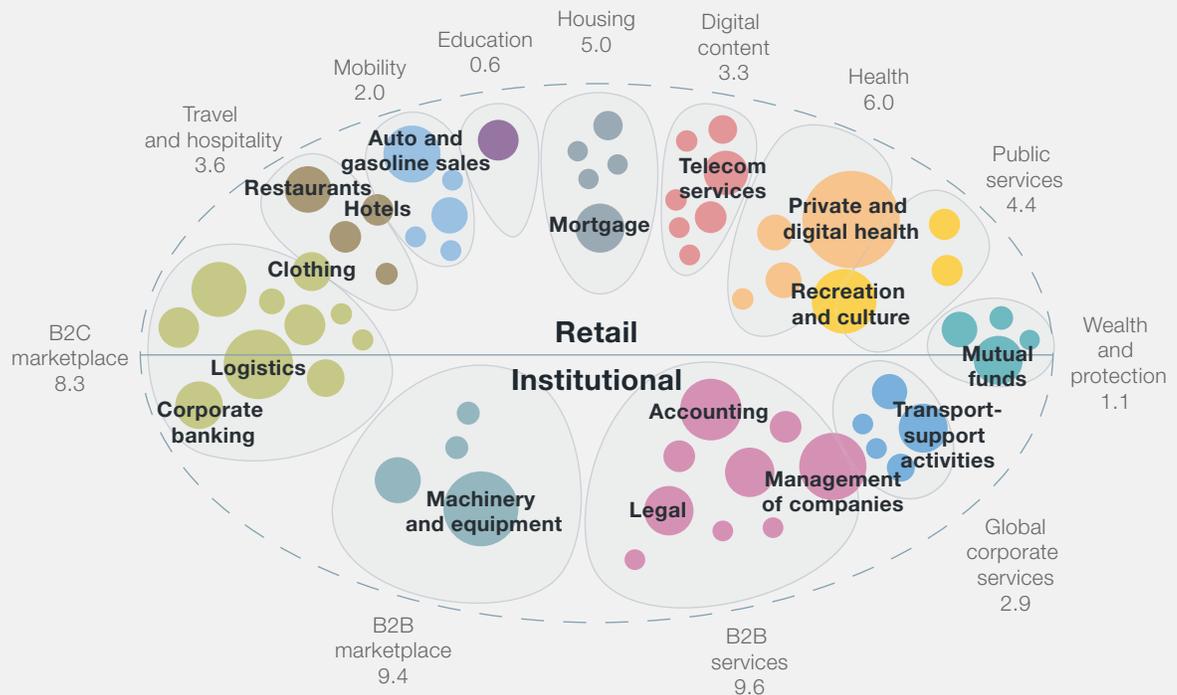
[1]Circle sizes show approximate revenue-pool sizes. Additional ecosystems are expected to emerge in addition to the those depicted; not all industries or subcategories are shown.

Source: IHS World Industry Service; Panorama by McKinsey; McKinsey analysis

Many of these initiatives will seem like baby steps when we look back a decade from now, but they reveal the significance placed by corporate strategists on the emergence of a new world.

While it might be tempting to conclude as a governing principle that aggressively buying your way into new sectors is the secret spice for ecosystem success, massive combinations can also be recipes for massive value destruction. To keep your bearings in this new world, focus on what matters most—your core value propositions, your distinct competitive advantages, fundamental human and organizational needs, and the data and technologies available to tie them all together. That calls for thinking strategically about what you can provide your customers within a logically connected network of goods and services: critical building blocks of an ecosystem, as we've noted above.

Value at stake

Based on current trends, observable economic trajectories, and existing regulatory frameworks, we expect that within about a decade, 12 large ecosystems will emerge in retail and institutional spaces. Their final shape is far from certain, but we suspect they could take something like the form presented in the sidebar.

The actual shape and composition of these ecosystems will vary by country and region, both because of the effects of regulations and as a result of more subtle, cultural customs and tastes. We already see in China, for example, how a large base of young, tech-savvy consumers, a wide amalgam of low-efficiency traditional industries, and, not least, a powerful regulator have converged to give rise to leviathans such as Alibaba and Tencent—ideal for the Chinese market but not (at least, not yet) able to capture significant share in other geographies (see sidebar, "China by the numbers").

The value at stake is enormous. The World Bank projects the combined revenue of global businesses will be more than $190 trillion within a decade. If digital distribution (combining B2B and B2C commerce) represents about one-half of the nonproduction portion of the global economy by that time, the revenues that could, theoretically, be redistributed across traditional sectoral borders in 2025 would exceed $60 trillion—about 30 percent of world revenue pools that year. Under standard margin assumptions, this would translate to some $11 trillion in global profits, which, once we subtract approximately $10 trillion for cost of equity, amounts to $1 trillion in total economic profit.[2]

Snapshots of the future

Again, it's uncertain how much of this value will be reapportioned between businesses and consumers, let alone among industries, sectors, and individual companies, or whether and to what extent governments will take steps to weigh in. To a significant degree, many of the steps that companies are taking and contemplating are defensive in nature—fending off newer entrants, by using data and customer relationships to shore up their

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[2] Our conclusions, which we arrived at by analyzing 2025 profit pools from a number of different perspectives, are based upon several base expectations about the coming integrated network economy, including average profit margin and return on equity (for each, we used the world's top 800 businesses today, excluding manufacturing initiatives), as well as the cost of equity (which we derived from more than 35,000 global companies based upon their costs of equity in January 2017).

China by the numbers

China has unique regulatory, demographic, and developmental features—particularly the simultaneity with which its economy has modernized and digitized—that are accelerating the blurring of sector borders. Still, the numbers speak for themselves and help suggest both the scale that digital ecosystems can quickly reach and the patterns likely to take hold elsewhere as ecosystem orchestrators in other countries stretch into roles approximating those played by Alibaba, Baidu, Ping An, and Tencent.

Alibaba

120 billion
assets under management by Yu'E Bao[1]

175 million
total Alipay transactions in one day[2]

44%
of global mobile-wallet spending, achieved by Alipay[3]

Baidu

346 million
online users

130 million
users of Ping An Good Doctor[4]

25 million
unique visitors daily to autohome.com.cn

Tencent

889 million
WeChat users[5]

70 minutes
spent every day by average WeChat user[6]

61%
of users open WeChat more than 10 times every day[7]

46 billion
"red packets" sent via WeChat for the Lunar New Year[8]

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[1] As of September 2016.
[2] As of August 2016.
[3] In 2016; see *Global Payments Report 2016*, Worldpay, November 8, 2016, worldpay.com.

[4] As of March 2017.
[5] As of Q4 2016.
[6] As of March 2016.
[7] As of June 2016.

[8] For Lunar New Year falling in 2017; see "WeChat users send 46 billion digital red packets over Lunar New Year—Xinhua," Reuters, February 6, 2017, reuters.com.

Large Chinese players have expanded their digital presence by 'land grabbing.'

Selected examples   Alibaba   Baidu   Tencent

2000

Market, consumption	Search	Messaging

2017

Market, consumption	Search	Messaging
Alibaba.com, Taobao, Tmall	Baidu Map, Baidu Search	QQ, WeChat
Baidu Wei Gou, Wanda e-commerce	Sogou	
We Store, Xi Yuan		

Dining	Entertainment, gaming	Finance
Ele.me	Alibaba Games, Alibaba Music, Alibaba Picture	Ant Financial Services Group
Baidu Nuomi, Baidu Takeout Delivery	Baidu Games, Baidu Music, Baidu Video, iQIYI	Baidu Consumer Credit, Baidu Wallet, Baidu Wealth Management
Meituan-Dianping	QQ Music, Tencent Games, Tencent Video	Caifutong, Tenpay, WeBank

Healthcare	News, encyclopedia	Transportation
Alihealth	Baidu Baike, Baidu News	
Ding Xiang Yuan		Didi Chuxing[1]

[1] Formed by merger of Didi Dache (backed by Tencent) and Kuaidi Dache (backed by Alibaba) and acquisition of Uber (backed by Baidu).

Source: Company websites

core. As incumbents and digital natives alike seek to secure their positions while building new ones, ecosystems are sure to evolve in ways that surprise us. Here is a quick look at developments underway in three of them.

Consumer marketplaces

By now, purchasing and selling on sites such as Alibaba, Amazon, and eBay are almost instinctive; retail has already been changed forever. But we expect that the very concept of a clearly demarcated retail sector will be radically altered within a decade. Three critical, related factors are at work.

First, the frame of reference: what we think of now as one-off purchases will more properly be understood as part of a consumer's passage through time—the accumulation of purchases made from day to day, month to month, year to year, and ultimately the way those interact over a lifetime. Income and wealth certainly have predictive value for future purchases, but behavior matters even more. Choices to eat more healthily, for example, correlate to a likelihood for higher consumption of physical fitness gear and services, and also to a more attractive profile for health and life insurers, which should result in more affordable coverage.

The second major factor, reinforcing the first, is the growing ability of data and analytics to transform disparate pieces of information about a consumer's immediate desires and behavior into insight about the consumer's broader needs. That requires a combination of capturing innumerable data points and turning them, within milliseconds, into predictive, actionable opportunities for both sellers and buyers. Advances in big data analytics, processing power, and AI are already making such connections possible.

This all generates a highly robust "network factor"—the third major force behind emerging consumer marketplaces. In a world of digital networks, consumer lenders, food and beverage providers, and telecom players will simultaneously coexist, actively partner, and aggressively move to capture share from one another. And while digitization may offer the sizzle, traditional industries still have their share of the steak. These businesses not only provide the core goods and services that end users demand, but also often have developed relationships with other businesses along the value chain and, most important, with the end users themselves. Succeeding in digital marketplaces will require these companies to stretch beyond their core capabilities, to be sure, but if they understand the essentials of what's happening and take the right steps to secure and expand their relationships, nondigital businesses can still hold high ground when the waves of change arrive.

B2B services

The administrative burdens of medium, small, and microsize companies are both cumbersome and costly. In addition to managing their own products and services, these businesses (like their larger peers) must navigate a slew of necessary functions including human resources, tax planning, legal services, accounting, finance, and insurance.

Today, each of these fields exists as an independent sector, but it's easy to imagine them converging within a decade on shared, cloud-based platforms that will serve as one-stop shops. With so many service providers available at the ease of a click, all with greater transparency on price, performance, and reputation, competition will ramp up and established players can anticipate more challengers from different

Different sectors come into play at every stage of the mobility ecosystem.

- Finance
- Service marketplace
- Government
- Insurance
- Retail marketplace
- Information marketplace

Search

Search and receive finance terms	Research vehicles
Search dealers	Test drive at dealer

Acquire

Obtain financing	Obtain insurance	Purchase or lease vehicle
Calculate registration fee and register vehicle	Calculate and pay taxes	Purchase service terms

Maintain

Adjust insurance dynamically based on vehicle condition	Purchase accessories and auto parts

Use

Adjust finance terms dynamically based on market	Adjust insurance dynamically based on driving history	Use mapping or GPS
Gain or use rewards points	Purchase gas	Schedule inspections and update registration
Purchase maintenance services	Purchase or schedule car washing (pick up car and deliver it cleaned)	Automatically track vehicle and component condition, to schedule service

Collaborate

Purchase accessories and auto parts	Adjust licensing if using car as rideshare driver
Use app to participate in car sharing	Use app to monetize vehicle (eg, ridesharing)

Sell

Benefit from new purchaser's ability to finance	Transition insurance coverage to next vehicle	List car for sale on platforms that connect potential buyers and sellers
Sell car	Register sale	Research car value (based on condition, mileage, model, geography, similar cars)

Source: Panorama by McKinsey

To keep your bearings in this new world, focus on what matters most—core value propositions, competitive advantages, human and organizational needs, and the data and technologies to tie them together.

directions. At the same time, it's likely that something approaching a genuine community will develop, with businesses being able to create partnerships and tap far more sophisticated services than they can at present—including cash-planning tools, instant credit lines, and tailored insurance.

Already, we can glimpse such innovations starting to flourish in a range of creative solutions. Idea Bank in Poland, for example, offers "idea hubs" and applications such as e-invoicing and online factoring. ING's commercial platform stretches beyond traditional banking services to include (among other things) a digital loyalty program and crowdfunding. And Lloyds Bank's Business Toolbox includes legal assistance, online backup, and email hosting. As other businesses join in, we expect the scope and utility of this space to grow dramatically.

Mobility
Finally, consider personal mobility, which encompasses vehicle purchase and maintenance management, ridesharing, carpooling, traffic management, vehicle

connectivity, and much more. The individual pieces of the mobility puzzle are starting to become familiar, but it's their cumulative impact that truly shows the degree to which industry borders are blurring (exhibit).

Emerging priorities for the borderless economy
These glimpses of the future are rooted in the here and now, and they are emblematic of shifts underway in most sectors of the economy—including, more likely than not, yours. We hope this article is a useful starting point for identifying potential industry shifts that could be coming your way. Recognition is the first step, and then you need a game plan for a world of sectors without borders. The following four priorities are critical:

- **Adopt an ecosystem mind-set.** The landscape described in this article differs significantly from the one that still dominates most companies' business planning and operating approaches. Job one for many companies is to broaden their view of competitors and opportunities so that it is truly multisectoral, defines the

ecosystems and industries where change will be fastest, and identifies the critical new sources of value most meaningful for an expanding consumer base. In essence, you must refine your "self vision" by asking yourself, and your top team, questions such as: "What surprising, disruptive boundary shifts can we imagine—and try to get ahead of?" and "How can we turn our physical assets and long-established customer relationships into genuine consumer insights to secure what we have and stake out an advantage over our competitors—including the digital giants?" That shift will necessarily involve an important organizational component, and leaders should expect some measure of internal resistance, particularly when existing business goals, incentives, and performance-management principles do not accord with new strategic priorities. It will also, of course, require competitive targeting beyond the four walls of your company. But resist the impulse to just open up your acquisition checkbook. The combinations that make good sense will be part of a rational answer to perennial strategic questions about where and how your company needs to compete—playing out on an expanding field.

- **Follow the data.** In our borderless world, data are the coins of the realm. Competing effectively means both collecting large amounts of data and developing capabilities for storing, processing, and translating the data into actionable business insights. A critical goal for most companies is data diversity—achieved, in part, through partnerships—which will enable you to pursue ever-finer microsegmentation and create more value

in more ecosystems. Information from telecommunications-services players, for example, can help banks to engage their customers and make a variety of commercial decisions more effectively. Deeper data insights are finally beginning to take ideas that had always seemed good but too often fell short of their potential to turn into winning models. Consider loyalty cards: by understanding customers better, card providers such as Nectar, the largest loyalty program in the United Kingdom, and Plenti, a rewards programs introduced by American Express, can connect hundreds of companies of all sizes and across multiple industries to provide significant savings for consumers and new growth opportunities for the businesses that serve them. Meanwhile, the cost of sharing data is falling as cloud-based data stores proliferate and AI makes it easier to link data sets to individual customers or segments. Better data can also support analytically driven scenario planning to inform how ecosystems will evolve, at which points along the value chain your data can create value, and whether or where you can identify potential "Holy Grail" data assets. What data points and sources are critical to your business? How many do you have? What can you do to acquire or gain access to the rest? You should be asking your organization questions like these regularly.

- **Build emotional ties to customers.** If blurring sector boundaries are turning data into currency, customer ownership is becoming the ultimate prize. Companies that lack strong customer connections run the risk of disintermediation and perhaps of becoming "white-label back offices" (or

production centers), with limited headroom to create or retain economic surplus. Data (to customize offerings), content (to capture the attention of customers), and digital engagement models (to create seamless customer journeys that solve customer pain points) can all help you build emotional connections with customers and occupy attractive roles in critical ecosystems. You should continually be asking your organization, "What's our plan for using data, content, and digital-engagement tools to connect emotionally with customers?" and "What else can we provide, with simplicity and speed, to strengthen our consumer bond?" After all, Google's launch of initiatives such as Chrome and Gmail, and Alibaba's introduction of enterprises such as Alipay and the financial platform Yu'E Bao, weren't executed merely because they already had a huge customer base and wanted to capture new sources of revenue (although they did succeed in doing so). They took action to help ensure they would keep—and expand—that huge customer base.

- **Change your partnership paradigm.** Given the opportunities for specialization created by an ecosystem economy,

companies need more and different kinds of partners. In at least a dozen markets worldwide—including Brazil, Turkey, and several countries in Asia, where in many respects data are currently less robust than they are in other regions—we're seeing a new wave of partnership energy aimed at making the whole greater than the sum of its parts. Regardless of your base geography, core industry, and state of data readiness, start by asking what white spaces you need to fill, what partners can best help with those gaps, and what "gives" and "gets" might be mutually beneficial. You'll also need to think about how to create an infrastructural and operational framework that invites a steady exchange with outside entities of data, ideas, and services to fuel innovation. Don't forget about the implications for your information architecture, including the APIs that will enable critical external linkages, and don't neglect the possibility that you may need to enlist a more natural integrator from across your partnerships, which could include a company more appropriate for the role, such as a telco, or a third-party provider that can more effectively connect nondigital natives. And don't assume that

if you were to acquire a potential partner, you'd necessarily be adding and sustaining their revenues on a dollar-for-dollar basis over the long term.

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No one can precisely peg the future. But when we study the details already available to us and think more expansively about how fundamental human needs and powerful technologies are likely to converge going forward, it is difficult to conclude that tomorrow's industries and sector borders will look like today's. Massive, multi-industry ecosystems are on the rise, and enormous amounts of value will be on the move. Companies that have long operated with relative insularity in traditional industries may be most open to cross-boundary attack. Yet with the right strategy and approach, leaders can exploit new openings to go on offense, as well. Now is the time to take stock and to start shaping nascent opportunities. ◆

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How tech giants deliver outsize returns—and what it means for the rest of us

Tushar Bhatia, Mohsin Imtiaz, Eric Kutcher, and Dilip Wagle

Networks and platforms reign within high tech, media, and telecom. Understanding the sector's dynamics is increasingly important for executives in all industries.

The ability of technology, media, and telecommunications (TMT) companies to create value is extraordinary. TMT companies generate more economic profit (net operating profit less the cost of capital) than any other sector of the global economy—more than the combined economic profit of companies in aerospace and defense, automotive components, and food products (Exhibit 1).

What makes TMT so profitable is a combination of unique factors, notably continuing advances in digital technology that open new markets, stimulate growth, and provide opportunities for companies that seize leadership positions to capture enormous value.

Yet a closer look at value creation across TMT also reveals a distinctive pattern: significant

concentration of economic profit at the top, a rapidly rising middle tier of value-creating companies, and considerable turnover among top players.

As more industries adopt digitally enabled business models—consider, for example, the impact of Amazon in retail, Uber in transportation, and Airbnb in lodging—will this pattern be repeated in other sectors?

While it is too early to say for sure, the way value is created in TMT, as well as how digital technologies shape value pools, is increasingly relevant to leaders across the global economy.

An astounding record of value creation

Based on our research of more than 2,400 publicly traded companies around the world, we estimate that the economic

TMT is unique in its value creation.

Average economic profit by industry,
2010–14, $ billion
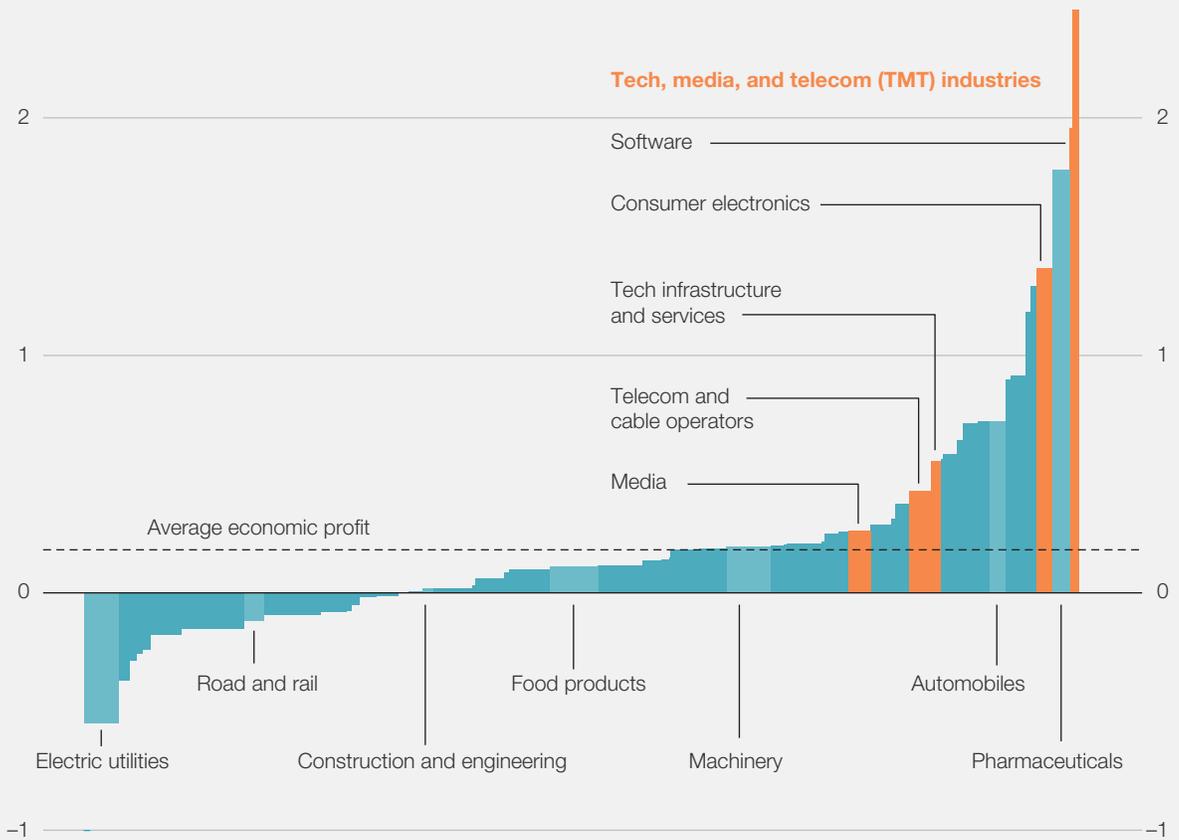
Source: McKinsey analysis of 2,414 public companies across 59 industries from 2000–14

EXHIBIT 2

TMT economic profit has grown exponentially, increasing more than 100-fold from 2000 to 2014.

Net economic profit for tech, media, and telecom (TMT) companies, $ billion

2010–14

258 | −44 | 214

2005–09

157 | −43 | 114

2000–04

73 | −71 | 2

| Positive | Negative | Net | Positive | Negative | Net | Positive | Negative | Net |
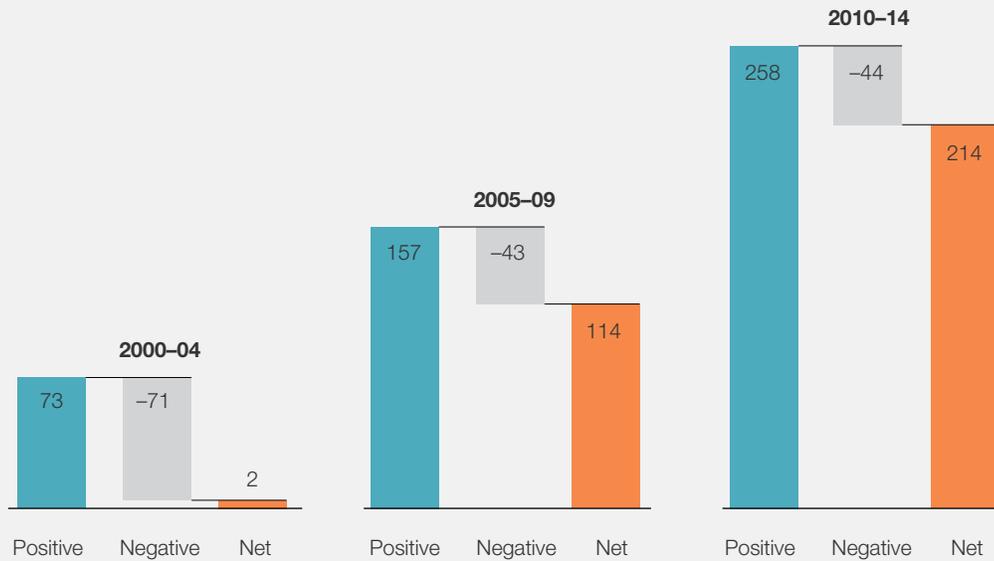
TMT companies creating value, %

45   60   70

2000–04   **2005–09**   **2010–14**
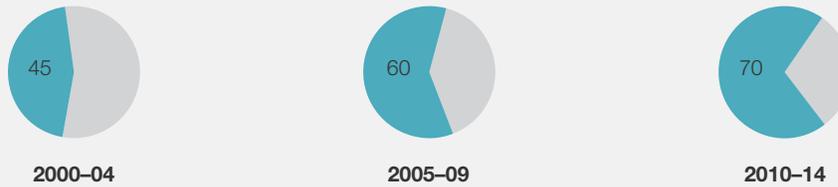
Source: McKinsey analysis of 2,414 public companies across 59 industries from 2000–14

profit generated by TMT companies grew 100-fold, or by $200 billion, from 2000 to 2014. Some 70 percent of the companies in our sample generated economic profits in the 2010–14 period, up from 45 percent in the 2000–04 period (Exhibit 2).

Moreover, each of the five subsectors that make up TMT (software, consumer electronics,

media, telecom and cable operators, and technology infrastructure and services providers) was among the most profitable of the 59 industries analyzed (Exhibit 3).

The fastest profit growth was among software companies and companies with software-enabled business models, such as Amazon, Tencent, and other "platform" enterprises.

EXHIBIT 3

Every subsegment of TMT is filled with success stories, most prominently within the software industry.

Companies with positive economic profit in tech, media, and telecom (TMT), 2010–14, %

Consumer electronics	Telecom and cable operators	Media	Tech infrastructure and services	**Software**
64	68	69	77	81
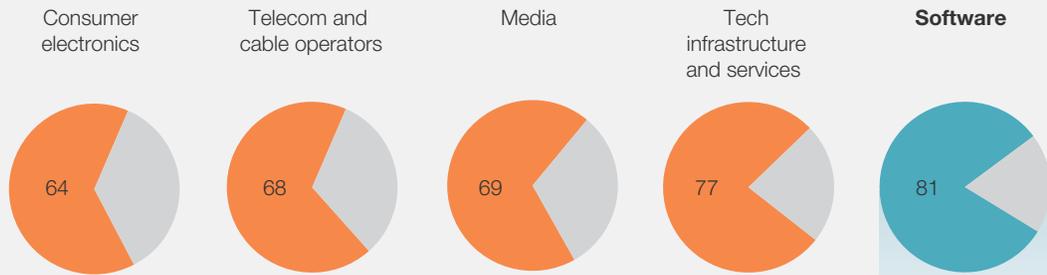
Average annual economic profit in software, 2010–14, $ billion

| | 0% | 20 | 40 | 60 | 80 | 100% |

Bottom quintile

Middle quintile

Top quintile

Average annual positive economic profit in software, 2010–14, %

| 10 | 25 | 65 |
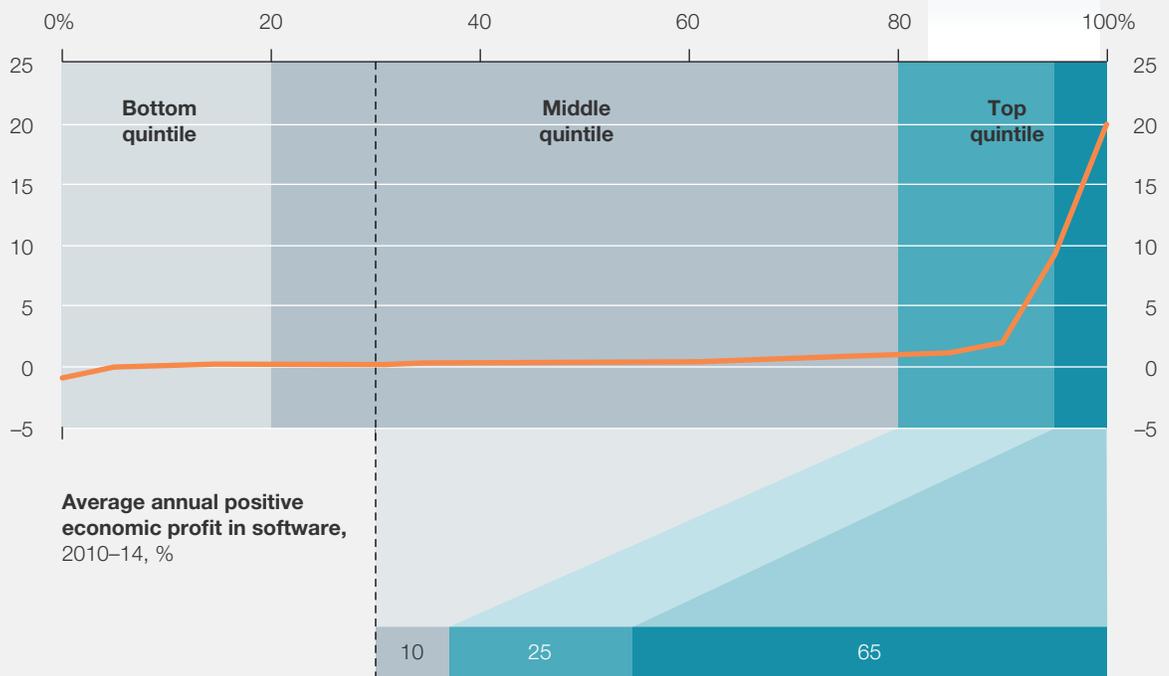
~90% of the positive economic profit comes from the top 20% of software companies

~65% comes from the top 5% of software companies

Source: McKinsey analysis of 2,414 public companies across 59 industries from 2000–14

EXHIBIT 4

Economic profit in TMT is highly concentrated in the upper regions of the top quintile.

Average annual economic profit in tech, media, and telecom (TMT),[1]
2010–14, $ billion

Bottom quintile

Middle quintile

Top quintile

▶ 70% of companies in TMT create value

Average annual positive economic profit in TMT, 2010–14, %

Most of TMT's profit is from a few winners

| 15 | 25 | 60 |

~**85%** of the positive economic profit comes from the **top 20%** of TMT companies

~**60%** comes from the **top 5%** of TMT companies
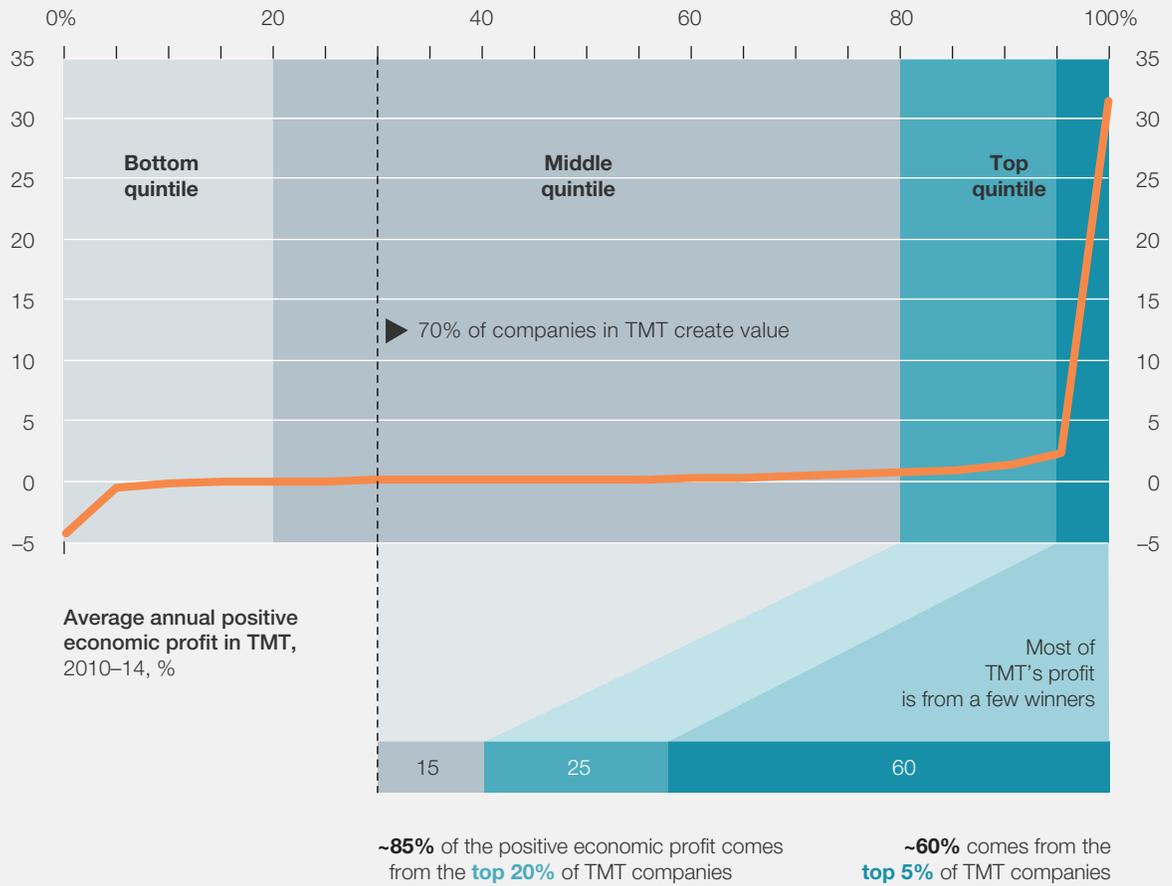
Cumulative economic profit in TMT, $ billion

−43   42   67   148
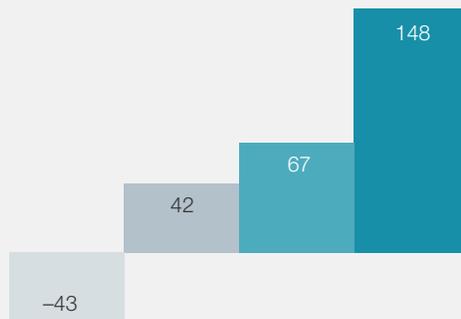
Average economic profit in TMT, $ million

−683   159   1,140   7,042
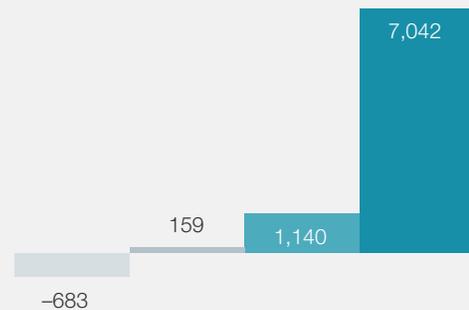
[1]Bottom-quintile upper limit = −$53 million; middle-quintile upper limit = $672 million; n = 417.

Source: McKinsey analysis of 2,414 public companies across 59 industries from 2000–14

Increasingly, the ranks of top players in TMT are populated by companies that have managed to create and scale successful platforms that benefit from network effects.

The economic profit of value-creating software companies grew nearly sixfold from the 2000–04 period to the 2010–14 period (rising from $5.8 billion to $33.7 billion).

Winners take most

Economic profit across TMT is concentrated, reflecting greater benefits of scale than in other sectors. This is seen in a range of TMT products and services, from smartphones to social media. In the 2010–14 period, the top 20 percent of companies captured 85 percent of the economic profit in TMT industries. The top 5 percent of companies—including tech giants such as Apple, Microsoft, and Alphabet (Google's parent)—generated 60 percent (Exhibit 4).

Increasingly, the ranks of top players in TMT are populated by companies that have managed to create and scale successful platforms that benefit from network effects. These can be technology platforms (for example, Apple's iOS), marketplaces (for example, Apple's app store), or platforms of another type—but in each case these winning platforms increasingly exploit "network effects," which means the value of the product, service, or underlying technology increases when more people use it. The more you use Facebook,

for instance, the more your friends will use it. There are also indirect network effects, which involve the creation of complementary products or services—the app markets that have grown up around smartphones and tablets, for example, or social gaming that is enabled by social networks.

Network effects contribute to concentration by creating barriers to entry and tying customers to the largest players: it's much harder to switch to a different smartphone if doing so means you have to give up all your apps, for example. However, it should also be noted that scale and network effects do not confer permanent advantages, and large companies can lose their leads if they don't keep up with technological shifts and innovation.

The rising middle tier

While the largest companies in TMT capture the majority of the economic profit, they also nurture a middle tier of companies that benefit from their networks. A growing group of middle-tier companies (in the 20th to 80th percentiles in terms of economic profit) is leading the sector in profit growth. Middle-tier companies' economic profits grew by a factor of ten between the 2000–04 period and the

EXHIBIT 5

TMT's middle tier creates significant value.

**Distribution of positive economic profit in tech, media, and telecom (TMT),**
$ billion
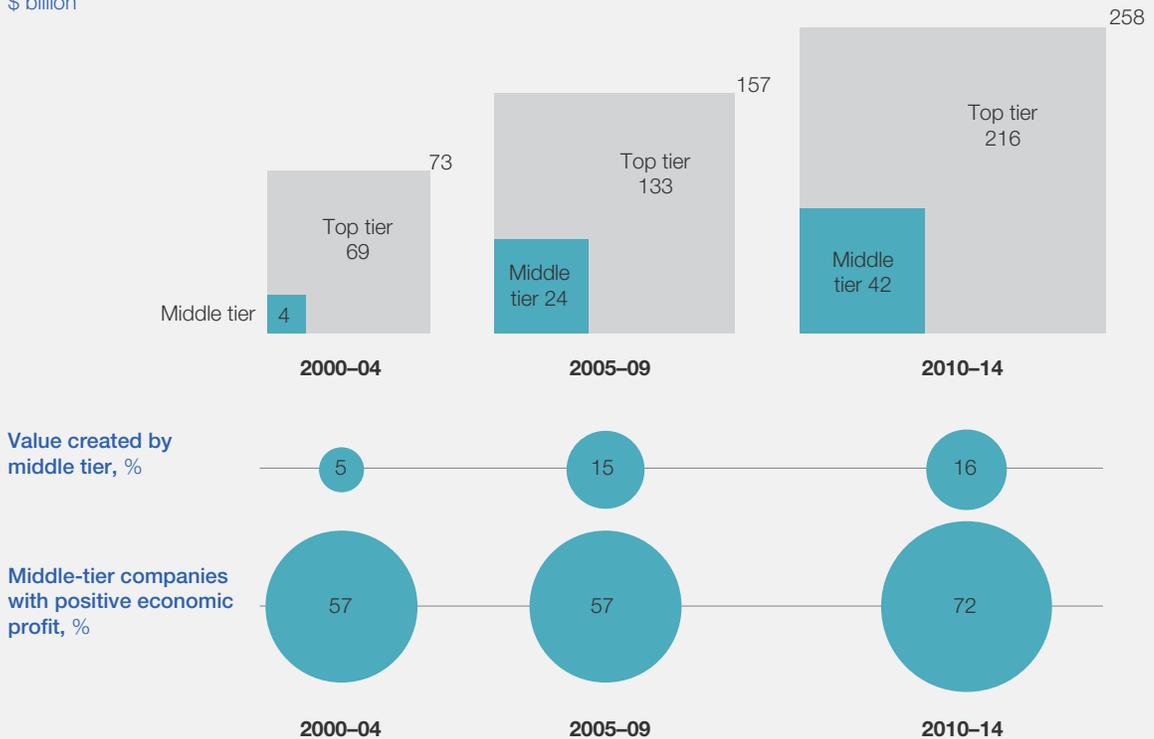
Source: McKinsey analysis of 2,414 public companies across 59 industries from 2000–14

2010–14 period, or more than three times the growth rate of technology giants (Exhibit 5).

The rising middle tier includes software and cloud services companies, as well as many players with software-enabled business models. Middle-tier players include Box, Baidu, Netflix, and WeChat. We see the growth of these and other middle-tier companies as fueled by a number of factors. Some have

latched onto existing platforms and designed business models that scale rapidly. Others are disrupting non-TMT profit pools, such as retail. Many are using programmatic M&A to move into adjacent industries.

Success can be fleeting: More profits, but also more flux and less stability

When a new technology appears or technology enables a new business model—using Uber

EXHIBIT 6

A far smaller percentage of TMT top-quintile companies from 2000 remain in the top quintile in 2014 compared with other industries.

All industry historic distribution, %

	Bottom 20% in 2014	Middle 60% in 2014	Top 20% in 2014
Top 20% in 2000	14	27	59
Middle 60% in 2000	14	78	8
Bottom 20% in 2000	43	41	16
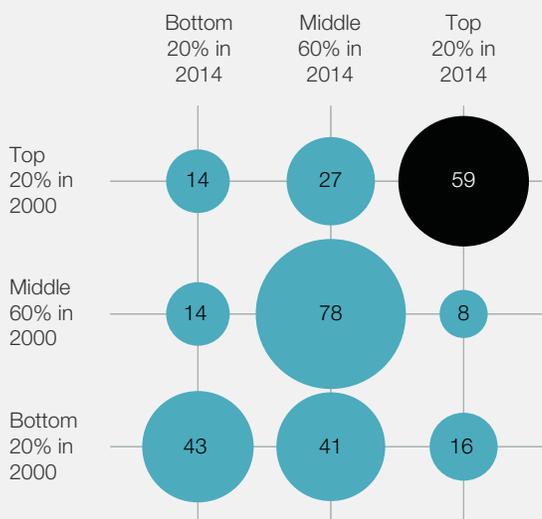
Tech, media, and telecom (TMT) historic distribution,[1] %

	Bottom 20% in 2014	Middle 60% in 2014	Top 20% in 2014
Top 20% in 2000	10	45	45
Middle 60% in 2000	19	70	11
Bottom 20% in 2000	36	43	20
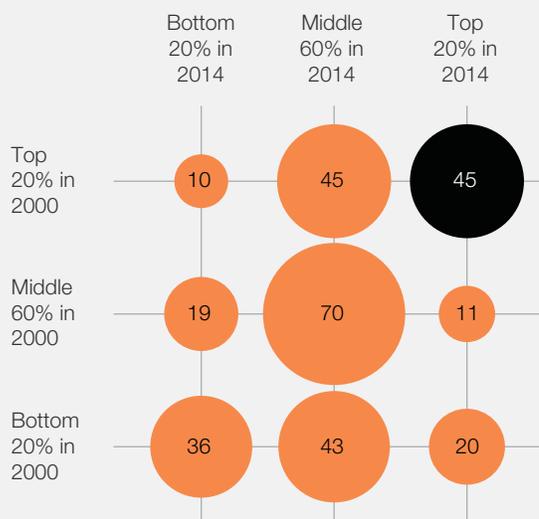
[1]Figures may not sum to 100%, because of rounding.

Source: McKinsey analysis of 2,414 public companies across 59 industries from 2000–14

to order a ride from your smartphone, for example—new profit pools open up. But old ones also come under attack. While the top 20 percent of TMT companies consistently capture an outsized share of profits, life at the top can be short.

Taking our data set as a whole, across all industries, nearly 60 percent of companies that were in the top quintile in economic profit in 2000 were still in the top quintile 15 years later.

In TMT industries, though, only 45 percent of top players from 2000 remained in the top quintile in 2014. The flip side is that over the same period, the percentage of companies that started in the bottom quintile and ended up in the top quintile was greater for TMT industries (20 percent) than for all industries (16 percent) (Exhibit 6).

This churn is explained in part by rapidly changing dynamics within TMT profit pools.

For example, within telecommunications, value capture shifted decisively from fixed line to mobile connectivity. In media, print and TV advertising evaporated, while mobile and online advertising soared. In consumer electronics, virtually all the economic profit shifted to two smartphone companies—Apple and Samsung—although the smartphone segment now could be showing signs of vulnerability.

Today some of the biggest value shifts are occurring in software and in software and Internet-enabled services. Traditional software players, such as Adobe, Symantec, and SAP, have high profit but low market-cap growth. Compare this with the medium growth in market cap of software-as-a-service players, such as Box, Salesforce, Slack, and Splunk, or with the more than 100 percent market-cap growth from 2012 to 2015 of companies such as Alibaba and Amazon that are providing digital services beyond TMT. Additionally, we see value shifting from the infrastructure layer to applications providers as software applications increasingly enable and monetize the unique functionality demanded by customers.

Implications for tech, media, and telecommunications companies

Against a background of rapid innovation in digital technologies, ranging from artificial intelligence and automation to the Internet of Things, we remain convinced that the TMT sector will, in the aggregate, continue to outperform other sectors. The digitalization of the global economy has only just begun.

Yet our research underlines that TMT leaders need to monitor carefully how profit pools are shifting. And they must be willing to act decisively if they want to remain among

those generating outstanding levels of economic profit.

In particular, we believe TMT companies need to build capabilities in four areas:

- establishing a strong position in one or more software or services platforms and building ecosystems around platform offerings to ensure access to the fastest-growing profit pools

- continuously evolving business models to avoid being disrupted by well-funded start-ups or existing TMT leaders expanding to new markets

- replicating successful platforms in underpenetrated or ring-fenced areas (markets or white spaces), taking proven business models to markets with greater headroom

- using programmatic M&A to develop capabilities to quickly attack new, rapidly growing profit pools or cannibalize profit pools in other industries; companies will need to continually reinforce and broaden their capabilities and have limited runway to develop such talent organically, particularly in areas such as cloud and analytics, where competition for talent is intense.

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It's no secret that the gales of creative destruction blow with singular strength in technology, media, and telecom. Our analysis sheds light on how this relentless turbulence shapes the sector, how companies can harness its energy, and what leaders must do to avoid being knocked off course by

unexpected gusts. As digital technologies and business models reshape more and more sectors of the global economy, the lessons are increasingly relevant beyond the blurring boundaries of TMT. ◆

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Management's next frontier: Making the most of the ecosystem economy

Jürgen Meffert and Anand Swaminathan

Engaging in digital ecosystems requires a new set of managerial skills and capabilities. How quickly companies develop them will determine if they succeed in the ecosystem economy.

Apple knows how. With its HealthKit open platform, it brings together participants from across the world of medicine—physicians, researchers, hospitals, patients, and developers of healthcare and fitness apps—to join forces in a digital ecosystem.[1] And Apple is not alone: leading ecosystem players such as Alibaba, Tencent, and Ping An are already shaping markets in China. For instance, 89 million customers use Ping An Good Doctor, a platform that connects doctors and patients for bookings, online diagnoses, and suggested treatments.[2]

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[1] See Jürgen Meffert and Anand Swaminathan, *Digital @ Scale: The Playbook You Need to Transform Your Company,* first edition, Hoboken, NJ: John Wiley & Sons, 2017.

[2] See Venkat Atluri, Miklós Dietz, and Nicolaus Henke, "Competing in a world of sectors without borders," *McKinsey Quarterly,* July 2017, McKinsey.com.

The emergence of ecosystems marks a shift in the landscape as unexpected alliances are forged, sector boundaries blur, and long-standing strengths count for less. It also marks a shift in how business leaders manage relationships within an ecosystem.

'Entangling alliances'

Relationships in an ecosystem take many forms. Some are transactional and informal, like those based on the APIs that allow systems to talk to one another to execute simple tasks.

Other relationships are more formal and complex, with contracts and service-level agreements in place to cover governance, escalation paths, and so on. Some of these relationships may be with companies that in other respects are rivals (see sidebar, "Coopetition: When competitors collaborate," for an example).

These relationships are built on myriad structures, from joint ventures to mergers, exclusive and nonexclusive partnerships, and other arrangements. As businesses scramble to find the right combination of complementary partners and allies, many are running into a thicket of "entangling alliances"—interlocking relationships that create complex competitive dynamics and lock players into platforms, technologies, and systems from which it may be difficult to extricate themselves. Graphics chipmaker Nvidia, for example, is working with eight different automakers to build embeddable computers for self-driving cars.[3]

Companies have always forged partnerships and alliances, but because relationships in ecosystems are on such a large scale and

are evolving so quickly, traditional management approaches are no longer fit for purpose. Successful companies are finding new ways to choose and manage partners and make deals.

Choosing partners

Any effective ecosystem strategy depends on understanding where the value is. That comes from calculating the value of your assets, such as customer relationships and proprietary data, and your existing capabilities and where market opportunities are emerging.

Equipped with that baseline, you can evaluate collaboration opportunities with an eye to finding capabilities, markets, and technologies that complement and support your company's strategic ambitions.

Any temptation to narrow your search to organizations in your sector or region should be resisted. A better approach is to systematically map ecosystem partners across industries, identify key criteria (such as access to new customers or capabilities), and consider likely trade-offs (such as language and market potential). Banks and retailers can make good partners, for example, because they often target similar customer segments but don't compete with each other for them.

We suggest companies follow a simple four-step process to assess potential partners:

1. Evaluate the market in which your potential partner operates and its level of competition. The most promising ecosystems involve market leaders with complementary skill sets and value propositions.

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[3] See Dave Gershgorn and Keith Collins, "The entangling alliances of the self-driving car world, visualized," *Quartz,* July 26, 2017, qz.com.

Coopetition: When competitors collaborate

Seeing rapid change in the US book market, Michael Busch, CEO of the bookstore chain Thalia, decided to band together with his competitors Hugendubel, Weltbild, and Bertelsmann. Having tried to market their own electronic readers without success, the booksellers in this emerging ecosystem needed access to technology, and so they brought Deutsche Telekom[1] on board as their technology partner (exhibit).

The partners knew their alliance had to move quickly, so they created a small core team and gave it extensive powers to make decisions and set rules for working together. The team decided that meetings would be announced 24 hours in advance, decisions had to be made within 30 minutes of the start time, and only CEOs plus one additional person per company would attend.

This new structure allowed the partners to develop the Tolino e-reader and a supporting mobile app and to invest in an advertising campaign across all digital channels. Launched in 2013, Tolino pulled level with Amazon's Kindle by 2015, with a market share in excess of 40 percent.[2]

EXHIBIT

Tolino is an alliance between German book retailers and Deutsche Telekom, with a combined 1,800 stores.

Hugendubel   Mayersche   Weltbild   Thalia   Osiander.de

Buch.de   Bucher.de   eBook.de   Meine Buchhandlung

Large store network   Established brands   Existing customer relationships   Market understanding

Tolino alliance: Complete e-reader offering

E-reader   E-bookstore   App

Established technology partner   Experience with hardware and software development

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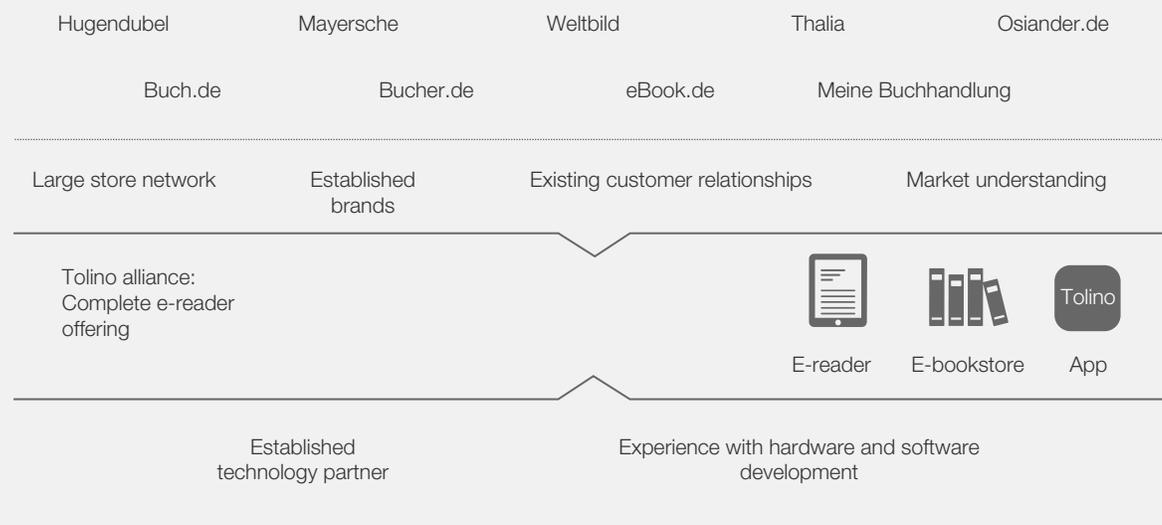
[1] In early 2017, Deutsche Telekom sold its share of Tolino to the Japanese–Canadian group Rakuten Kobo, the world's third-largest online retailer after Amazon and Alibaba. Rakuten Kobo has its own generation of e-readers and e-books.

[2] It's important to note that Tolino's success has not benefited all partners: Weltbild applied for insolvency, and Bertelsmann closed its book clubs in late 2015. On the other hand, several new partners have joined, including Libri, with its 1,300 stores, and the alliance has also expanded into Austria, Belgium, Italy, the Netherlands, and Switzerland.

To be successful, an ecosystem must have a compelling value proposition that is attractive, open, and relevant to multiple businesses.

2. Consider the company's business model. Is it fit for purpose and future-proof? What products and services does the company produce? How nimble, innovative, and customer-focused is it? Can it keep pace with you and the external environment?

3. Weigh the human factor. How strong is the company's management team? How effective are its employees?

4. Look at the culture. How does your potential partner do business? How does its way of working fit with your own company's culture?

Making deals

To be successful, an ecosystem must have a compelling value proposition that is attractive, open, and relevant to multiple businesses. Beyond that, however, forging multiple complex relationships across an ecosystem requires a substantial investment of energy and resources. Leading companies are putting in place industrial negotiating teams that are similar to central sales teams in B2B companies but include executives and managers from corporate development, management, legal, business development, and technology. Involving legal specialists in negotiating teams is particularly important, given the host of questions raised by working with third parties—questions about cybersecurity, intellectual property, data ownership, licensing, privacy, profit sharing, liability, regulatory compliance, and customer management. Companies are also likely to need people with unfamiliar technical skills, such as full-stack IT architects who can integrate multiple technologies across infrastructure, apps, and services.

The main responsibilities of the ecosystem negotiating team are to continuously review companies, reach out to prospective partners, and screen likely candidates for compatibility. The team should put in place a pipeline to track progress and hold frequent reviews at specific milestones to determine whether and how to pursue promising options and when to drop unsuccessful efforts. The team also decides on how new relationships should be structured—as joint ventures, mergers, or partnerships—depending on competitive

pressures and market opportunities. Specific leaders will need to lead these ecosystem deal teams, such as the head-of-fintech position recently created at Asian bank DBS to lead fintech engagements locally and regionally.

New processes and capabilities are needed to enable these teams to work quickly. Procurement is often a prime culprit in delays. One unfortunate fintech went out of business while waiting for a major bank to complete its 18-month procurement process. To streamline and accelerate the process, nimbler organizations are adopting new digital-procurement tools and solutions, such as work-flow tools and supplier collaboration platforms.[4] DueDil, a private-company information platform, has an API that provides company data, enabling clients to automate many aspects of data sourcing, diligence checks, and credit decisions.

A company that is dealing with hundreds of partners has no time to customize agreements and operating processes so it's important to standardize governance principles and support them with service-level agreements (SLAs), technology protocols, and simple rules. Establishing realistic (and not too onerous) requirements for software release cycles, for example, can simplify development management.

Given the role of APIs as the connective tissue in ecosystems, we're seeing some businesses create API centers of excellence. These teams oversee API design and development across the organization and manage all the APIs in a company's catalog to avoid duplication, enable reuse, and assist with developer access.

Managing partners

Many partnerships underperform because they don't have the right management infrastructure in place. Without it, people can easily get distracted by issues in their day job, become overwhelmed, or pass the buck to IT. This state of affairs can be disastrous for an ecosystem.

To counter it, companies need to invest in building an ecosystem-relationship-management (ERM) capability with dedicated staff. At its most basic level, this means answering emails promptly and fixing simple problems that partners have. More sophisticated functions include resolving more detailed issues or joint development of new products or services. Part customer service, part issue resolution, and part account management, the ERM capability is crucial to the smooth running of an ecosystem.

Another important function of ERM teams is to track performance in the ecosystems they participate in. That requires establishing common standards and metrics. Common key performance indicators (KPIs) and metrics that are agreed to and shared by ecosystem partners can help track performance and assess impact, such as traffic or revenue generated, compliance with budgets, and arrival at milestones. Companies can guard against cybersecurity breaches by setting stringent protocols for encryption and data security for themselves and their partners.

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[4] See Pierre de la Boulaye, Pieter Riedstra, and Peter Spiller, "Driving superior value through digital procurement," April 2017, McKinsey.com.

Fraud is another common problem, and one best tackled through fraud-identification systems that use algorithms and machine learning to analyze behavior (such as speed of response or volume of correspondence) and predict when an issue may arise.

Developers are among the most important stakeholders in an ecosystem, so creating the right conditions for them is crucial. Using open-source software, for example, makes it easier for developers to plug into the ecosystem. Developing clear and user-friendly onboarding processes is also helpful and should include well-organized documentation and software-development kits as well as streamlined reviews and approvals. The marketplace

launched in 2016 by BBVA Compass, a Spanish bank with a growing global presence, makes it simple for developers to build apps that interface with its back-end systems; BBVA channels the energy and creativity of fintech start-ups while retaining its leadership position within the ecosystem.[5]

The best companies go even further and invest in support channels for developers, appointing a relationship manager to provide assistance as needed, from responding to questions to supporting an entire collaboration. GE holds regular developer forums to help peers support one another. Other companies stage one-off events to provide education, introduce new features, and strengthen bonds. They also

[5] See Peter Dahlström, Driek Desmet, and Marc Singer, "The seven decisions that matter in a digital transformation: A CEO's guide to reinvention," February 2017, McKinsey.com.

make developers feel valued by giving them early access to news and releases.

It's important to bear in mind that the organization at the center of an ecosystem must be prepared to share the surplus. Greed could threaten the whole ecosystem.

Building ecosystem capabilities

Effective ecosystem management calls for a wide range of capabilities. We've found two steps particularly critical in developing them:

Invest in tools to scale ecosystem support. Managing ecosystems requires a balance between standardization (to prevent a chaotic mess) and flexibility (to capture opportunities fast). Standardizing core processes such as pipeline management, negotiation templates, and software acceptance guidelines can help accelerate the development of a successful ecosystem. At the same time, putting in place tools to track performance in real time, establishing flexible agreement structures, and investing in agile processes can give companies the flexibility they need to adapt to the changing dynamics of ecosystems.

Tracking KPIs and managing processes across what may be hundreds of partners in an ecosystem, however, is a mammoth task. The best companies are turning to automation for tracking and issue resolution, escalating to human intervention for the relatively few cases where complex judgments are needed.

Build an adaptive and collaborative culture. Embracing ecosystems requires a shift

toward collaboration. Working with partners or vendors to develop new initiatives, establishing frequent communications on progress, and institutionalizing the use of collaborative tools such as Slack and video conferencing can help cement the new mind-set. One way to help foster collaboration is to put in place protocols and incentives that reward players not for their own performance but for that of the whole ecosystem. For instance, in the marketing ecosystem of agencies and channels, some client organizations are experimenting with agency payments based not only on how effectively they deliver their services but also on their contribution to the overall success of a given initiative.[6]

Creating an incubator may be a useful option to foster a collaborative culture that the rest of the business might struggle to embrace. These ecosystem incubator teams can experiment with advanced techniques, such as using data analytics to uncover promising opportunities in real time, bringing in a range of partners to help shape new offerings, and executing quick-turnaround experiments to create bottom-line impact.[7]

Investing in open-IT architecture, APIs, and microservices will be key to developing a technical platform capable of supporting the level of flexibility and agility needed in ecosystems. At the same time, organization leaders must role-model desired behavior, such as treating ecosystem management as a top priority and spending time with external partners.

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[6] For more examples of best practices in marketing ecosystems, see Thomas Bauer, Jason Heller, Jeffrey Jacobs, and Rachael Schaffner, "How to get the most from your agency relationships in 2017," February 2017, McKinsey.com.

[7] See David Edelman, Jason Heller, and Steven Spittaels, "Agile marketing: A step-by-step guide," November 2016, McKinsey.com.

Who will profit from tomorrow's self-driving cars, real-time multichannel financial transactions, equipment for smart homes and workplaces, and health and fitness platforms? The answer is groups of businesses working together in ecosystems—and now is the time to work out how to build and manage the partnerships involved. ◆

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Photo credit/Getty Images

Adopting an ecosystem view of business technology

Driek Desmet, Niels Maerkedahl, and Parker Shi

To fully benefit from new business technology, CIOs need to adapt their traditional IT functions to the opportunities and challenges of emerging technology ecosystems. Here's how it's done.

IT has traditionally functioned as the foundation to keep a company running. One of its core functions has been to protect company operations with firewalls and encryption to keep external technologies out. With the advance of technologies, however, a vast array of capabilities and sources of competitive advantage are emerging beyond a business' traditional walls. Those capabilities are coalescing in a wealth of new ecosystems (Exhibit 1).

These ecosystems often overlap. A social payment app, for example, may be part of the mobile, social, data, and banking-services ecosystems. The Internet of Things (IoT) is an ecosystem where multiple applications communicate with one another as a network.

By plugging into these ecosystems, companies can get access to entire networks. They can, among other benefits, find new customers,

EXHIBIT 1

As technologies advance and companies develop new capabilities, various kinds of ecosystems are taking shape.

	Objectives	Examples
Sales	• Allow users to interact with one another socially • Attract as many customers and social interactions as possible	• Individual social platforms such as Facebook, Instagram, Line, Tencent, Twitter, and Wechat • Professional social platforms such as LinkedIn
Data	• Share data using standard data definitions • Provide additional data-and-analytics-based services • Capture and use external and proprietary data	• Internet of Things efforts by Caterpillar Minestar, GE Aviation, and John Deere • Apple iHealth • Property-and-casualty insurers (eg, using weather data patterns to assess fire risks)
Technology	• Enable through industry standard software and hardware • Provide better/faster IT delivery through broad range of specialist IT firms and technologies	• Consumer mobile such as Apple iOS and Google Android • Enterprise-technology platforms such as Microsoft Office, Oracle ERP, SAP ERP, and SAP Hans • Visa/MasterCard's payment-processing platforms, and blockchain
Customer journeys	• Leverage company's core commerce functionality and value proposition to attract large number of customers • Add capabilities to complete the customer journey and create network effect	• Ridesharing platforms such as Lyft and Uber • Shopping platforms such as Amazon • Travel platforms such as Airbnb • Banks allying with fintech players in value chain, eg, SME app players linked via APIs into bank
Services	• Integrate multiple companies' services to holistically address customers' pain points and make the initial product/services much more attractive for customers • Bundle either transparently or explicitly	• Transparent add-ons such as Amazon Alexa and Slack • Explicit services platform such as Salesforce.com and the Salesforce ecosystem/AppExchange

Source: McKinsey customer-journey benchmark

tap into new sources of data, and improve established business processes.

CIOs and IT organizations have a huge role to play in capturing these opportunities. But they can't do it through a "business as usual" approach. In an ecosystem environment, an exclusive focus on protecting the center can limit a company's ability to capitalize on emerging opportunities. To adapt their complex business-technology architecture to function in a world of ecosystems, CIOs will have to figure out how to simultaneously draw external technologies closer while managing security issues and getting a handle on the accelerating stream of technological innovations.

IDC predicts that by 2018, more than 50 percent of large enterprises—and more than 80 percent of enterprises with advanced digital-transformation strategies—will create or partner with industry platforms.[1] At the same time, there will be more than 50 billion connected devices expected by 2020, according to Cisco.

These numbers point toward a radical reframing of what IT is and how CIOs manage it—not as an internal collection of information technologies but as a broad network of ecosystem technologies (ET). For the CIO, this shift also creates a significant opportunity to work closely with the CEO on business priorities and to become a prime strategic partner.

Understanding ecosystem technologies

ET encapsulates an expanded set of IT capabilities and functions (Exhibit 2). The CIO still needs to manage the multispeed IT functions[2] as well as current bilateral programs. The new layer of ET represents a new set of capabilities as well as the extension of existing ones.

CIOs can define and shape their ET in three ways:

1. Open up internal IT to the outside world

This approach is about architecting IT to link internally driven systems and capabilities into external systems. One example of this in action is Delta Air Lines' mobile app, which extends to using Uber so travelers can order a car upon landing. Kraft has expanded its recipe app to become a pantry-management tool, generating a shopping list that seamlessly connects with the grocery-delivery service Peapod. Think of it as extending the customer's journey— and the company's relationship with the customer—through integration with other service providers.[3]

Many companies have already been providing integration capabilities to upstream and downstream partners—technologies such as electronic data interchange (EDI) have been in existence for decades. However, those integration points are often static. They are bilateral connections with a small, preselected group of partners such as distributors and

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[1] "IDC predicts the emergence of 'the DX Economy' in a critical period of widespread digital transformation and massive scale up of 3rd platform technologies in every industry," *Business Wire*, November 2015, businesswire.com.

[2] Oliver Bossert, Chris Ip, and Jürgen Laartz, "A two-speed IT architecture for the digital enterprise," December 2014, McKinsey.com.

[3] Examples from David C. Edelman and Marc Singer, "Competing on customer journeys," *Harvard Business Review,* November 2015, hbr.org.

EXHIBIT 2

Ecosystem technologies consist of an expanded set of IT capabilities and functions.

Ecosystem IT

Vendors/partners

Social

Bilateral

Transport services

Supply-chain providers

Government (eg, tax)

Other industries

Customer facing

Experiments and pilots

Trial "sandboxes"

Data and customer sources

IT providers

Internally focused

Trading partners

SaaS[1] platforms

Smart homes

Parent company/ subsidiaries

Agile development

Banks

Payments

B2B2C

Manufacturing partners

E-commerce

Online to offline

[1]Software as a service.

suppliers. Those points of integration happen infrequently and often in a batch.

The future of integration into external ecosystems will force companies to interact with many more partners covering a broad range of functions, ranging from customer sourcing to social advertising to payment solutions. That's because the low cost of technology and a dynamic start-up environment has led to a massive increase in the rate at which new services are being introduced. This means that the IT function must follow the "Amazon principle" of making system components available as a service to enable integration with the ecosystem. The interfaces must be open, dynamic, and functional in real time so that they can integrate partners, technologies, and applications on an as-needed basis.

One clear implication is the need to design lightweight technology architecture built on microservices and APIs to allow third parties to easily hook into the new ecosystem. CIOs need to start viewing through the lens of platform architecture—the same that auto-industry OEMs use to allow for future upgrades across the ecosystem. Companies may even need to offer an app store to allow consumers to pick and choose desired capabilities—and, of course, the infrastructure must be robust and secure.

One example of how this can play out can be found in telecom players that expand their connected services to e-commerce, music, health, insurance, education, media, and smart homes. These services are all connected to one ecosystem offering the customer multiple avenues through the telco's technology backbone. Salesforce's AppExchange is

already doing this by creating an environment in the cloud where developers can create and release their own apps.

2. Internalize external IT

This approach focuses on opening up internal IT systems so that the business can plug in the external capabilities available in the ecosystem to better serve its own customers, support its own employees, or create new products and capabilities, often offered via SaaS and APIs. A simple example is integrating a third-party point-of-sale application into a company's internal payment systems to simplify a customer's in-store purchase process. Or integrating a third-party customer-service chat function into a company's website. Or even integrating Yammer to help with employee productivity.

This approach clearly changes how IT designs and manages its systems. It's no longer about buying software packages and building bespoke solutions on premises or working with a few systems integrators to deliver a business solution. It's now about understanding the end-to-end customer experience and how external and already available services can be utilized with internal solutions to offer a complete and unique offering. Companies will need to complement internal skills with external specialization integrated deeply into the ongoing fabric of its IT application development and infrastructure management. It's about creating a 24/7 environment that enables product offerings to millions of customers globally.

One leading international travel company, disrupted by start-ups in the market, decided it needed to build up its capabilities to drive its transformation. An important component of its

To adapt their business-technology architecture to a world of ecosystems, CIOs will have to draw external technologies closer while managing security issues and technological innovations.

strategy was to use specialized vendors from the external ecosystem to support different capabilities, for example, mobile, search engine, customer relationship management, payments. This approach allowed the company to accelerate its transformation, scale up its services, and tap specialized talent as technologies evolved and demand spiked.

3. Modernize IT to scale innovation

We've all heard often enough how torrid the pace of new technologies has become. But it's worth remembering that many of the new tools have the potential to fundamentally change a company's business model, though that may not be clear at first. To guard against being caught unprepared and to adopt a more aggressive competitive posture, companies should begin testing these technologies to be ready to bring them on board as soon as their value is proven and they can work at scale. This may be a matter of "playing" with new technology (eg, alike open source standards) in dedicated sandlots where the connectivity between the internal IT and external IT can be tested. Furthermore, IT leaders will need to actively form partnerships or alliances with vendors and service providers to really

understand and evaluate how the technology can be used in their business environment.

It is true that many companies have already been actively investing in emerging technologies. For example, many financial-services companies have set up internal corporate venture-capital funds to invest in technologies such as blockchain and the IoT. However, companies have demonstrated less progress—and success—in integrating those technologies into their existing IT infrastructure and successfully extending the value proposition to their customers. The start-ups often have immature technologies that cannot scale, and they often leverage external cloud services that may not be compatible with companies' own cloud infrastructure. Therefore it's important for companies to think through how they enable a smooth integration of both technical solution and working culture to fully capitalize on the products that the start-ups are offering. If not done correctly, companies will create the next wave of spaghetti IT infrastructure.

Given the scale of innovation, it would be virtually impossible to keep up unless the CIO

Questions the CEO can ask the CIO

- Have you identified the set of technologies, platforms, and vendors that can help us accelerate our digital strategy?

- How quickly can a potential partner integrate our services into its services?

- How quickly can we add a new vendor/partner to accelerate a specific capability such as live-data connectivity?

- What are the three most important sources of value that the external ecosystem can provide?

- What talent and capabilities have you identified that we need to succeed in the ecosystem? How are you building them?

- Do our cybersecurity policies and practices cover external partners? And their partners?

- How are we ensuring that our services are exposed to and can interact with the broader ecosystem?

designates specific analysts or architects whose job it is to identify and assess the compatibility of external technologies. The DBS Innovation Group, for example, has established a fintech senior-vice-president role responsible for identifying, integrating, and managing potential ecosystem members. This person leads and drives fintech engagements locally and regionally, and reports to the global head of partnerships.

Regardless of which way—or combination of ways—the CEO and CIO choose, IT moves to the forefront not just of technology but also of business-model innovation.

Getting started with ET

While building out ET is complex and based on many interdependencies, we've found that focusing on the following six elements gives CIOs and CEOs a big advantage in getting the most value from it:

1. Rethink the business's strategy. Which way, or combination of ways, a company chooses to interact with various ecosystems (or create its own ecosystem) depends on three things: its strategy, the market environment, and the risk appetite of the overall enterprise. This in turn requires the CIO to work closely as a partner with the CEO and C-suite to help

shape the business strategy by identifying emerging technologies and ecosystems that could disrupt the marketplace, determine where future sources of value are, and develop necessary strategic actions to capture it. This dialogue is a two-way and constant exploration in which technology and business strategy are inextricably linked. The CIO's role is not just to determine feasibility but to help the business determine what threats and opportunities exist in engaging in ecosystems.[4]

2. Develop the infrastructure. The new bidirectional integration of technologies is dynamic in nature; it happens in real time with thousands of invoking partners or end consumers. This requires companies to redesign the next-generation integration architecture to support it and enforce open standards that can be easily adopted by external parties. A company's existing master data-management catalog will also need to be extended to include third-party data and potential integration with external master-data providers. There has to be a clear data architecture and governance in place to ensure data cleaning, rationalization, and standardization for the systems to work.

3. Reinvent customer-management processes and structures. When customers call with technical issues, it will be challenging to figure where the fault points are in an ET environment. Is it the company's systems, a third party's services, the cloud that houses the service, the network—or some combination of the above? This reality will require companies to fundamentally rethink their infrastructure-support processes.

Creating SLAs that clearly define issue resolution and escalation protocols that all parties agree to will be crucial. Creating standard identifying tags or "tripwires" and integrating them into participating ET services, partners, and technologies will be important to locate issues quickly so they can be resolved.

These standards and agreements, however, are not an excuse for shuttling customers from one partner to another and another. The customer-facing company needs to solve the issues behind the scenes and spare the customer the complexity of navigating the partners' ecosystems.

4. Define the parameters for cybersecurity, legal, and partnerships. As a result of the extended infrastructure, internal cybersecurity policies and processes will need to include third-party partners and vendors. A new set of security standards should be defined and agreed to that clearly articulates how the integration will take place and what kind of data can be exchanged with whom.

Working with a broad range of third parties will raise other legal questions as well. intellectual property, liability, privacy, profit sharing, and regulatory/compliance issues all have the potential to severely impede potential benefits from engaging in the broader ecosystem. Licensing issues have already emerged between cloud companies and on-premises hardware and software businesses because of competing and different business models. Data ownership and customer management in particular will be crucial given the need for companies to access both.

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[4] For more, see Angus Dawson, Martin Hirt, and Jay Scanlan, "The economic essentials of digital strategy," *McKinsey Quarterly,* March 2016, McKinsey.com.

This will call on significant negotiating skills and a commitment to develop and apply a broad set of standards to avoid constant renegotiating with each new partner or vendor from scratch. Setting up an app-store approach where standards are clearly stated, tools provided, and agreements specifically made at the beginning may provide a useful model.

Engaging with a network of vendors also requires changes in skills certification and vendor performance management. Companies will need to clearly define the standards and procedures under which vendors must operate and guidelines that define how the vendor will be included in the delivery life cycle. Home Depot is developing standards with the manufacturers of its products to ensure compatibility with the Wink connected-home system. Companies that do this most effectively treat vendor relationships as partnerships with strong transparency. The internal-supply and vendor-management functions will need to be restructured to work more like M&A, which can integrate new partners or establish new alliances quickly and efficiently.

5. Cultivate an 'open' mind. CIOs have traditionally focused on protecting systems and ensuring that they run well. But the new digital world demands more active engagement with the outside world to understand competitive threats and sources of value. CIOs should start with developing a much more externally compatible view of the current IT infrastructure and thinking about how to design new ways of meaningfully integrating external systems. Spending a long time building overly complex "bulletproof" systems is counterproductive; testing an application or new platform

environment should take a matter of days or weeks.

6. Invest in new capabilities. As businesses increasingly engage with external ecosystem technologies, full-stack architects and convergence infrastructure engineers are needed who can provide expertise in third-party packaged software, have fluency in multiple best-of-breed technologies, and bring experience integrating multiple technologies. "Translator" capabilities will also be crucial to bridge the gaps between business goals and technology requirements to be provisioned through the ecosystem. Any new function within the enterprise architecture should work closely with business to understand how external services can be integrated with products to extend the customer value proposition.

With the advancement of cloud computing and infrastructure as programmable software, infrastructure resources (for example, networks, servers, storage, applications, and services) can now be rapidly provisioned, managed, and operated with minimal effort. That requires DevOps (the integration of development and operations) and cloud engineers, who have the experience to navigate a rapidly changing cloud-computing ecosystem and program software, as well as data scientists, automation engineers, and enterprise architects. Companies will also need to find a few senior developers who can set up app-store development standards.

Companies have outsourced many of these capabilities. But due to the increased importance of engineering and automation skills, many are rethinking that approach as IT evolves from utility to enabler.

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Integrating a company's IT with third-party capabilities creates opportunities to capture substantial new sources of value. But until IT expands to become ET, the vast majority of those opportunities will remain out of reach. ◆

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How the convergence of automotive and tech will create a new ecosystem

Sven Beiker, Fredrik Hansson, Anders Suneson, and Michael Uhl

As the high-tech and automotive worlds merge—with four disruptive technology trends driving change—a complex ecosystem is creating new rules for success.

As four technology trends reshape the global automotive sector, customer preferences are moving away from its traditional strongholds, such as chassis and engine development. This shift in customer preferences and the sheer size of the automotive sector have attracted new players: a potent mix of large high-tech companies and start-ups. Both differ from the automotive incumbents on virtually every level.

These new entrants and the disruptive trends they bring—electrification, autonomous driving, diverse mobility, and connectivity— will transform typically vertically integrated automotive value chains into a complex, horizontally structured ecosystem. The newcomers are well positioned (and expected) to make moves in novel areas such as autonomous driving. Consequently, today's OEMs and tier-one suppliers must abandon

strategies aiming at total control of vehicles and instead pick and choose where and how to play by shedding assets, streamlining operations, and embracing digital acquisitions.

Four trends that favor software-driven innovation

The fortunes of players in the automotive sector have always depended on what customers see as valuable. Most of this value has resided in the hardware of vehicles and in the automakers' brands. However, future innovations will probably focus on disruptive technology trends, so the customers' perceptions of value will shift, increasingly putting incumbents in danger. The four trends that will favor the newcomers are these:

- **Electrification.** Drivetrains will shift toward hybrid-electric, electric, and fuel-cell technologies as they mature and become cheaper.

- **Autonomous driving.** The operation of automated cars will move from advanced driver-assistance systems to fully autonomous driving as the technology matures.

- **Diverse mobility.** As the sharing economy expands and consumer preferences change, the standard model will continue to evolve from outright purchase or lease to rentals and car sharing.

- **Connectivity.** The possibilities for "infotainment" innovations, novel traffic services, and new business models and services will increase as cars get connected to each other, to the wider infrastructure, and to people.

Attracted by the shift in customer preferences, the importance of the new trends, and the global automotive market's massive size and value-creation potential, technology players are making their way into the sector. As they develop new software options, cars are evolving into computers on wheels, a change similar to events in the computer industry 20 years ago and the cellphone industry ten years ago. As a result, we anticipate that a complex ecosystem will emerge in the automotive sector (Exhibit 1).

Although the sector adheres to a vertically integrated business model, with OEMs in full control of their supplier networks, the new tech players are more focused on horizontal moves:

- A number of high-tech players are developing autonomous-driving systems that are quite likely to merge into an operating system.

- Disruptors from the taxi and ridesharing industries are developing innovative new business models.

- Two leading online and technology companies are focusing on in-car entertainment platforms, which they hope will become the standard for applications.

No single player is likely to dominate any part of such a horizontally organized, complex value chain by itself. But many of the new tech entrants are well positioned to take the lead in the software-focused parts. For each part "of the ecosystem, there might be room for only a few winners, since few players will be able to invest the resources necessary to reach scale (Exhibit 2).

EXHIBIT 1

In the future, cars will become computers on wheels as tech players move into the automotive sector to leverage their existing capabilities.

■ Vehicle hardware   ■ Vehicle software   ■ Alternative business models

Hardware
Corner modules, advanced sensors, etc

Drivetrain
Electric motors, power electronics, advanced batteries

Industrial design
Modular bodies, advanced user interfaces

Entertainment platform
Features and connectivity mirroring the home-entertainment experience

Autonomous drive/ operating system
Advanced central operating system with self-driving capability

Apps and services
Full library of applications from 3rd parties

Alternative business models
Autonomous vehicle sharing, new service offerings, etc

Data analytics
Fully connected cloud processing and data feeds for manufacturers

Source: 35 expert interviews (across Asia, Europe, and the United States)

The automakers have invested billions in car hardware, from engine plants to stamping facilities and beyond, so they have the best position to dominate the hardware-focused areas. In software, the tech players enjoy significant advantages, including leading-edge capabilities, agile operating models, and the financial muscle required to pursue exploratory investments aggressively. For the automakers and tech players, success in tomorrow's mobility sector will depend on how well they build on these natural advantages.

OEMs and suppliers face tough new competition

Many OEMs and tier-one suppliers can see the shift coming but might underestimate how much strategic change they must undergo to be part of the automotive sector's future: they may lag behind the tech entrants in the asset

EXHIBIT 2

A couple of specialized players will probably dominate each niche of the future automotive ecosystem.

Future scenario as a horizontal move for players

	Category	Description
	• Mechanical hardware	Subassemblies get standardized, and players merge to benefit from scaling up—ie, chassis components, body substructures shared across models/brands
	• Drivetrain	3–5 players with competitive advantage scale up production—ie, batteries for electric vehicles, fuel cells, drive units for modular cars
	• Industrial design • Branding	Vehicle interiors and exteriors remain a key differentiator, and importance of brand value rises in an increasingly commoditized sector
	• Operating system	2–3 standard operating systems for autonomous drive (and potential other systems—eg, onboard communication architecture) as a plug-and-play solution
	• In-car entertainment	2–3 large-scale multimedia ecosystems present attractive opportunity for 3rd-party development, probably established mobile platforms (iOS, Android)
	• Cloud • Data analytics	Analytics skills and server technology are leveraged to create services that facilitate the usage of big data for commercialization and customer satisfaction
	• Apps and services	Built-in navigation and media get replaced by apps provided by 3rd-party developers, curated via app store, and more widely connected via online services
	• Alternative business models	Vehicle provided to consumer just for duration of ride and specific to trip purpose, making mobility the actual product

Source: Expert interviews

EXHIBIT 3

Tech players have much more financial flexibility, giving them opportunities to pursue new investments more aggressively.

Auto OEMs and tier-1 suppliers　　　　**Tech players**

Japan mass OEM	US mass OEM	European premium OEM	European tier-1 supplier	US tech	US tech	China tech	China tech

Market capitalization, $ billion

158	54	57	20	511	502	56	222

Cash equivalents, $ billion

19	14	5	1	21	17	2	6

Return on invested capital, %

8.7	6.6	7.5	21.3	34.1	14.2	34.6	20.8

Profit and loss breakdown, %

	COGS[1]	SG&A[2]	R&D	EBIT[3] margin
Tech players	35–60	15–20	10–15	20–30
Tier-1 suppliers	40–60	20–30	4–8	15–20
Premium OEMs	65–75	6–12	5–8	10–15
Mass OEMs	68–80	8–14	3–6	8–13

[1]Cost of goods sold.
[2]Selling, general, and administrative expenses.
[3]Earnings before interest and taxes.

Source: Thomson Reuters

base, skills, and resources needed to respond to this new competitive environment. Still, it makes sense to assess the readiness of OEMs and tier-one suppliers as well as tech players in the important indicators of competitiveness: financial flexibility, the deployment of capital and people, operating models, culture, and customer-centricity.

Financial flexibility. Traditional OEMs often have limited financial flexibility as a result of low operating margins, low returns on invested capital (ROIC), and moderate market-

capitalization levels. Tech players, in contrast, tend to enjoy high financial agility, with robust operating margins, high ROIC, and large market caps (Exhibit 3).

Some tech companies enjoy valuations ten times higher than those of leading OEMs. As a result, exploratory investments in new disruptive technologies, which might cost as much as 10 percent of a leading OEM's market cap, would cost only 1 percent of the market caps of the largest tech players. As Wall Street flooded the tech sector with money over the

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EXHIBIT 4

Tech players have fewer employees and more software developers, and they are in a better position to attract engineering talent.

Total number of employees

Traditional OEMs

Japan mass	US mass	European premium
344,000	199,000	116,000

Tech players

US	US	China	US
115,000	57,000	42,000	13,000

Engineers with artificial-intelligence expertise

Auto players
118

28×

Tech players
3,372

Ratio of software to nonsoftware engineers

11×

Software 8.5%	Nonsoftware 91.5%

0.5×

Software 62.2%	Nonsoftware 37.8%
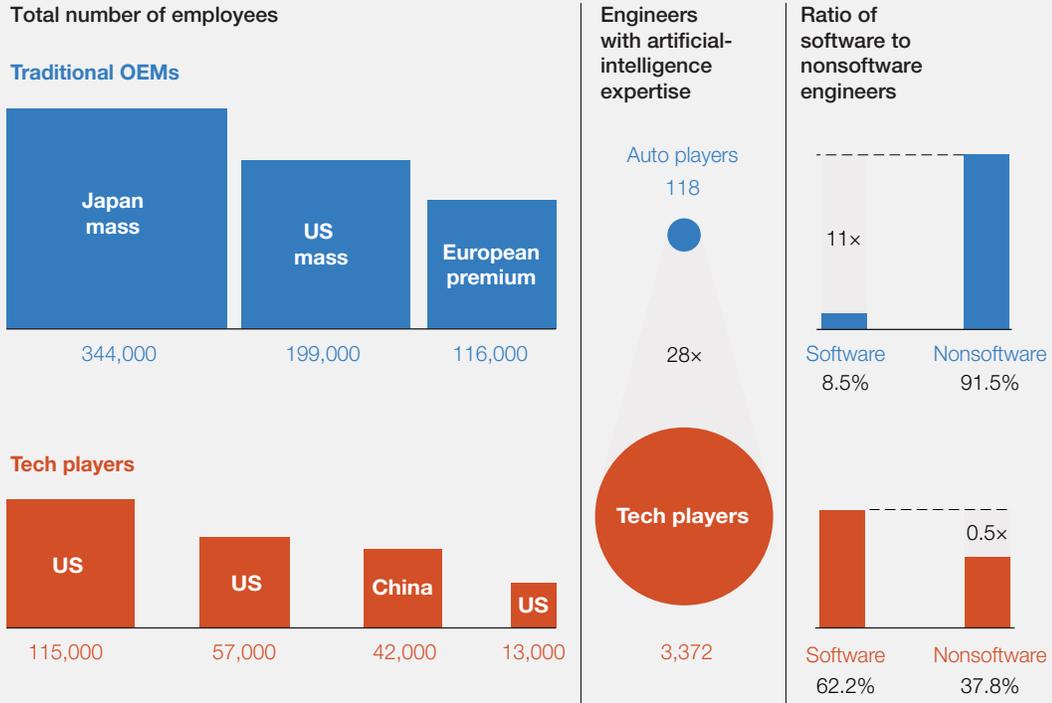
Source: Glassdoor; LinkedIn; McKinsey analysis

past decade, companies in it have made a high priority of pursuing growth and business opportunities that can justify these valuations. Investors expect such exploratory investments, so tech companies enjoy higher financial flexibility. For many OEMs, by contrast, the top priority is to achieve full asset utilization (given high fixed costs) and to increase volumes of current models. That limits opportunities for exploratory investments.

Deploying capital and people. Automakers command manufacturing and mechanical-engineering assets and have large workforces weighted toward these disciplines. Technology companies focus much more on software and frontline computer assets, such as machine learning, with workforces weighted heavily toward software development (Exhibit 4).

Automakers not uncommonly spend up to 75 percent of their overall capital-expenditure distributions on traditional product-development and manufacturing assets. Tech players instead allocate a similar ratio to software development and the customer experience. The largest technology entrants also spend more on R&D than automakers do—more than 10 percent compared with less than 5 percent, of their revenues, respectively—and allocate more of this spending to disruptive technologies.

Operating models and culture. Automotive incumbents operate by a rich legacy of sectoral norms and conventions. They often adhere to rigid, rigorous, and unique product-development practices; work with complex supply chains; and sell through extensive franchised retail-dealer networks. The culture of OEMs values consistency, quality, and the minimization of risk. Tech players prefer experimental, fast-moving cultures that

reward innovation and risk taking. OEMs have traditionally favored incremental hardware innovations, while tech companies actively seek disruptive software products or services. OEMs use traditional marketing tools and techniques. Tech players tend to be more focused on customers, engaging them early and often.

The operating models of the two sides differ dramatically. For example, automakers reengineer their core products approximately once every seven years, with noticeable updates every three years, but do not update existing products. Tech companies redo their core products about every two years, make noticeable updates every two months, and provide continual updates for existing products. The OEMs' systematic "waterfall" approach to product development tends to slow down innovation; the average time to market is about five years. Most tech players depend on agile operating models that enable a time to market of roughly two years.

Customer perceptions. Mass-market automotive brands, while strong, often evoke traditional values, such as reliability and efficiency, and thus lack the "coolness factor" that leading tech players enjoy thanks to their reputation for innovation and agility. In fact, tech brands took six of the top ten positions on a recent tally of the world's most valuable brands; the first automotive one held 28th place.

Future OEM and high-tech automotive strategies

For mass-market OEMs, the emerging strategy is to go all out to build additional scale. This probably means additional consolidation in the sector, and the resulting entities might integrate backwardly to obtain key strategic suppliers.

To succeed, OEMs will have to focus strongly on developing and producing market-leading hardware, such as bodies and interiors. They must also increase their margins by embracing digital manufacturing techniques (including 3-D printing and automation), added purchasing power, and the dilution of overhead. These changes would be similar to those undertaken by hardware manufacturers in the mobile-phone industry. In low-margin areas, scale is needed to generate substantial profits.

In contrast, premium OEMs could streamline their platforms to free up capital, shed low-value manufacturing assets to double down on worthwhile hardware attributes (such as look and feel), and provide extensive personalization. Their development efforts should focus on a single new area, such as in-car entertainment, autonomous driving, or mobility services. These companies should also secure partnerships to exploit other disruptive technologies and focus on maintaining their brand strength.

Tech players have several options to enter the sector through horizontal plays. One likely choice is to be a technology supplier focused on new high-tech products but then to evolve into a dominant platform player by acquiring all relevant competing assets, such as infotainment ecosystems or autonomous-driving systems. These companies would partner with OEMs to push products to the market on the backs of solid hardware platforms from the established players, thereby breaking up the vertically oriented structure.

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The convergence of the automotive and high-tech sectors will rewrite the rules of competition and lessen the chances of survival for traditional players that fail to act. The competitive space remains fluid at this point, but that could change quickly as incumbents move to position themselves advantageously and tech companies solidify their investment strategies. ◆

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Using data and technology to improve healthcare ecosystems

A Verily Life Sciences executive explains how the company targets better patient outcomes by harnessing analytics, machine learning, and other digital tools.

Patient outcomes are taking over from products and services as the focus of healthcare. But reorienting away from product development, and toward a holistic approach to patients, demands the convergence of data from every part of the healthcare system. In this interview, part of our Biopharma Frontiers series on how the pharmaceutical industry is evolving, Jared Josleyn, global head of corporate development at Alphabet-owned Verily Life Sciences, talks with McKinsey's Michele Raviscioni about the need to integrate health data and apply it to patients' lives in ways that achieve enduring impact.

McKinsey: What is Verily's mission?

Jared Josleyn: Verily is a data healthcare company that extracts high-fidelity data from the healthcare ecosystem and applies it to patients' lives to improve human health. Everybody today talks about the need to focus on patient outcomes, but a lot of those conversations break down because of a lack of high-quality, longitudinal data—because we don't know how well people manage their diseases on a daily basis, or we don't understand comorbidities across different chronic diseases well enough—and so we

can't predict the effect a treatment will have on a patient population. Right now, data sets, whether from pharmaceutical companies, hardware companies, clinical work flows, or patients, sit separately within the ecosystem, which doesn't effectively enable a true outcomes-based model that properly aligns incentives for all parties so that patients arrive at optimal outcomes. Verily's purpose is to collect and integrate these massive and disparate data sets, observe new patterns, extract insights, and provide those insights to clinicians and patients to enable better management of health and disease.

Take medical-device hardware. Verily's goal isn't to create the next incremental invention in hardware; it's to ask what exists in a particular space and whether it's sufficient to extract the highest-quality data to enable better outcomes. For example, we looked at continuous glucose monitoring for patients who are diabetic. After doing an assessment, we didn't think the applications currently available were wholly effective for patients with type 2 diabetes, because they are not user friendly, they are too narrowly focused, or they overlooked other important behavioral aspects of diabetes management. So we entered that space. We start with the problem first, and if an available wearable or other sensor doesn't collect the right data so we can provide inputs back to the patient, the providers, and the clinicians, we want to create a solution.

The approach is equally applicable to pharmaceutical companies. We look at how we can improve a company's ability to predict whether a particular combination therapy will be precise enough to be effective for a given patient population.

On the provider side, we look at how to create tools providers can use to create recommendation engines, to improve clinical work flows, to improve clinical outputs—and to offer doctors all the tools and data so they can make the best clinical decision possible and do what they went to medical school to do, which is to focus on the patient, not spend an inordinate amount of time entering information into systems.

McKinsey: What do you see as the short-term and longer-term opportunities for impact in the way healthcare is delivered?

Jared Josleyn: To create short-term impact in people's lives, you need to focus on the delivery of certain applications. This can include the continuous glucose monitor, as I described before, or the diabetic-retinopathy screening tool that we're developing with Nikon, the goal of which is to improve the speed, accuracy, and accessibility of diabetic-retinopathy screening as a way to prevent blindness. Short-term impact in healthcare is driven by the regulatory system, however. We know we can deliver a continuous glucose monitor into the marketplace, for example, but we still have to follow a regulatory process to get it there.

The long-term opportunity is to build chronic-disease models to help people manage their diseases and lead them into a better path toward a better outcome. There are certain disease states, like diabetes, where the management of the disease isn't just about the device or titration of the insulin—it's also about what food you eat, or how to be more active. In other words, it requires behavioral changes that people can find hard to make, and be

consistent, which can cause them either to use the systems in an unoptimized way, or not to use them at all. By building the user experience first, we look at designing solutions that result in widespread adoption because they are easy to use, develop habitual-behavior change, and ultimately help people better manage their health without negatively affecting their daily lives.

McKinsey: How do you decide which areas to focus on in healthcare?

Jared Josleyn: We look at what creates the most impact. We became involved with diabetes, for instance, because we believe we have the tools and expertise to improve the lives of people with this condition in a big way, not just incrementally.

As part of Alphabet, we have opportunities to work with a lot of different companies and innovative thinkers within Google. We can tap into Alphabet's experience with user design and machine learning to develop solutions that will be adopted and sustained. The areas we choose may be high-value areas, but we don't necessarily pick high-value areas: we pick high-impact areas.

McKinsey: Can you take an example of a partnership you're working on and describe what you're trying to achieve?

Jared Josleyn: I can give you several. We have a joint venture with Johnson & Johnson called Verb Surgical that is aimed at reducing surgical complications by making robotic surgery more portable and usable across a wide range of indications. Research suggests that 50 percent of surgical cost is related to 3 percent of complications in surgery, so if

we can reduce the complication number to 1 percent, we'll drastically impact the lives of patients and significantly reduce healthcare costs.

With 3M, we're using machine learning and a suite of data-analytics tools to develop software, called the Performance Matrix, that gives visibility to operational inefficiencies in hospitals—so that the hospital can better understand what's going on day to day and make improvements to hospital operations that will reduce negative patient outcomes and healthcare costs.

With GSK, we have a joint venture called Galvani focused on bioelectronics. We're working on creating therapeutic interventions for a number of conditions, with a level of investment that hasn't been seen before, relating to neuromodulation. By modulating a nerve, we believe we can create an effect within the body that may improve function and quality of life for refractory patients that are not effectively treated by currently available therapies.

In all of these partnerships, we're looking at involving providers, patients, payors, technology companies, and pharmaceutical companies in creating the best solution for people rather than the best product in a particular space.

McKinsey: What is your perspective on others that are doing this?

Jared Josleyn: Many groups are focused on becoming a disruptor by taking a technological approach to data and deploying it in a healthcare system in a new way. We all have similar ways of viewing improvement in outcomes, but we take different technological

approaches to achieving those improvements; for example, Apple takes a hardware-centric approach, while IBM takes a software-centric approach. Verily builds capabilities in a vertically integrated way. We have domain expertise, with some of the world's foremost medical experts building platforms with our software and hardware engineers and creating a dialogue about what the data we collect actually means. We have a scientific team that's building first-in-class systems-biology programs and analytical tools and marrying these tools with things like digital pathology, which Google Brain recently announced. From a software perspective, we utilize machine learning to learn and predict rather than learn and react. We're really pushing to use all these different capabilities to bring a proactive rather than reactive approach to health management within a collaborative ecosystem. ◆

Michele Raviscioni is a partner in McKinsey's Tokyo office. **Jared Josleyn** is the global head of corporate development at Verily Life Sciences, which is owned by Alphabet.

Krunja/Getty Images

What it really takes to capture the value of APIs

Keerthi Iyengar, Somesh Khanna, Srinivas Ramadath, and Daniel Stephens

APIs are the connective tissue in today's ecosystems. For companies that know how to implement them, they can cut costs, improve efficiency, and help the bottom line.

Application programming interfaces (APIs) were once largely limited to technical domains but have now become a significant engine of business growth. As the connective tissue linking ecosystems of technologies and organizations,[1] APIs allow businesses to monetize data, forge profitable partnerships, and open new pathways for innovation and growth.

Early adopters across industries are already using APIs to create new products and channels and improve operational efficiency. Within the automotive industry, for instance, APIs are used to embed efficiency data, driving statistics, route information, and real-time alerts into dashboards. Some retailers are using APIs to set up multibrand shopping platforms, track inventory, and

[1] Venkat Atluri, Miklós Dietz, and Nicolaus Henke, "Competing in a world of sectors without borders," *McKinsey Quarterly,* July 2017, McKinsey.com.

help consumers locate stores. And a handful of banks are partnering with fintechs and retailers, among others, to develop APIs that help customers integrate banking data into bookkeeping and investment software and to provide faster internal access to a range of account information.

The value at stake is significant. McKinsey analysis has estimated that as much as $1 trillion in total economic profit globally could be up for grabs through the redistribution of revenues across sectors within ecosystems.[2] That makes APIs, which play a crucial role in linking organizations and technologies in ecosystems, a significant competitive battleground capability (see sidebar, "How APIs create value").

Furthermore, McKinsey estimates that the number of public APIs will triple over the next 12 months. As the functionality evolves, APIs will deliver more advanced services, such as powering the wider use of digital wallets and currencies, enabling machine learning to deliver more sophisticated operations, and supporting advanced conversational capabilities. In addition, API marketplaces and app stores will make it easier for users to access sophisticated business and consumer offerings.

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[2] Ibid.

How APIs create value

Being unclear about the value of APIs can lead to lost focus and missed opportunities. We see three primary sources of value in API programs:

Simplifying the back end. APIs can connect internal systems relatively simply, allowing access to data—even when it's buried deep within legacy IT systems—quickly and repeatedly. This allows IT to simplify and automate tasks and to speed development.

Personalizing offers. Data aggregation and on-demand reporting through APIs can enable the delivery of personalized products and services, such as user authentication, fraud management, credit approvals, paying for services with cash or points, and finding and tracking subscriptions. For instance, S&P's Capital IQ API integrates key information, including investment research, companies' financials, credit ratings, global market data, and alpha and risk models into personalized business applications for customers.

Developing an ecosystem of innovation and engagement. The connective capability of APIs allows companies to access new value outside the business. API developers, for example, can create innovative products and services that tie into a company's systems. Advanced API capabilities allow developers to create a richer customer experience by pulling together a deeper array of data sets (rather than simply scraping data). Salesforce.com's partner ecosystem, for example, offers a developer-friendly toolbox that has spurred partners to build a huge number of employee and customer applications that rely on APIs. As a result, more traffic comes through the Salesforce APIs than through its website.

However, the number of companies with mature API programs remains small. Most organizations have just a dozen or so APIs instead of the hundreds needed for a robust portfolio. And apart from a few early movers, most do not have a formal API strategy, are unclear about the true value at stake, and are uncertain about how to implement a program that quickly maximizes consumer and business impact.

With the API market gaining momentum, institutions that move quickly to define a business-backed strategy and monetization model, institute the right governance, and drive adoption can create powerful new avenues for revenue growth and value.

Driving successful execution of the API strategy

In our experience, the most successful companies implement an API strategy by following four steps:

1. Identify—and prioritize—the value

APIs can generate massive amounts of value, but institutions first need to understand where best to apply them. Leaders in the field analyze where value can be destroyed or created, then they size the potential impact with respect to revenue, customer experience, and productivity.

Analyzing customer journeys is often the best way to identify API opportunities. One bank pulled business and technology professionals into a joint team and tasked them with identifying where APIs could help resolve several long-standing customer pain points.

Their review revealed opportunities to develop advanced calculator APIs capable of pulling from multiple sets of data, know-your-customer APIs, and product-aggregation APIs that could help customers access needed information more quickly and cut down on form-filling requests. The team then prioritized those opportunities that would deliver the most near-term impact, given existing capabilities. That data-driven approach gave the bank greater mission clarity and built momentum for the API program.

Understanding what it takes to develop the APIs requires a deep knowledge of the data environment, especially back-end systems where the API work is often done. Once the best opportunities are identified, API developers can identify which and how many APIs are necessary to unlock value. A prioritization matrix can help whittle down the list of APIs, based on the answers to a specific set of questions about strategic value and implementation complexity, taking technical, privacy, security, and regulatory concerns into account (Exhibit 1).

2. Manage monetization actively

With a clear vision in place, companies then need to focus on what they need to implement in order to capture the value they've identified, a step many organizations surprisingly tend to shortchange. Determining what and how to charge, for example, requires quantifying how much the underlying data or service is worth (often based on how proprietary it is and its role in generating value), the revenue streams the APIs open up, and how much developers and users might be willing to pay to access them. Those answers, combined with the company's overarching strategy, will inform which monetization arrangements to pursue with different partners.

Options typically include "pay for use," where developers pay based on usage volume;

EXHIBIT 1 **A disciplined process can help with evaluating APIs.**

Main criteria or questions

Strategic attractiveness	Business impact	• What is quantitative impact of capability on business objectives and customer needs? • What is differential impact of using APIs vs status quo?
	Strategic alignment	• How much will capability contribute to company's strategic goals?
Readiness to execute	Complexity to execute	• What is technical difficulty in building APIs for capability (eg, back-end systems and integration needs)?
	Business readiness	• What is readiness, from a business, legal, and policy standpoint, to deliver APIs for this capability?

High

Long-term opportunities   **Priority**

6   4   3   2   1   5

Strategic attractivness

7

No priority   **Hold**

Low

Low   **Readiness to execute**   High
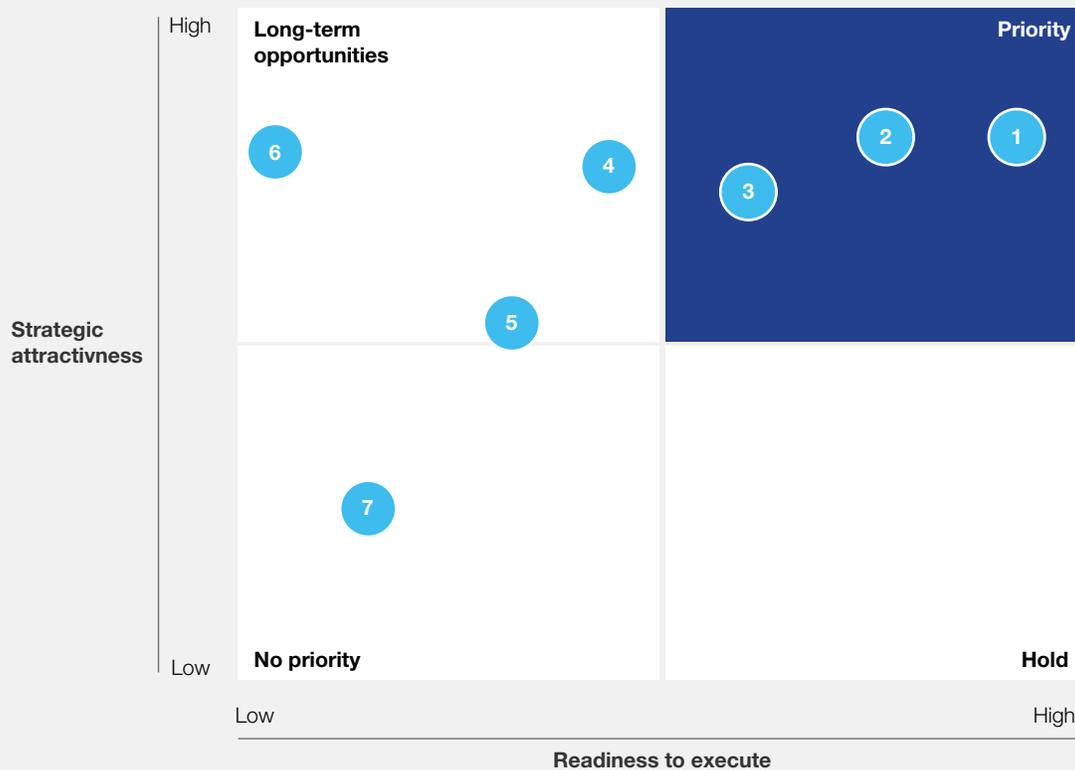
Source: McKinsey analysis

revenue-sharing models, where the API partner or developer gets paid for the incremental business it generates for the API provider; and "freemium," when it's strategically valuable to scale a product's or brand's reach.

In determining which monetization approach to use, providers should think about how their data and APIs can add distinctive value for different audiences. Those insights can help them put together thoughtful partnerships. The traffic app Waze, for instance, uses APIs to create a two-way exchange between municipalities and other partners to share data on road closures, accidents, construction delays, and potholes. Similarly, American Express uses its Pay with Points APIs to create mutually beneficial partnerships with merchants, arrangements that have increased retail sales, card use, and brand loyalty.

The focus on monetization of APIs should extend to internal functions as well. Effectively using APIs can reduce operational or technology costs by simplifying and accelerating development. One bank, for instance, created a library of standardized APIs that software developers could use as needed for a wide variety of data-access tasks, rather than having to figure out the process each time. Doing so reduced traditional product-development IT costs by 41 percent and led to a 12-fold increase in new releases. Seeing these kinds of tangible benefits makes it easier for business leaders to increase their expectations of their software engineers to develop better products more efficiently. Quantifying that potential value in potential savings, efficiencies, and full-time-equivalent reassignment is crucial in building a business case to invest in developing APIs.

As teams implement APIs that break down barriers between systems and organizations, they can continually unlock new sources of value that weren't evident at the beginning of a project. One large financial institution, for example, used APIs to help connect systems with a wealth-management institution it had acquired. One set of APIs was used to connect the interface on the web to the wealth-management company's back-end systems, while another set linked the master customer data so that customers could be immediately authenticated and didn't have to reregister. The APIs greatly simplified the integration process, eliminating the need to rewrite any applications and allowing each system to operate until it was time to merge. The organization could then offer customers an integrated solution rather than a series of individual products. For this reason, the monetization process needs active and ongoing management to continually identify opportunities that APIs create.

3. Create a centralized governance and organizational model

Using APIs effectively requires a new way of thinking about partnerships, a new way for business and technology to work together, and a new pace of development, funding, and coordination. It also comes with new challenges to data privacy and security.[3]

Establishing a centralized body, such as an API center of excellence (COE), is crucial for overseeing API design and development across the organization. With the help of visual dashboards and related tools, the COE can manage all the APIs in the catalog to avoid duplication, enable reuse, and assist with developer access. Effective API leadership establishes clear decision rights (about

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[3] *Digital blog,* "Opening up your APIs and keeping the cybercrooks out," blog entry by Srinivas Ramadath, September 19, 2017, McKinsey.com.

what APIs to develop, for example, or how to resolve conflicts) and identifies both what API capabilities are needed and what new APIs the business needs to evolve. At one large business, the API COE reported to the chief technology officer.

The COE's role in establishing security standards and protocols is especially important. These include two-factor authentication, access-management controls, and appropriate network monitoring to detect bots and other unwanted cyberactivity. A clear set of data and security protocols provides the necessary standardization to ensure interface compatibility, simplify management, and more effectively manage risk.

COE governance also extends to managing funding requests. The most advanced organizations dedicate specific funding to develop a set number of APIs while maintaining enough flexibility to seize on new ideas that emerge. They continually vet and reprioritize their portfolio to ensure resources support the highest-value opportunities.

Some COEs launch specialized hubs to court crucial developer relationships. Success requires sustained commitment to ongoing platform support and API development to maintain the confidence of external developers and partners. For example, one bank located near a high-tech hotbed created an open banking platform that provides developers with access to data and payment operations that they can integrate into their own platforms and applications. The bank underlines this commitment by also providing a technical dashboard view of API usage and processing volumes, and the ability to manage API keys and access with bank-grade authentication within the digital platform.

Finally, the COE needs to ensure that the API program is staffed effectively. Leaders with experience directing API portfolios are crucial to establishing the necessary governance and development approach. Software engineers and use-case specialists must be able to turn user stories into executable APIs and integrate them into products and systems, and "translators" are needed to convert business needs into technical requirements to help the business understand any relevant technological constraints.

## 4. Drive usage and adoption to gain scale

Like any product or service, a successful API program requires a thoughtfully managed adoption campaign backed by rigorous performance management. The best approaches begin with the initial customer and developer pilots, advance to formal production requirements, and then orchestrate and oversee the wider-adoption push to achieve critical mass.

It's important to find pilot partners who have an appetite for innovation and are willing to invest the time. API teams work closely with project teams to continually refine and iterate the API prototype until it meets predefined performance targets (Exhibit 2).

Rigorous, ongoing performance measurement should focus on relevant usage and traffic metrics, such as the number of user registrations, the percentage of users by customer type, and the number of requests over time. This provides teams with the insight needed to make targeted improvements. Tracking data errors or API response times helps to test and validate desired strategic and customer outcomes. One institution prioritized tracking the processing time per API to ensure customer journey targets were being met.

EXHIBIT 2

A bank's API development teams work with project teams across all phases.

	Initiation	Planning and design	Execution	Deployment and monitoring
Project team	Project-initiation documents shared with API team for early API identification	API PO[1] engaged during solution process to provide detailed API identification	Earlier checkpoints set up with API team to avoid delays or rework	• Test project functionality with APIs before production • Monitor performance to communicate any API changes
API team	API PO identifies API impacts and engages domain expertise	PO brings API requirements (user stories, acceptance criteria) back to team	API teams typically sprint at least 1 sprint ahead of project teams	• Dependent APIs go to production with or before projects • API performance and versioning changes monitored
Output	• Project-initiation document • User stories • Scope, timelines	• Commitment (which sprint) • API contract	• API contracts • Access point • Design charter	• Test results • Maintenance playbook

[1]Product owner.

Source: McKinsey analysis

Historical trends and metrics that gauge product or service performance also allow teams to manage the API portfolio as a whole, letting them know which APIs to promote and which to retire. Such regular service-catalog grooming cuts down on bloat and ensures APIs are well organized and easily discoverable.

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API management is emerging as a crucial capability to navigate the digital age. But only those that master its implementation will be able to sustain the value. ◆

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Making sense of Internet of Things platforms

Eric Lamarre and Brett May

The Internet of Things platform space is important, but also crowded and confusing. How do you go about finding the platform that's right for your business?

To get value from the Internet of Things (IoT), it helps to have a platform on which to create and manage applications, to run analytics, and to store and secure your data. Like an operating system for a laptop, a platform does a lot of things in the background that makes life easier and less expensive for developers, managers, and users.

In many mature markets, there are often two dominant platform choices and a long tail of smaller players; for example, iOS and Android in mobile, Windows and Mac OS in desktop operating systems, and PlayStation and Xbox in gaming. But not in IoT, not yet. In IoT, sometimes it seems like there may be more platforms than things. Search Crunchbase for venture-funded IoT platforms, and you will get well over 100 hits. And that list doesn't include many bigger technology players entering the market with IoT platforms, such as Microsoft, IBM, and SAP, or several industrial companies with similar aspirations, such as GE, Bosch, and Siemens.

Platforms big, small, short, and tall
There are IoT platforms of every shape and size.

There are platforms for specific industries, such as commercial real estate and family health. Some focus on one type of device: for example, there are at least two platforms focused on augmented-reality headsets. Some are focused on a particular function, such as manufacturing. There is even an IoT platform for dogs.

Businesses and developers have a bewildering array of platform options to choose from, which may have very different capabilities. The term "platform" has been overused to the point where it doesn't convey much information beyond "more assembly required."

What is a platform, and why do I need one?

Most broadly, a platform is software and hardware, which may include an operating environment, storage, computing power, security, development tools, and many other common functions. Platforms are designed to support many smaller application programs that actually solve business problems.

Platforms are helpful because they abstract a lot of common functions away from the specific application logic. For example, regardless of whether you are trying to write an application to optimize fuel consumption or classroom space, a lot of the underlying technology needs are essentially the same. Application developers just want to focus on the specific problem they are solving and use common capabilities for computing power or storage or security. A good platform dramatically reduces the cost of developing and maintaining applications.

In the IoT, platforms are designed to deploy applications that monitor, manage, and control connected devices (Exhibit 1). IoT platforms must handle problems such as connecting and extracting data from a potentially vast number and variety of end points, which are

sometimes in inconvenient locations with spotty connectivity.

It's good to be a platform

Why so many platforms? Look at successful software platforms such as Windows for operating systems. Platforms make a lot of money and are high-margin franchises that endure for decades. People and companies don't switch platforms very often. Often, switching costs are significant and platform choices persist for many years.

As a result, many start-ups aspire to become platforms, because the winners create enormous shareholder value. Their investors push them to market themselves as platforms because winning platform companies can create 100-fold returns.

There are two main problems with this strategy. First, platform companies aren't as focused as application companies on direct customer business value. A pure-play platform alone won't solve a business problem; an application is still needed. The platform's value proposition is harder to explain to business leaders. This translates into a higher cost of sales.

The second problem is that there can be only a handful of winners in each platform space. Application developers don't want to learn multiple platforms. Businesses and consumers don't want to use and pay for multiple platforms. If there are 100 IoT platforms, then there is no platform, just aspirants. The market, over time, decides who the winners are, and the providers consolidate around two or three leaders.

So how do I choose an IoT platform?

Today, there is no one-size-fits-all best platform for every application. It may be years before the market anoints the winners in the IoT platform derby.

EXHIBIT 1

Internet of Things technology stacks must address multiple applications.

Nonexhaustive examples of typical components

Business applications	Predictive maintenance	Fuel optimization	Vehicle routing
P **Platform layer**			
L **Development environment**	Programming tools	Testing environment	Version control
A **Analytics services**	Anomaly detection	Rules engine/ rule sets	Regression services
T **Visualization services**	2-D/3-D graphing	Report creation	Augmented reality
F **E-commerce services**	App store	Usage metering	Billing and collection
O **Security services**	Authentication	Encryption	Threat detection
R **Data-wrangling services**	Extract, transform, and load	Data cleaning	Data modeling
M **Device management**	Provisioning	Monitoring	Control
Cloud			
Storage and software support	Hadoop	Relational-database-management system	Time-series historian
Infrastructure hardware	Compute/ servers	Data storage	Networking
Communication edge			
Wide area	Optical fiber	Cellular 3G/4G/LTE	Microwave
Local	802.11 or Wi-Fi	Bluetooth	RFID
Edge platform	Local storage/ compute	Authentication/ access	Local analytics
Connected devices	Vehicle	Drone	Appliance
Sensors	Temperature	Pressure	Camera/video

In the meantime, choosing a platform should start with a good understanding of your IoT strategy. Identify the kinds of problems you are trying to solve, get a short list of likely solutions and use cases, and try to determine where you will need specialization and depth. If you have an idea of what kind of business problem you are solving and where the biggest challenges lie, you'll be able to quickly come up with a short list of platforms (Exhibit 2).

Avoid the temptation to select a platform simply because it has a particularly interesting initial use case. This would be like choosing a game console because it included a cool game in the box. Included applications matter but are only part of one element of a platform strategy. We have identified the top five characteristics of IoT platforms on which to base an evaluation. While these five are not an exhaustive list, they are the areas most likely to differentiate platforms in an important and sustainable way.

Applications environment
There are three main application considerations when choosing a platform: what applications are available out of the box, what is the application-development environment like, and what are the common enterprise-application interfaces. Many platforms will include one or more applications that may be of some value out of the box, such as the stock-market or weather apps that ship with iPhones. Sometimes, very simple applications are the most popular. One manufacturing executive once told us, "I'd be thrilled to have an app that just told me what machines were on my factory floor and if they are switched on or off."

However, you may need to develop sophisticated IoT apps yourself. Platform providers don't understand your business problems the same way you do. Confirm that the application-development environment

included in the platform is compatible with your own developers or your trusted development partner. Make sure the development environment supports a way to "containerize" applications using a common service so that they can be ported to another platform should you decide to switch. Finally, you may need your platform to interface with large-enterprise applications, such as common customer-relationship-management (CRM) or enterprise-resource-planning (ERP) suites. Some platforms may include connectivity to popular CRM or ERP suites, and this may be an important feature depending on your IoT use cases.

Data ingestion and wrangling
Often, 80 percent of a data scientist's time is spent combining, formatting, cleaning, and processing data to get them ready for analysis. Other companies have created new roles for data engineers, whose main job is to curate and cultivate data sources. Some platforms contain shortcuts or special tools that allow you to build a robust model of your important data much faster, reducing people costs and time to market significantly. Indeed, there are some highly regarded platform companies that specialize in just this capability and use off-the-shelf technology for the other parts of the platform. Apart from the ability to conceptualize the data and understand what they are, also important is the ability of a platform to handle and manage a large number of high-velocity data streams coming from multiple different sources. The ability to handle vast, fast data may be critical, and there are some specialized technologies that focus only on that. Some are being licensed into different platforms.

Ownership of cloud infrastructure
Big IoT platform providers tend to also offer their own cloud hardware infrastructure (including storage, compute, networking, and data centers). For example, Amazon and Microsoft

EXHIBIT 2

These are the top ten questions to ask before choosing an Internet of Things (IoT) platform.

	Platform domain	Question	The answer matters most when:
1	Applications	Does the platform have a facility for developing, testing, and maintaining multiple applications?	You plan to develop a significant number of custom applications yourself
2		Does the platform include compelling prewritten applications to use?	Your development capability is nascent, or you are looking for a plug-and-play solution to a particular key business problem
3		Can the platform connect easily to your current business applications (eg, ERP,[1] MES[2])?	Data in your existing business systems are crucial to achieve maximum value from IoT applications
4	Data management	Does the platform have a capability of structuring and joining multiple unfamiliar data sets?	You have multiple data sources that are unstructured, distributed, or come from 3rd parties
5		Can the platform rapidly ingest high-velocity streams of data?	Data volumes are vast/fast, especially at the edge, or analytics must enable real-time decision making and control
6		How does the platform handle cleaning, formatting, and correction of data?	Data sources are error prone, not well understood, or not in your control
7	Infrastructure	Does the provider own and operate its own data centers with their own cloud infrastructure? If not, which public cloud provider(s) does it use?	You require a specific cloud provider or have specific geographic requirements for data storage, or you don't need the platform to run in your private cloud or on your own premises
8	Security	What commercial-grade authentication, encryption, and monitoring capability does the platform have? Are any of these capabilities distinctive?	You need/want to meet a specified security or privacy standard, or the data are used to make immediate operational or financial decisions
9	Edge process/ control	Does the platform have a capability to do analytics at the edge, without first bringing data into the cloud?	Local connectivity or bandwidth is expensive, or when local decisions need to be made quickly
10		Can the platform be easily configured to "control" the local assets without human intervention?	You need assets at the edge to be able to self-adjust or change state without human intervention

[1]Enterprise resource planning.
[2]Manufacturing execution systems.

both provide a software-platform layer with IoT services, as well as a hardware-infrastructure layer that is broadly applicable across public cloud applications. The hardware-infrastructure layer is capital intensive, has high fixed costs and significant economies of scale, and tends toward commoditization over time. As a result, most smaller platform players avoid offering it, providing only the software layer. They certify their platform on one or more of the leading public cloud providers. Many of the nascent platform companies may not be certified on all the major cloud providers (and often may run on only one of them). This is relevant for enterprises that may be seeking to standardize on a particular public cloud solution for other reasons. Make sure your IoT platform provider and your broader enterprise cloud strategy are compatible.

Data sovereignty and security
You may be content to have your data stored in the public cloud anywhere in the world with standard encryption. Or, it may be that, for security or regulatory reasons, your data must be stored on your premises. Perhaps your data can be in the public cloud but only within certain political boundaries. You may have specific security requirements, either in the cloud or on your remote devices. There may be certain kinds of encryption, access management, or authentication that are required. Blockchain support may or may not be required. IoT platform capabilities vary here. Some are distinctive in certain areas of security.

Edge processing and control
It is one thing to have a platform that takes data from your things and pipes them all up to the cloud for analysis by humans. It's another thing

to run the analytics at the edge. Sometimes, the communications overhead of moving data to the cloud is onerous; transmitting terabytes of data from a remote mine or a ship at sea to the cloud could be prohibitive. Some platforms have specialized capability in handling this. Sometimes local autonomy is needed; some platforms enable you to take the human out of the loop and allow the platform to autonomously change the behavior of the connected end points or shift data only at convenient times. Moving applications from the cloud to the edge, and potentially allowing them to adjust operating variables such as fuel flow or direction or temperature, may be a requirement.

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To get value from IoT across multiple use cases, it helps to use one (and only one) platform in your organization. The IoT platform market is immature, and there are more than 150 options to choose from. As this market consolidates, try to find a partner that is either large and in it for the long run or highly focused, distinctive, and successful in solving your most difficult problems. Look at the whole technology environment, not just the applications. Your most important requirement may be data wrangling, security, or local automation. Use fungible/off-the-shelf technology for the things that are less critical.

Choosing a platform is an important decision, because whether it is game consoles, smartphones, or the Internet of Things, it's likely that whatever platform you choose will be with you for a long time. ◆

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