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Introduction

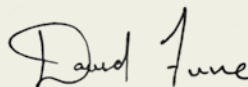
Many governments around the world are facing a growing conundrum. Even as their spending reached \$37 trillion, or around 33 percent of global GDP (as of 2016), their citizens have grown increasingly uneasy with programs and services that fall short of their expectations. Both emerging and developed economies are facing disruption from technology, the advances of globalization and migration, and growing disparities of wealth and income.

Solutions do exist, however. Around the world, local, regional, and national governments have successfully been testing and implementing practices to improve citizens' lives while improving fiscal sustainability. In many ways, the real challenge for global society, then, is the diffusion of best practices among and within governments.

In this new publication from McKinsey's Public and Social Sector Practice, we and our colleagues will tackle that challenge. In these pages, we will explore a wide range of topics examining the ways governments around the world are, and could be, improving their performance and delivering better outcomes for less cost, despite the unique challenges they face. We hope you find these insights useful, and we welcome feedback sent to McKinsey_on_Government@McKinsey.com



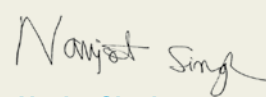
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The trillion-dollar prize: Plugging government revenue leaks with advanced analytics

Few fiscal opportunities are bigger than reducing revenue leakages from tax and payment abuse. Now, new sources of data and new analytics tools are giving governments the upper hand.

Susan Cunningham, Jonathan Davis, and Tom Dohrmann



© aislan13/Getty Images

Rare is the government today whose fiscal challenges don't handcuff leaders seeking to provide for the future through investments in infrastructure, education, and healthcare. Often the difference between funded and deferred policy priorities comes down to the perennial and seemingly intractable challenge of revenue lost to tax noncompliance and improper government payments.

Our analysis suggests that close to 20 percent of government revenues worldwide, or about \$5 trillion, go missing each year, either in dollars owed but never paid or in outbound payments gone awry. In this era of growing demands for government services and pressing budget challenges worldwide, few fiscal opportunities loom larger than reducing these leakages (Exhibit 1).

The good news is that truly game-changing advances in big data and advanced analytics are providing governments with capabilities that would have been difficult to imagine even five years ago. While applying these new capabilities in revenue administration and payments is still a young science, some pioneers are already securing large gains. In one case, a ministry of finance set up a new unit to combine data sets from tax, customs, and business registrations, along with external data from the banking sector, to target fraud and noncompliance. The team quickly integrated new data and analytics to identify suspicious patterns of customs declarations and tax payments. Within a matter of weeks, the unit was testing interventions and plugging revenue gaps that previously would have taken years to uncover. In another example, a finance ministry and a tax authority collaborated on

a completely new approach to compliance infused by analytics strategies and identified opportunities to increase total revenue collected by 5 percent over several years.

Overall, our research suggests that in larger, developed economies, these capabilities have the potential to increase total government revenues by 1 to 3 percent. In less formal, developing economies, the opportunity is much larger, as much as 10 percent or more. To put this number in context, worldwide government deficits are expected to be 2.6 percent of estimated GDP in 2021.¹ Improving revenue collections just 1 percent of GDP would eliminate more than one-third of the deficit, equipping leaders to make and implement better policy choices.

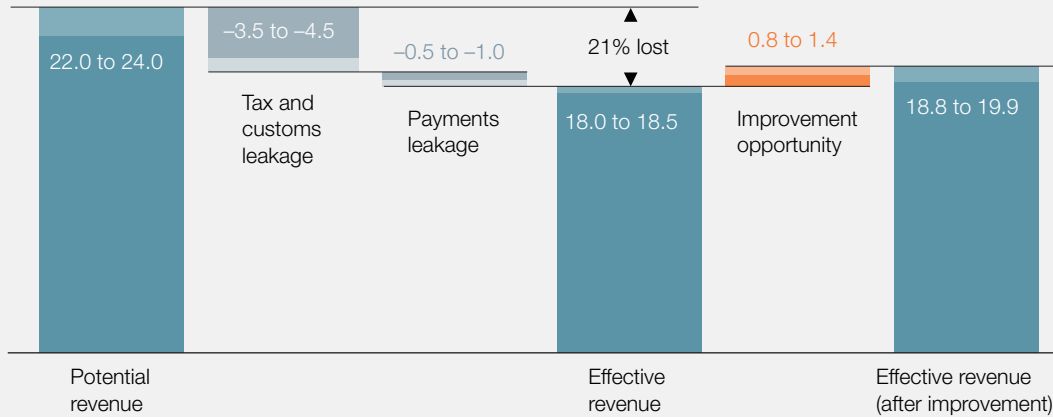
Unfortunately, a handful of common barriers stymie government efforts. First, we find that very few governments globally have taken the systematic approach necessary to deploy these new capabilities at scale. Second, agencies often lack exposure to and experience with the latest innovations. Third, well-meaning civil servants may resist analytics-driven approaches that may challenge long-held assumptions and practices. Finally, effective use of analytics requires mastery of rapid, small-scale tests that can push the boundaries of traditional organizational agility.

Still, leading governments have realized that the value at stake greatly outweighs these challenges, and there are emerging practices that can be deployed to surmount them. Citizens, increasingly accustomed to businesses' sophisticated use of data and analytics, will create urgency and expectations of innovation

Improving revenue collections just 1 percent of GDP would eliminate more than one-third of the deficit.

Exhibit 1 Leading practices enabled by data, analytics, and more-proactive approaches to revenue collection could save \$1 trillion worldwide.

Government revenue leakage in 2015, \$ trillion



Source: GOV.UK; Internal Revenue Service; Organisation for Economic Co-operation and Development; US Office of Management and Budget; World Bank; McKinsey analysis

within governments. The increasing pace of innovation will make the gap between followers and innovators more difficult to surmount.

This article explores why governments now have unparalleled opportunities for improving their outcomes in revenue administration and payments, how big the opportunity could be, and what it takes to effectively seize it.

A rapidly changing game

The substantial leakage of government revenues and improper payments is a persistent challenge for governments. However, three trends create a unique and immediate opportunity for governments to mobilize for greater success: the availability of data,

the plummeting costs of data and analytics tools and storage, and new techniques for translating analysis into action.

The explosion in available data

The rapid digitization of consumer and business life is transforming the way that companies and governments conduct their business. Digitization creates a massive trail of data that can support more-effective revenue and payment programs. There is an emerging consensus globally that governments can and should use these data to reduce revenue leakage, subject to strong privacy constraints prescribed by policy makers. (See sidebar “Addressing privacy head-on.”)

Consider the following examples:

- As *e-commerce* swells and cash becomes less prevalent, tax authorities can unearth businesses that have been “off the radar.” In developed countries, the share of cash transactions by value has tumbled by half in the past decade. Across Denmark, Norway, and Sweden, the share is less than 1 percent (Exhibit 2). More than half of Sweden’s 1,600 bank branches no longer keep cash on hand or take cash deposits.
- The volume and quality of satellite and other *digital imagery* brings new opportunities to use geospatial data to address fraud and leakage, such as by identifying suspicious payment addresses and detecting undervalued properties for tax purposes.
- Governments themselves have increasingly *digitized operations*, making previously offline or limited digital data sets much richer and timelier. Examples include data on business ownership, professional licenses, travel records, and police and court records.
- *Private companies* also have significant amounts of data that can inform government administration. For example, power-consumption patterns may indicate a likely presence of a business operation in a home or a larger commercial enterprise than reported.
- *Cooperation and data sharing* among global tax authorities is accelerating, with standardized reporting by and about multinational enterprises and on individual holdings. Examples include the Organisation for Economic Co-operation and Development’s Common Reporting Standard and the US Foreign Account Tax Compliance Act.

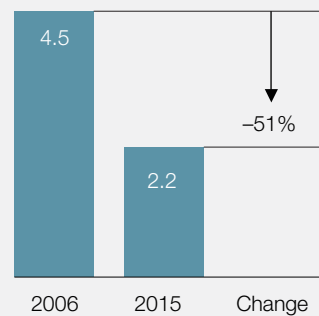
Addressing privacy head-on

Data-driven transformations require governments to become much more adept in accessing and analyzing large amounts of data. Successful programs tackle data-privacy concerns (which vary by jurisdiction) through a handful of common best practices, including the following:

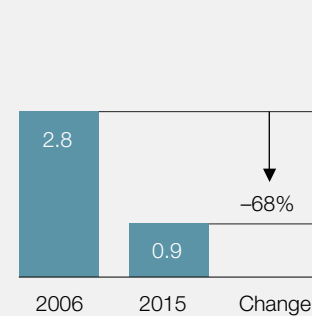
- maintaining strict protocols to ensure that data analysis is performed using masked data wherever possible, with only those with a need to know able to see personally identifying information
- creating transparency into how data will be used (for example, by limiting which agencies can use the data for which purposes)
- developing streamlined channels for citizens to respond when data that agencies rely on are inaccurate or out of date
- providing clear public communications on the outcomes achieved through usage of big data so that the public understands that better analysis means improved outcomes with less irritation for those playing by the rules

Exhibit 2 The share of cash payments by value has fallen sharply, in some regions to below 1 percent.

Share of cash payments in developed countries, %



Share of cash payments in Denmark, Norway, and Sweden, %



Source: McKinsey analysis

Newly accessible and affordable tools

Not only are more data available, but it is now significantly faster and cheaper to extract, process, store, and analyze them. This makes it possible to rapidly transform data into insights and to put both data and insights directly in the hands of decision makers.

Legacy processes for ingesting and storing data are being completely transformed by the following:

- rapid advances in *data assembly and storage* capabilities (for example, through cloud technologies, unstructured data lakes, and data warehouses)
- an expanding set of *tools to manage and manipulate unstructured data* such as free text images, sounds, and video
- quickly evolving *algorithms that can automatically detect patterns* across vast sums of complex data (for example, to detect

unusual concentrations of payments going to a specific geography, or to uncover hidden links with known fraudsters)

- *advances in visualization tools* that allow analysts to convert algorithms to insights leaders can understand (for example, to explore relationships in the data to better understand why algorithms flagged specific transactions)

Now consider how governments are putting these new tools and data to work to identify large and untapped revenue pools. First, advanced models can predict compliance risks that are overlooked by human judgment. For instance, governments are predicting the likelihood of insolvency and unpaid tax debt based on subtle changes in financial statements or payment behaviors such as timing and method of payment.

Second, governments can create an outside-in estimate of business revenues and tax liability, which can then be compared with self-reported values, for example, by

using data on electronic payments and then estimating how much cash the business should be reporting. One example of this is using statistical techniques to predict net income based on business type, specific geography, and benchmarks on input costs.

Finally, agencies can detect linkages between seemingly disconnected entities in ways that can reveal fraud. For example, network analysis can detect organized fraud hubs improperly claiming government benefits or identify healthcare claims submitted by providers colluding to commit insurance-reimbursement fraud.

Innovative ways to operationalize analytics insights

It's no secret that government agencies and employees tend to be risk averse, in ways that can stifle innovation. As a result, most agencies make changes in big steps: they deliberate, agree on direction, and immediately roll out the change to all citizens, sometimes after a short operational pilot. With new analytics tools and skills, agencies can control risk and drive rapid improvements by shifting from this "big bang" approach to innovation to a more controlled, iterative "test and learn" approach. (See sidebar "Mastering the art of test and learn.")

For example, one tax authority tackled tax evasion in the small- and medium-size-enterprise sector through a robust test-and-learn program. A vast number of businesses underreporting income were identified through analytics, first by combining data sets across time and agencies and then iterating advanced predictive models to estimate the likely revenues of each business. The agency carefully tested a range of new treatments, both "hard" enforcement actions and "soft" reminders and educational communications, to determine the return on investment of each treatment for each business. The testing included outreach to taxpayers and their advisers and varied the channels used (mail, phone calls, and mobile messages) as well as the messaging and the actions initiated. For example, authorities sent some businesses a request for self-correction, others a request for limited additional

information, and some a notice of audit conducted by mail or in person.

Combining advanced analytics with carefully designed randomized control tests can help governments make the most of insights from new data and analytics, while minimizing resource demands and reducing risks. In addition to immediate revenue improvements, this rapid, successful innovation can fuel a hunger for analytics-driven initiatives across the organization. As a result, we see government teams moving away from their previous mind-set of no action holding the lowest risk to safely designing and testing innovative solutions.

A trillion-dollar opportunity for governments

These trends—in data, processing, analytics, and agile operations—have converged to open new pathways to recapture revenue leakages. While specifics will vary by geography, our research reveals substantial revenue opportunity available to governments worldwide.

Government revenue leakages come in many forms. Revenue lost from direct tax leakages alone—the "tax gap"—stubbornly hovers around 5 to 15 percent of tax revenue for developed nations and can be more than 60 percent in emerging economies. This represents underreporting and underpayment by individuals and businesses in the formal economy as well as activities in the informal sector that are not visible to tax and customs authorities. It also includes honest mistakes from citizens who are busy trying to provide for their families, run small businesses, and are confused or out of date with frequently changing tax policies or requirements.

In addition, improper payments due to fraud, waste, and abuse cost at least 5 percent of total payments. Improper payments can range from the relatively innocuous, such as an individual claiming a tax deduction for ineligible expenses, to the egregious, such as large-scale fraudulent benefit claims. In the United States, the Government Accountability

Mastering the art of test and learn

The best data-driven organizations run frequent small tests of different potential changes. For instance, Internet marketing tests run hundreds of randomized, controlled A/B trials, showing one of two versions of a message to viewers and comparing the resulting consumer behavior to select the best option.

This agile, test-and-learn approach differs from a traditional “pilot then roll out” approach in the following ways:

- **Test results drive the rollout.** Test results determine whether to proceed at all, with which approach, and for which population. The testing drives the rollout plan, rather than the other way around, as done in traditional pilots.
- **Technical skill sets power the process.** Analytics experts define the decisions being evaluated, design statistically valid samples

and control groups, and capture and evaluate test data.

- **The approach is much more flexible.** Testing multiple treatment options may involve varied call scripts and different versions of notices and website journeys—all while tracking the citizens’ responses separately.
- **Failures are small and opportunities for learning great.** An evidenced-based test-and-learn program dramatically reduces the cost and risk of failure, improves overall return on investment, and builds rapid buy-in.
- **Successes scale quickly.** Once interventions have been tested on a small scale, the winning approaches can be rapidly and confidently scaled up, while lackluster approaches can be either abandoned or significantly retooled.

Office estimates that in 2016, the government lost \$144 billion, or 4.6 percent of all government payments, to improper payments, with some multibillion-dollar programs reporting more than 20 percent in leakage.²

Beyond the estimated \$5 trillion of direct costs of revenue leakages worldwide, the indirect costs of this lost government revenue are also large—a significant debt-servicing burden, uncertain and reduced social benefits, lack of investment in infrastructure for the future, inequity, and, in some cases, social and political unrest.

How much revenue can governments recapture with data and analytics? Taking full advantage

of the advanced-analytics revolution to reduce revenue leakage is still in its early days, with many countries yet to formally establish programs. Only a handful have a track record of more than five years. Still, our experience in both the private and public sectors suggests that governments can capture about 20 percent of the leakage over several years of concentrated effort. Worldwide, that represents a trillion-dollar opportunity.

The private sector has a longer track record in deploying well-planned analytics transformations including these latest advances. For instance, in the insurance industry, machine-learning algorithms have improved fraud detection in insurance claims, in some cases by as much as 50 percent. In retail, analytics-

driven demand forecasting is expected to reduce forecasting errors by 30 to 50 percent, making overall inventory reductions of 20 to 50 percent feasible. In equipment-intensive industries, the explosion of data and associated analytics has enabled entirely new capabilities of predicting when parts will fail, allowing for substantial reductions in downtime for repair.

In addition to helping with fiscal challenges, these advances have the potential to improve citizens' confidence in government, contribute to greater fairness in the system, and advance government sustainability.

Capturing the analytics opportunity

We believe that the tools and approaches discussed here are broadly accessible. The technology behind the data-and-analytics revolution is sufficiently mature, and successful private- and public-sector use cases abound. The investment in IT, data, and analytics infrastructure is modest compared to the potential revenue gains. Of course, transforming agencies to take full advantage of data and analytics requires a comprehensive strategy and dedicated leadership. But while a full-scale transformation takes time, governments can get started quickly and begin capturing revenue gains immediately.

In our experience, we have found seven practical steps that help governments establish a successful analytics program and begin to tap these gains. These steps can help governments achieve rapid momentum and progress, while putting in place measures to prevent typical setbacks and failures. These steps include the following:

- *Enlist a small team of experts with real-world, relevant expertise to launch the effort.* Even large organizations can start with a modest entrepreneurial effort led by individuals with

real-world experience applying analytics techniques and a clear understanding of what the end state looks like. Agencies may attract private-sector leaders, often from the financial-services sector or the digital/high-tech community, with an interest in public service. A team of two or three practitioners, supplemented with specialized external expertise as needed, can create substantial momentum, even in organizations with many thousands of employees. One large developed-economy tax authority recruited senior leaders with experience in advanced analytics in credit-card marketing and risk analysis to lead its new analytics and innovation unit.

- *Pair analytics experts with rising operational leaders, charging both with two-way learning, rapid results, and shared success.* Small, cross-functional groups can quickly learn from one another and unlock massive creativity in problem solving. Consider pairing an up-and-comer in the tax authority's audit function with a seasoned analytics leader, or link an operational leader in an unemployment-benefits agency with a data scientist. Such pairings drive a virtuous cycle of demand, as individuals inside operating units get hooked on new analytics techniques and share their experience with others. At the same time, analytics experts focus more clearly on improving operational results.
- *Design a portfolio of analytics initiatives that ranks challenges and opportunities for delivering impact.* The most successful teams boldly tackle a few truly advanced approaches to solve very large problems and a few smaller, quick wins that serve as confidence builders for the organization. Organizations that fail to design a diverse portfolio end up overweighting highly

speculative initiatives that can stall, or they select a large number of smaller initiatives that are difficult to distinguish from “business as usual.”

- *Commit senior leaders to support and provide resources for the analytics transformation, celebrating successes and learning from failures.* Recognize that those in a government agency’s rank and file are likely to perceive that they are taking risks by working differently. Leaders should actively engage in the effort from the beginning—for example, hosting kickoff events, personally reaching out to team members to celebrate landmarks and successes, and broadly recognizing team learning. These visible support gestures are critical to building and maintaining enthusiasm. Collaboration between the public and private sectors can also accelerate learning and success.
- *Deploy agile processes, a nimble technology team, and analytics “sandboxes” to accelerate progress.* Launching analytics-driven transformations need not involve large-scale IT programs. A small, nimble technology team can ensure a secure yet flexible environment to enable analytics innovation. With a sandbox environment that encourages experimentation, innovation can proceed without creating demands on the systems and platform that run critical day-to-day operations. Often this can greatly accelerate and simplify future IT requirements, saving considerable time and money.
- *Execute iteratively, moving quickly to improve based on initial findings.* Most agencies equate speed with risk. Combining analytics with test-and-learn techniques can eliminate this trade-off, but organizations need a push to operate differently. Governance mechanisms designed for large, multiyear implementation

should be tailored for the smaller, faster test-and-learn approach. While the first iterations of this new operating paradigm benefit from substantial senior-leadership time to move analytics-driven innovation forward at pace, subsequent cycles are much more self-sufficient.

- *Measure and report on progress regularly.* It is critically important to pay attention to how the benefits of analytics initiatives are measured and communicated. Progress in detecting fraud and reducing errors can easily be swamped by day-to-day operations and expectations. Having an established baseline for comparing results and clearly communicating progress are important in building support for long-term change and a continuous-improvement program.

Finally, in embarking on such a journey, government leaders may face many naysayers. Critics will cite a variety of hurdles—fear of a big, ongoing IT transformation; “organ rejection” of new approaches by the existing culture; data-privacy concerns; fear of overburdening constituents; and the scarcity of data-science talent. These are legitimate concerns, requiring engaged leadership and regular communication to overcome. In our experience, a modular approach that orients the organization to learn by doing and to take on risks in manageable increments holds the key for success.

For example, one government was eager to use analytics to improve tax compliance but feared the effort might derail the complex technology modernization program already in progress. However, leaders realized that by using secure analytics sandboxes and small-scale tests, they could start their analytics program in parallel and accelerate the improvements they sought, while generating buy-in to the new IT system.

The result was an on-time IT modernization, with faster adoption and rapid compliance results.



For governments everywhere, the ability to fund policy priorities in an environment of fiscal constraint is only becoming more critical. Fortunately, advances in data analytics offer a rare opportunity for tax and benefit agencies to tap large effective revenue pools that for a long time have been out of reach. For those willing to take the leap, the benefits of improved government finances and citizen service delivery can be dramatic. ■

¹ World Economic Outlook Database, International Monetary Fund, imf.org.

² “GAO-16-357R US government’s 2015 and 2014 consolidated financial statements,” Government Accountability Office, February 25, 2016, gao.gov.

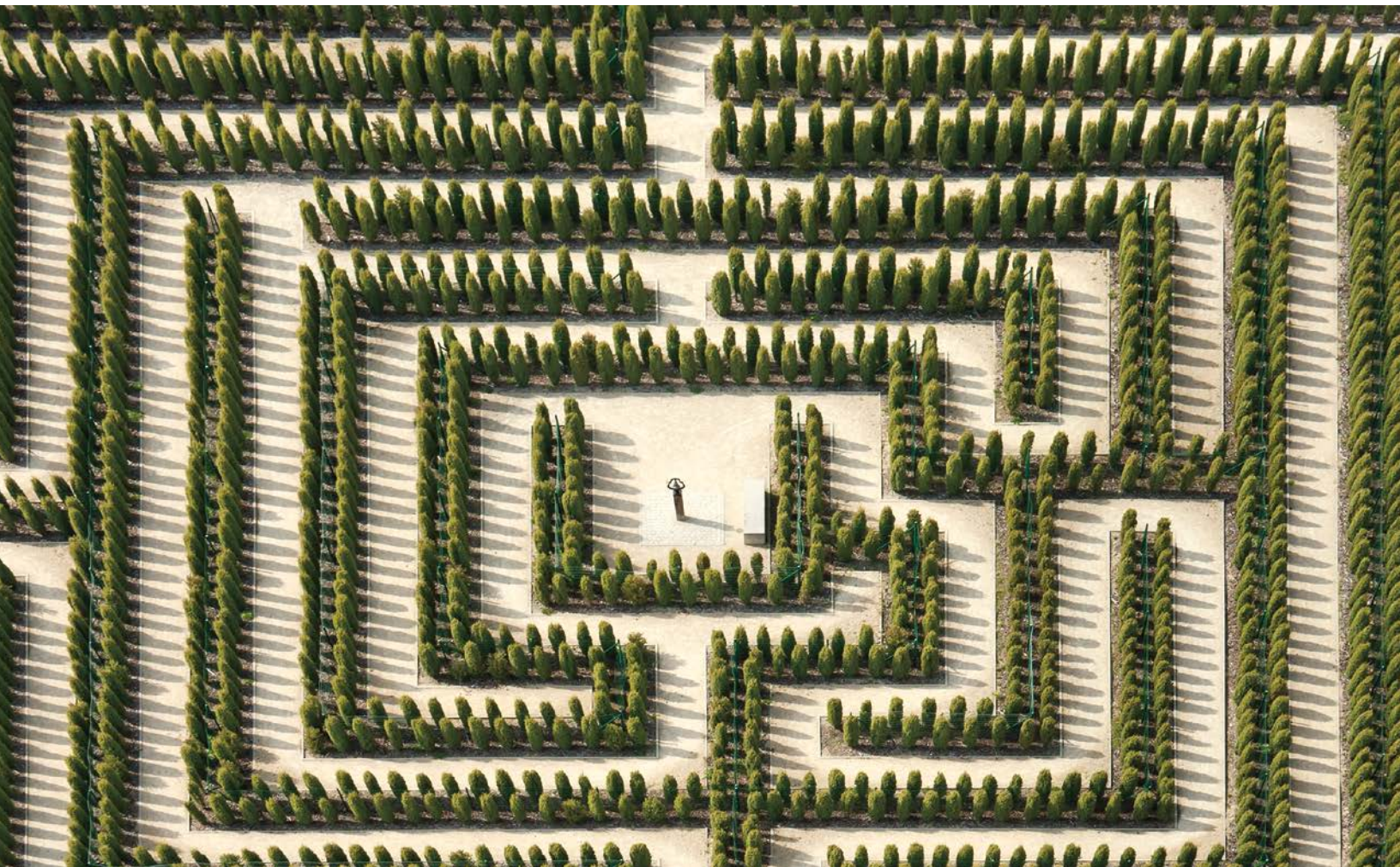
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How the public sector fits in the productivity puzzle

A benchmarking study finds that governments could save \$3.5 trillion a year by 2021 if they were to improve at the rate of their best peers.

Tera Allas



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Few topics in economics today generate as much debate as the productivity puzzle. In most advanced economies, productivity growth has declined sharply—from a rate of 2.1 percent per year between 1995 and 2004 to a rate of 0.8 percent per year between 2004 and 2016.

Economists have offered various explanations for this trend, including the mismeasurement of productivity in increasingly important sectors and a slowdown in technological innovation. But so far they have failed to reach a consensus.¹ It will be critical for them to do so: lower birthrates are slowing the expansion of the workforce, so about 80 percent of future economic growth will have to come from productivity improvements.²

As the debate continues, economists should take care not to overlook a critical piece of the puzzle: government productivity. Yes, it is challenging to accurately measure the inputs and outputs of government entities. But can we really afford to overlook a sector that accounts for 18 percent of global employment and 34 percent of global GDP? And one whose prominence has increased substantially over time?

The answer is a clear no.

McKinsey has developed a benchmarking tool to understand government productivity in 42 countries and seven sectors, over a period of 15 years. We've defined productivity as a measure of outcomes achieved relative to the underlying expenditure—looking, for instance, at the relationship between healthy life expectancy

and health expenditure per capita, or between level of skills and knowledge attained and spending per student.³ Given that it can be misleading to compare such metrics because of country-specific structural factors—such as demographics, geographies, and culture—we were particularly focused on understanding trajectories: Which countries improved their productivity most, and which got worse? What were the overall productivity trends?

We found that, with the exception of spending on public safety and tax collection, unit costs in government sectors have been rising faster than inflation—on average, between 2 to 4 percent per year. In most sectors, this increase in expenditure has been associated with better outcomes, but there are exceptions. In primary and secondary education, for instance, average unit costs rose by about 2 percent and 4 percent, respectively, but average levels of skills and knowledge attained—as measured by the Program for International Student Assessment—fell by 0.7 percent and 0.4 percent, respectively. By any measure, this indicates deteriorating productivity.⁴

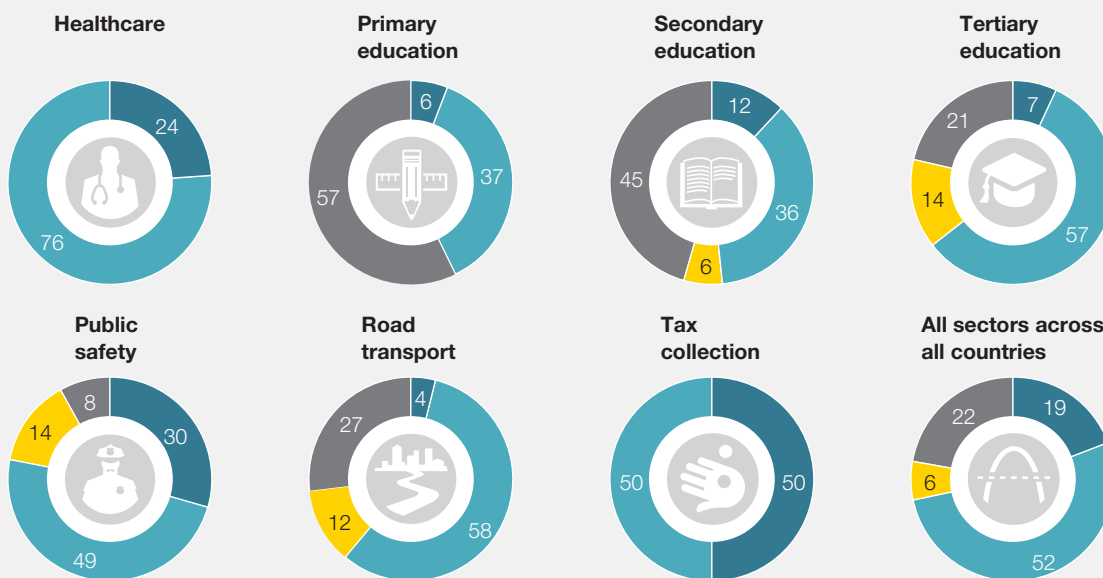
The good news is that every government sector also boasted its share of outperformers—countries that had improved outcomes while reducing expenditure or increasing it only slightly (exhibit). Our research indicates that if all countries were to increase their productivity at the rate of their most-improved peers, governments could save \$3.5 trillion a year by 2021 with no negative impact on outcomes. This would be enough to close the global fiscal gap in 2021.

Unit costs in government sectors have been rising faster than inflation—on average, between 2 to 4 percent per year.

Exhibit All government sectors have pockets of productivity excellence.

Change in productivity of countries analyzed,¹ % share

- **Improvers**
Lower cost per unit but higher outcomes
- **Spenders**
Higher cost per unit and higher outcomes
- **Savers**
Lower cost per unit and lower outcomes
- **Stragglers**
Higher cost per unit but lower outcomes



¹ Researchers looked at 42 countries and categorized them based on changes in cost per unit of output (efficiency) and outcomes (effectiveness) in each sector. Researchers looked at data for the most recent 5-year period available. When analyzing primary and secondary education, they used data within a 6-year period. Figures may not sum to 100%, because of rounding.

Source: McKinsey analysis

In many cases, aggregate figures can hide vast differences between organizations, sectors, and geographies. But our numbers reveal clear incentives for governments to share best practices and learn from others. ■

⁴ For more on educational outcomes, see Emma Dorn, Marc Krawitz, and Mona Mourshed, “How to improve student educational outcomes: New insights from data analytics,” September 2017, McKinsey.com.

For detailed findings from McKinsey’s productivity research, see *The opportunity in government productivity*, on McKinsey.com.

Tera Allas is a senior fellow in McKinsey’s London office.

¹ For more, see “New insights into the slowdown in US productivity growth,” McKinsey Global Institute, March 2017, on McKinsey.com.

² For more, see “Can long-term global growth be saved?” McKinsey Global Institute, January 2015, on McKinsey.com.

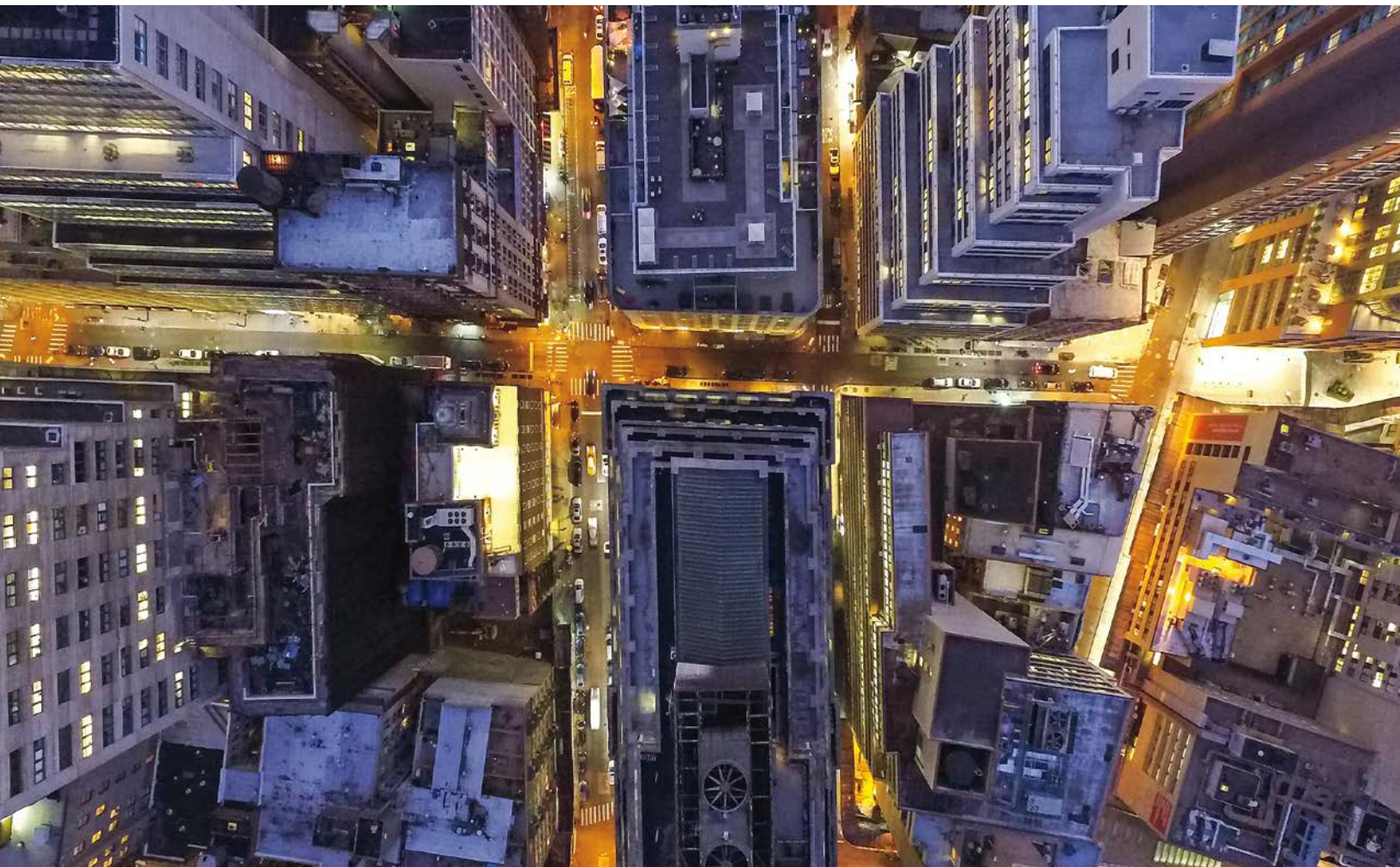
³ Life-expectancy figures are adjusted to factor in the quality of health throughout people’s lifetimes.

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Harnessing the power of digital in government agencies

A focus on customer journeys, a dedicated digital team, agile methods, and strong talent can help government agencies move beyond incremental improvements and achieve transformative change.

Steve Cheng, Mike Joyce, and Mark McMillan



© Jack Berman/Getty Images

Government agencies cannot rely on expanding budgets to keep up with increasing demand for their services. What's more, agencies are being asked to deliver high-quality solutions to increasingly complex problems at an ever-faster rate. To close the gap, they must get more done, and do it better, often without additional resources. McKinsey has estimated that the world's governments could save \$3.5 trillion per year by 2021 if they match the productivity gains that leading countries have made in four functions, of which one is digital technology and data analytics.¹

Digital technology has given many governments the means to fulfill their missions with greatly increased productivity. Through digital transformations, agencies can integrate cutting-edge technologies (such as cloud, mobile, artificial intelligence, and automation) and modern management practices (for instance, agile software development) to dramatically improve services and outcomes for constituents.² The United Kingdom's Government Digital Service, for example, reported that initiatives like migrating websites to gov.uk saved £600 million in the five years through April 2016. One US federal agency is on track to complete a large IT modernization effort using only 25 percent of its projected budget by taking advantage of agile development, cloud technologies, and other features of a modern digital approach.

Results like these—greater output, with the same or better quality, produced more efficiently—exemplify the “stacked wins” that are possible with digital applications (Exhibit 1). Just as important, a digital transformation establishes systems and ways of working that enable federal agencies to continually adapt to the changing needs of their customers by strategically prioritizing the transformation of services that need to operate with increased efficiency and effectiveness.

Such results are as yet uncommon, though. Overall, US government entities trail organizations in other sectors in adopting digital technologies and

approaches.³ Our experience suggests that digitization efforts in US government agencies typically fall short of their potential for four reasons: cumbersome and bureaucratic internal rules and procedures, scarce funding for technology projects, a narrow perspective on individual functions and customer touchpoints, and a shortage of “digital native” talent.

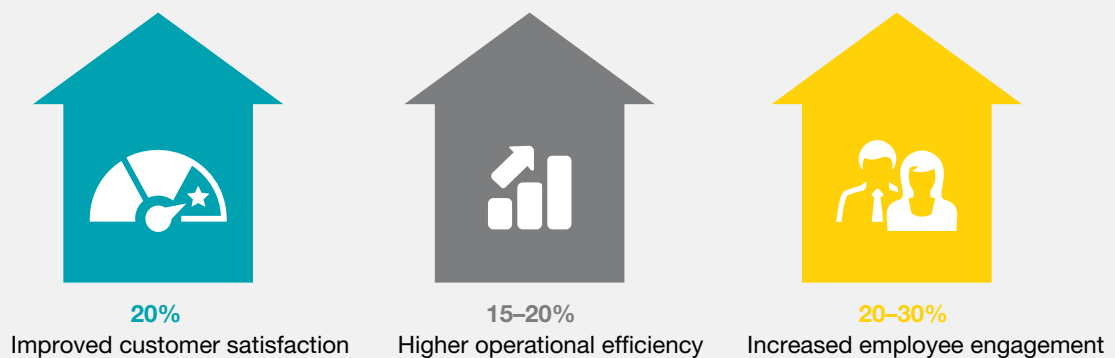
These barriers are being lowered to some degree by top-down pushes like the creation of the US Digital Service; the passage of the Federal Information Technology Acquisition Reform Act, which strengthens the role of chief information officers (CIOs); executive orders to reduce waste and move technology infrastructure to the cloud; and the Report to the President on federal IT modernization. Some agency CIOs are starting to pursue digital transformations by developing strategies to guide technology investments and mandating the use of agile-development principles. In many cases, though, rapid digital transformations are only possible if agencies make fundamental changes to how they operate.

Four changes stand out as especially helpful: establishing a digital nerve center with a clear mandate and singular accountability to drive change; adopting agile project methodologies to increase flexibility and accelerate time to market; reimagining end-to-end customer journeys rather than simply optimizing touchpoints; and building a core group of experienced, in-house digital specialists to lead the transformation. In this article, we offer federal and state officials a closer look at these practices, along with ideas for how to start digital transformations that deliver powerful results.

The barriers that impede digital transformation

In our experience, the people working on digital projects at large government agencies must work around organizational barriers that can be just as formidable as the technical challenges they face, if not more so. As we discuss next, the complexity of government projects, the difficulty of coordinating them across departments, and the scarcity of digital

Exhibit 1 Private- and public-sector organizations can realize significant performance gains following digital transformations.



Source: McKinsey analysis

talent make digital projects costlier and slower than they ought to be. They can also prevent digitization efforts from having a transformative effect on operations and performance.

The complexity of project execution

Even modest initiatives to digitize government processes or services are typically governed by a welter of guidelines and restrictions, many of which were established for good reasons, such as ensuring that taxpayers' money is well spent. To ensure compliance, agencies typically establish additional procedures, multilevel approval processes, and strict rules, all of which impede progress by requiring tasks to be completed in a particular sequence. It is not uncommon for this type of process to continue for months without building a single function that users can experience and critique. Passing through the litany of gates also requires staff to spend time on planning, process management, and documentation instead of development, design, and testing. Violating these rules can delay a project, add costs, or even bring it to an end, but following them does not ensure success, only long timelines and significant overhead.

When software service providers are involved in digital projects, as they often are, matters become

even more complicated. Within agencies, controls on spending and vendor selection also tend to prolong the procurement process—so much so that technology, which is state of the art when first ordered, might be out of date by the time it is acquired and implemented. And if an agency determines that the project requirements have to change, this can lead to delays and additional costs.

Current controls are also often designed around traditional ways of working. This typically means highly sequential waterfall-based methodologies, on-premise architecture, and closed-source technologies, even though the development world is shifting in the opposite direction (for example, toward agile development, cloud-based architecture, and open-source). While agencies have attempted to alter these controls to add flexibility, few have succeeded in harnessing the power of digital approaches at a significant scale.

Limited flexibility in funding new technology

Most agencies only have a certain degree of flexibility when it comes to paying for the transition from analog to digital. One issue is that budgets have remained flat. Another is that government agencies spend a large majority of their IT budgets on

operating and maintaining legacy systems: almost 78 percent, in the US on average, with some agencies spending 90 percent on the upkeep of older systems. The swelling of operations and maintenance expenses during recent years has cut into the proportion of agencies' IT budgets that is available for modernizing systems or developing new ones.⁴ (The complex processes and risk-averse development pathways described in the previous section also tend to inflate project costs, so the money that agencies obtain for new digital solutions doesn't go as far as they might like.) Furthermore, agencies' "investors" in the US Congress take a skeptical view of new funding proposals, having seen many IT projects run behind schedule or over budget without achieving their intended objectives. Together, these factors make it challenging for federal agencies to secure the money they need to adopt the latest digital technologies.

Narrow perspective on users' experiences

Often, multiple departments within an agency administer different parts of an end-to-end customer journey. The communications department might run the website while field offices provide in-person customer service and another group manages the call center. In many agencies, these departments are allowed to digitize, or otherwise change, their operations without considering how their changes might affect other stages of the customer journey.

When a customer journey is digitized in piecemeal fashion, the overall experience can become frustrating and time-consuming. Suppose that a person wishes to file an application for a permit. After calling a hotline for help, she visits a cleanly designed website offering a user-friendly application form. But once she has submitted the application, she finds it hard to get a status update from the website. When she calls the hotline again, the representative cannot access the application system and has to transfer her to someone who can. Each individual step in that process might be easy for the customer and for the agency, but the lack of integration among steps means that the entire

process is troublesome for the customer. Having to switch from one channel to another makes the overall experience unsatisfactory, according to McKinsey research.

A shortage of digital talent

Government agencies routinely struggle with assembling the right talent to complete digital-transformation projects. Their first challenge is to figure out which skills they need. Senior officials might know they want to explore the applications of big data and advanced analytics. But if they are unfamiliar with the tools and methods used to analyze big data, they might find it difficult to assess candidates for the expert positions they need to fill.

Even if agencies hire software architects or other specialists who can effectively identify and judge technical talent, they must still contend for product owners, designers, and user-interface/user-experience-design experts. These workers command high salaries and are naturally drawn to the culture of innovation and flexibility that companies can offer more readily than government agencies. To fill the talent gap, many agencies try outsourcing. But software-service providers, too, must compete for scarce digital talent—talent that can be hard to bring on board when a provider is accustomed to "lowest price technically acceptable" government contracts. And agencies still need enough of the right in-house technical expertise to develop appropriate work orders and manage the collaboration between agency staff and contractors.

Principles for success in government digital transformations

It's typical for government entities to focus on shifting their operations from analog platforms to digital platforms and neglect the supporting organizational changes: simplifying processes, removing internal barriers, or resetting strategic priorities, to name a few. Such organizational changes can make the difference between a digitization program that delivers breakthrough improvements in efficiency

and customer satisfaction, and one that merely retrofits digital features onto structures and systems that could work better (Exhibit 2). Here are four principles that government agencies can use to plan and carry out truly transformative digital programs.

Set up a digital nerve center to power the transformation

Transforming an organization, whether with digital technology or otherwise, requires consensus about what the organization ought to do differently and careful coordination of the necessary changes. Consensus and coordination are especially important when projects are subject to the sort of complex requirements and controls that we identified as barriers to digital transformation at government agencies. Our experience with US government agencies suggests that a digital transformation proceeds more smoothly when a senior official is put in charge. The leader of the digital transformation

must make sure that the transformation has the support of the agency’s leaders, along with adequate funding and staff.

Staff who are assigned to manage a digital transformation will ideally be organized into a single team, or nerve center. Such a nerve center should include members who are capable of redesigning operations as well as technology, coordinating activities across departments, and managing the transformation effort from day to day. A key responsibility of the nerve center will be to conceive low-cost, high-value projects that the agency can pay for without requesting extra funds up front (though the success of initial projects can be used to make the case for more funding later). Focusing on digital initiatives that deliver large benefits at modest expense also helps agencies avoid the cost overruns and missed delivery dates that often occur on government IT projects, particularly projects with large budgets and lengthy implementation periods.⁵

Exhibit 2 A digital transformation produces major changes in the ways that government agencies use digital assets and capabilities.

Before	After
Digital projects led by IT with business input	Digital projects jointly owned, with business driving design
Waterfall methodology requiring full vision of solution before development begins	Rapid prototyping and development, with changes informed by user feedback
Agency-focused experience design	Citizen-centric experience design
Tightly controlled delivery processes	Team-determined delivery processes
Development in a series of finite projects	Development on a continual basis by a digital factory
Traditional, inflexible technology (eg, ERP, ¹ custom legacy applications)	Nimble technology that is configurable or open source
Heavy on-premise infrastructure	Cloud computing

¹ Enterprise resource planning.

Source: McKinsey analysis

Another responsibility is to ensure that those projects can launch and advance quickly. This may require digital specialists to collaborate with agency leaders on developing alternative ways of working that still conform to the basic principles that govern the agency's operations, instead of obtaining short-lived exceptions to rules. It also involves documenting lessons and refining the transformation process accordingly.

The nerve center will also have to expand the agency's capacity for developing new digital applications. Some federal agencies have set up a digital factory, which is a central development team that begins with a few pilot projects of a similar kind, then gradually adds capabilities so it can handle a wider variety of assignments. Other organizations create a distributed cohort of delivery champions, each of whom joins an existing development team to steer it toward new methods. Either approach can work as long as the organization has a nerve center to guide the scaling process.

Implement agile methodologies

Swift decision making, a clear systems-development road map, and agile processes can all help an agency overcome the organizational complexities that might encumber its digital transformation. Traditional approaches to systems development involve defining all the requirements before coding begins. An agile approach entails forming small, multifunctional teams of business specialists, product managers, and software developers to jointly design and create minimally viable features, expose them to users

so feedback can be collected, and then refine them through multiple development cycles.

To realize the full benefits of agile, an agency must also foster collaboration among its product team, finance department, procurement department, and senior leadership, as well as other constituencies. Each group can embrace more flexible ways of working that let it readily adjust to new information. For example, product and procurement teams can prepare contracts that allow specifications to be defined as development progresses (rather than up front, as in waterfall development). A finance team may need to accept greater uncertainty about when and how the funds for the project will be spent. Investments in engineering practices and operations also help with scaling agile development across the organization. The most sophisticated agile development groups follow an "automated everything" approach, in which most testing and deployment is programmed.

Transitioning to agile development is not easy, but the benefits can be significant. The US Social Security Administration recently shifted to agile development with the aim of making its \$300 million IT-modernization program more effective. The program had faced budget and timeline overruns, and the reigning waterfall methodology caused delays and usability complaints. After implementing agile methods, the program delivered new application capabilities for one-third of the regular cost, while exceeding customers' expectations.

This may require digital specialists to collaborate with agency leaders on developing alternative ways of working that still conform to the basic principles that govern the agency's operations.

Rethink and reorganize around customer journeys

Government agencies ordinarily put separate departments in charge of specific interactions, or touchpoints, with customers (for example, accepting passport applications online), which understandably narrows their perspective on improving satisfaction. A better approach is to pursue improvements by looking at the customer's journey through a process (obtaining a passport) as a continuous whole. McKinsey research indicates that customers report higher satisfaction with government services when agencies manage journeys well from start to finish.⁶ By assessing an entire journey from the customer's perspective as well as the agency's perspective, an agency can better identify possible cost savings, efficiency increases, and satisfaction improvements.

Another helpful practice is to encourage greater collaboration among the departments that support a customer journey. In some instances, agencies might benefit from reorganizing themselves, by putting all the people who work on the same customer journey into a single unit. Greater collaboration also helps agencies make smarter investments in digital technology: rationalizing operations before digitizing them usually means that less money has to be spent on enabling technologies. Agencies can get started by identifying the most frequently used customer journeys and then reimagining them from end to end.

In an ambitious effort to transform its customer experience, one federal program worked closely with internal and external stakeholders to map and redesign eight core customer journeys. The new journeys enabled the program to deliver customer services five times faster than before, resulting in a dramatic improvement in the customer experience.

Build a core of digital change agents and draw on outside talent as needed

Faced with a shortage of digital talent, government agencies need to be creative and resourceful about how they staff their digital transformations. Development teams ideally include a mix of in-house

employees, to retain knowledge and build a healthy culture, and flexible contractor support, to provide necessary expertise when it's needed, without adding fixed costs to agencies' tight and relatively inflexible IT budgets.

In-house employees can establish the consistency that teams need to follow modern IT-development methods, such as agile, which involves adapting quickly to new feedback and working on a near-continual basis, rather than until a delivery date. These team members are best used for strategic and management tasks such as working with stakeholders to define a vision for a digital transformation, evaluating and prioritizing projects, building relationships across the agency, defining feature sets, and determining what capabilities are needed. Some agencies have in-house digital teams to handle projects ranging from quick fixes of faulty or outdated systems, to prolonged transformation efforts. Many of the people on the team joined the government from technology companies and offer experience and perspectives that complement those of in-house employees.

When it comes to supplementing their in-house teams with specific capabilities or extra manpower, federal agencies have resources within the government that can help them build capacity and acquire knowledge. The US Digital Service has a broad mandate to help agencies digitize customer-facing services and shared platforms and streamline procurement processes. It can provide an agency with a valuable bridge to more advanced digital capabilities.

Of course, the modest capacity of the US Digital Service relative to the massive scale of the federal government means that many agencies will continue to rely on contractors for digital services. But new contracting mechanisms like multiple-award blanket purchasing agreements (BPAs) can help agencies meet the changing demands for staff that agile development often creates. With multiple-award

BPAs, agencies grant several contractors the option to compete for particular assignments defined by skills, experience, timing, cost, and deliverables. By splitting a project into numerous self-contained parts, agencies can avoid the risk of vendor lock-in, promote competition among the BPA awardees, and contain costs. Over time, the organization can observe how contractors perform and direct more work to the best ones.

Getting started: Catalyzing digital transformations with pilot projects

Digital transformations are most effective when they are reinforced by major organizational changes. The UK government, for example, established an 18-point standard for making its public-facing services “digital by default.” This standard covered everything from the structure of the teams supporting government services, to the use of agile methods, to the quality of the customer experience. But such far-reaching changes are prone to arouse skepticism, if not reluctance. One way to convert skeptics to supporters is to rapidly complete a series of digital pilot projects. This approach quickly demonstrates the art of the possible: that a cross-functional team can design improved processes and that modern development tools can increase efficiency.

In our work with government and private-sector clients, we have seen pilot projects generate working prototypes and beneficial process changes in as little as 8 to 12 weeks. This creates momentum for the transformation with minimal investment. To ensure the effort doesn’t conclude with the pilot projects, those projects should be planned with the ultimate transformation goal in mind, so the agency can apply what it learns from the pilots throughout the organization.

Government entities can develop pilot projects according to the following process. It is built around concept sprints, which are collaborative workshops to rapidly identify improvements that digital initiatives should seek.

Step 1: Establish a transformation aspiration.

Successful digital transformations begin with the end in mind. An organization should therefore determine the goal of its transformation—usually a combination of cost reduction, better customer experience, more informed decisions, faster delivery, and more innovative services—then identify high-priority customer journeys as candidates for pilot projects.

Step 2: Stage and launch concept sprints.

For each opportunity, the organization should form a small team (typically 6 to 12 people) to reimagine a customer journey as seamless, efficient, and satisfying. In several cross-functional workshops, the team sketches out new operating processes and supporting technologies for the journey. Concept sprints are typically facilitated using techniques from design thinking, which can promote the creativity and collaboration that lead to transformative ideas. At the end of a concept sprint, teams should have a customer-centric design that engineers can start realizing in code.

Step 3: Build, test, refine—and repeat, using delivery sprints to build a minimum viable product.

Based on the new concept for the customer journey, software engineers start coding new features and applications, in close collaboration with functional groups. This agile development approach should allow developers to create interactive functions every two weeks, gather feedback from users, and make refinements, while functional specialists revise their operating processes and apply changes to other projects. After 12 weeks, the team should have a minimum viable product that customers can use, along with guidance on how the process should work.

After the team has built the minimum viable product, it has effectively piloted product development using agile, design thinking, and a business-led customer-focused approach. During the process, agencies will identify barriers to this new way of delivering digital solutions. Some barriers might be easy to work around; others will require further thought. Following the concept sprints, the agency can come

together, under the leadership of its digital nerve center, to craft a tailored delivery process and use these concepts in more of its IT development.



In spite of their desire to improve performance with digital transformation, many federal and state agencies have been unable to realize the full potential of digital technology. The barriers they face are formidable. Complex methods of project management and software development inhibit innovation. Agencies' IT budgets include little money for new projects. Departments optimize their activities without considering whether the overall customer experience is coherent and straightforward. And difficulty attracting the right software designers and developers limits the use of leading-edge solutions and tools. By putting a senior official and a dedicated team in charge of the digital transformation, shifting to agile development and other advanced techniques for executing projects, reexamining their operations with regard to end-to-end customer journeys, and refreshing how they build their digital workforces, government agencies can maximize the benefits of digital transformations—and ultimately deliver better services. ■

¹ For more, see *The opportunity in government productivity*, McKinsey Center for Government, April 2017, on McKinsey.com.

² For more, see Bjarne Corydon, Vidhya Ganesan, and Martin Lundqvist, "Transforming government through digitization," November 2016, on McKinsey.com.

³ James Manyika, Sree Ramaswamy, Somesh Khanna, Hugo Sarrazin, Gary Pinkus, Guru Sethupathy, and Andrew Yaffe, "Digital America: A tale of the haves and have-mores," McKinsey Global Institute, December 2015, McKinsey.com.

⁴ IDC Community, "Legacy system money pits—Our federal IT budget analysis spotlights the problem," blog entry by Shawn P. McCarthy, October 12, 2016, idc-community.com.

⁵ For more, see *Government productivity: Unlocking the \$3.5 trillion opportunity*, McKinsey Center for Government, April 2017, on McKinsey.com.

⁶ Aamer Baig, Andre Dua, and Vivian Riefberg, "Putting citizens first: How to improve citizens' experience and satisfaction with government services," November 2014, McKinsey.com.

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Digitizing the state: Five tasks for national governments

Public authorities cannot build great digital services on their own. They need national governments to provide the right conditions for them to succeed.

Matthias Daub, Axel Domeyer, Julia Klier, and Martin Lundqvist



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For some countries, the provision of comprehensive digital public services is no longer just an aspiration. In Estonia, for instance, the only services that still require a personal interaction with a civil servant are marriage, divorce, and real-estate purchases. In other nations, too, public authorities are building digital services that are just as compelling as the products of leading Internet companies. They have done so by focusing on customer needs and implementing the same agile “test and learn” development practices that online giants use.¹






But it’s not enough just to change work flows and mind-sets within public authorities. Agencies and municipalities need the national government to

provide the right conditions for them to succeed.

Our research and global experience with digital transformations in the public sector suggest there are five core tasks that national governments could perform to facilitate the launch and uptake of digital public services: they could set an overarching digital strategy and targets, provide common IT platforms, define technical standards, facilitate change through legislation, and underwrite and support pilot projects that help public authorities build critical digital skills (Exhibit 1).

Our review of ten European nations shows that when national governments do these tasks, and do them well, countries can achieve high rates of adoption

Exhibit 1 National governments should focus on performing five tasks critical for launching digital public services.

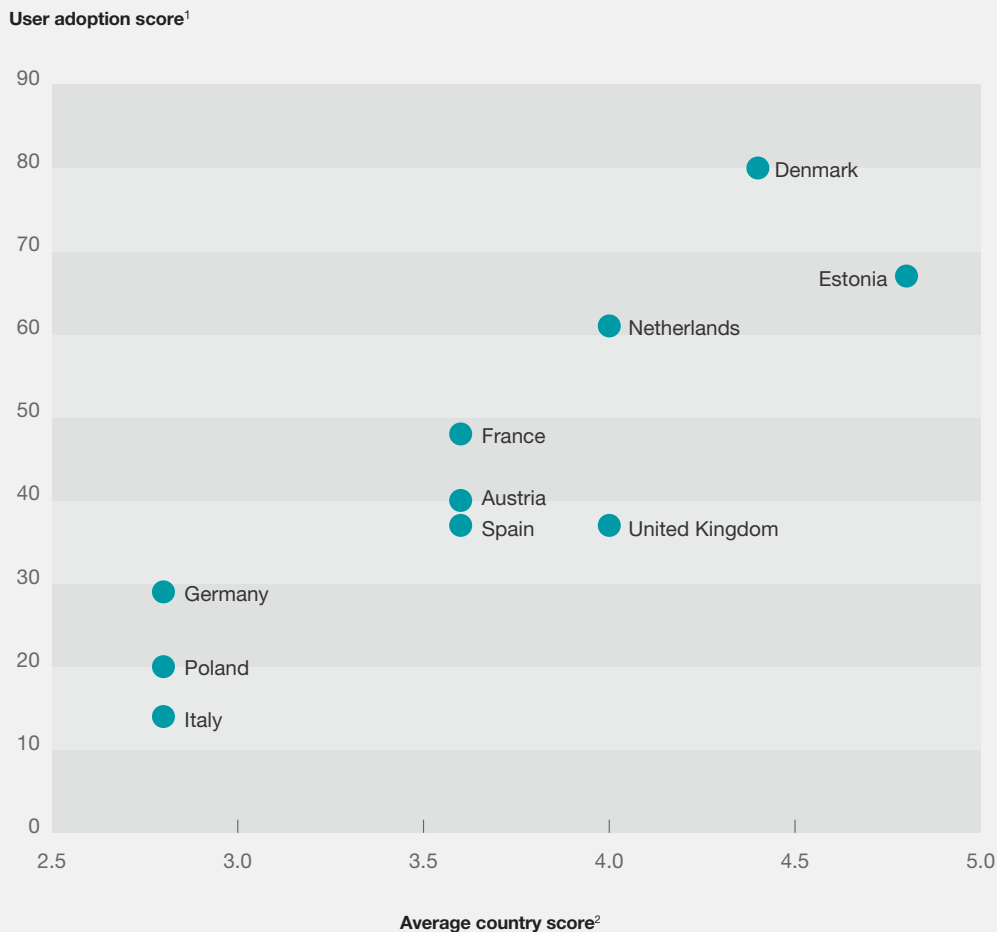
Task	Criteria for success
 <p>1. Set a clear digital strategy and targets</p>	Set ambitious but measurable goals; adopt a unified management approach
 <p>2. Provide common IT platforms</p>	Enable electronic identification, easy access to information, and seamless data exchange across public-sector institutions
 <p>3. Define technical standards</p>	Actively guide development of enterprise architecture, best practices in IT project management, and standardization of core IT
 <p>4. Facilitate change through legislation</p>	Make aspirational digital goals more formal; scan administrative rules to remove obstacles to digitization
 <p>5. Incubate pilot projects and build critical skills</p>	Support development of “lighthouse” case studies, strengthening internal capabilities in process

Source: McKinsey analysis

for digital public services (Exhibit 2).² A closer look at the most successful countries in this cohort reveals another important factor behind their strong performance: they have established central units to coordinate their efforts in supporting digitization of the public sector. The Danish Agency for Digitisation, for instance, has played a crucial role in shaping

national strategy and supporting public authorities with their implementation of digital initiatives. In this article, we explore the five core tasks national governments have focused on to support digital innovation by these public authorities, and we consider the elements required to build a strong central digitization unit.

Exhibit 2 When public authorities receive support from national governments, user adoption of digital public services increases.



¹ Calculated based on share of citizens age 16–74 who submit public-service forms online (weight 2/3), and on share of citizens age 16–74 who get information about public services online (weight 1/3).

² Assessment of whether a country meets established criteria for success across five tasks; rated from 1 (not at all) to 5 (demonstrates best practices internationally).

Source: Eurostat, McKinsey analysis

Task 1: Set a clear digital strategy and targets

Governments can achieve three main benefits from digitization: improved citizen experiences, higher productivity and efficiency, and better policy outcomes.³ To create these benefits, governments rely on actions from a range of public authorities—each with its own priorities, capabilities, and timelines.

It is therefore useful for national governments to communicate to public authorities the overarching digital strategy and priorities for different time horizons. In this way, they can help to ensure that public authorities' efforts are focused and synchronized. And when individual change efforts are linked to a simple, well-articulated, overarching vision, innovators in public authorities are more likely to overcome resistance from internal stakeholders and get things done.

The Danish government, for instance, made a strategic decision to move as many existing public services online as possible and worry about other digitization objectives later. It captured that goal with the following mandate: “No more printed forms and letters.” Many stakeholders in the process later noted that this simple statement played a big part in the ultimate success of the strategy. Once that initial goal was achieved, the Danish public sector could shift its attention to new priorities such as redefining the citizen experience and developing digital services that would promote priorities, such as economic growth.

National governments could also measure progress against goals and monitor the implementation of digital initiatives by public authorities. One of the performance metrics associated with the Danish 2016 to 2020 digitization strategy, for instance, is to reduce the administrative burden on companies by about 3 billion Danish krone (or about \$460 million)—an objectively measurable indicator. An interministerial steering committee continually reviews how Danish public authorities are performing against the stated timelines and goals.

Task 2: Provide common IT platforms

Digital public services are easier to launch and manage when typical functions and components—for instance, the ability to securely log in to an online form—are available to all public authorities as “reusable building blocks.” Because of the cost and complexities involved, it is impractical for public authorities to build the necessary technology and management infrastructures on their own. National governments can instead help to establish common IT platforms that all public authorities can use. We believe that three applications, in particular, are important to provide: electronic identity management, easy access to digital services for citizens, and seamless exchange of data among public authorities (Exhibit 3).

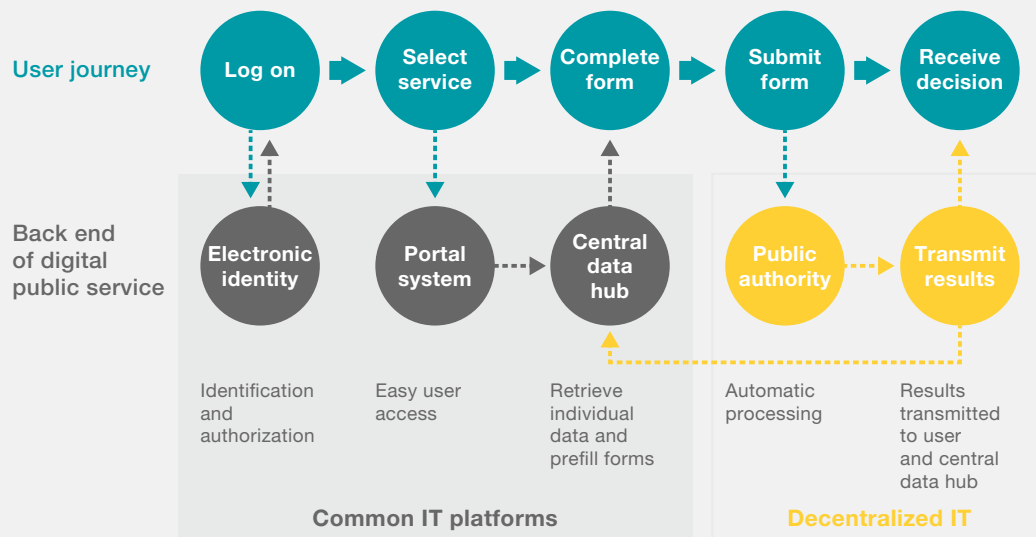
Managing electronic identity

To receive a public service online, citizens and companies need to be able to identify themselves and provide a legally binding digital signature. The challenge for national governments is to set up a comprehensive system that is both secure and user-friendly enough to encourage widespread adoption. Germany, for example, initially saw low usage of its electronic identification (ID) system. Citizens needed to own a physical card reader to conduct secure online transactions using their electronic IDs. Few citizens had such a device, so public authorities had little incentive to incorporate the electronic ID into their digital services. To break the cycle, the government has released a smartphone application to replace the card reader. The hope is that the use of digital identifications and signatures will become as common in Germany as they are in, say, Estonia, where two out of every three citizens regularly use a national electronic ID to perform online transactions.

Providing easy access to digital services

Public services are delivered by a multitude of public authorities at different geographic levels, all with their own presences online. Such fragmentation

Exhibit 3 To ensure success with digital public services, national governments need to provide common IT platforms.



Source: McKinsey analysis

can thwart the creation of a simple and unified user experience, and can make it time consuming for citizens and companies to interact with the state. Some national governments have created centralized access points, or portals, dedicated to the most common service requests. Users can typically navigate these portals based on life events. So when a new parent selects from a drop-down menu, “I am having a child,” he or she is automatically routed to the relevant online services—for instance, applications for child benefits.

The government of Denmark has established an online portal dedicated to citizen services and another one for corporate services; all public authorities are required to link their digital services to the respective sites. Under this model, individual accounts are created for citizens and companies so they can track their various online interactions

with the government in one place. And officials in Denmark are now exploring ways to use search-engine optimization and other digital tools to make these digital services more visible to citizens, and therefore even easier to access.

Ensuring seamless data exchange

To process the case at hand, public authorities need to ask citizens and companies to share sensitive information. To determine whether they qualify for social welfare, for example, citizens may need to report household incomes, wealth, family status, and the like. Ideally, public authorities would ask for such data only once and make that information available in digital form to whichever public authority needs them to provide a service. However, for security, technical, and other reasons, data sets often are not shared among public authorities. Citizen information remains siloed.

National governments can facilitate seamless data exchange by providing a common technical infrastructure for exchanging data, rules governing the use of this information, and safeguards to protect sensitive data from unauthorized access. Estonia is the most advanced country with regard to seamless data exchange. Its State Information Agency has mapped all data owned by the national government and provides a standardized technical environment, called the X-Road platform, for secure information sharing with all users in the public and private sectors. To ensure that data are not used without proper authorization, transactions on the platform are logged, and citizens can check to see who accessed their information using individual online service accounts. In 2016, there were about 250 government databases and about 1,800 individual data services available through X-Road. Citizens and companies accessed this information about 575 million times throughout the year—a large number given that Estonia has only 1.3 million citizens.⁴

Research indicates that national governments could unlock massive productivity gains and higher quality of service if they could improve their data-exchange infrastructures and protocols. In Germany, for example, paper forms can be a big time sink for both citizens and public authorities: consider that citizens need to submit up to 17 documents along with their application for parental leave. If paper were eliminated from the most common service transactions, citizens could gain 64 million hours of free time per year, companies could reduce their administrative costs by €1 billion per year, and public authorities could save 59 percent of the work hours spent processing cases.⁵ In addition, public authorities might avoid costly errors resulting from incomplete or false information. By using data shared and verified by a range of public authorities, social-welfare agencies, for instance, may be able to spot fraudulent benefit applications earlier in the process.

Task 3: Set technical standards

National governments as a whole are typically giant users of IT, but their systems are, necessarily,

dispersed across countless public authorities. Therefore national governments may be able to play a central role in ensuring interoperability—that is, identifying and managing the relationships and dependencies among different IT systems, and setting principles and guidelines for how systems are developed. The government of Finland, for instance, set up a national enterprise architecture function through a 2011 law.⁶ Since then it has developed a tiered approach to managing IT systems: the group has established principles and reference architectures for managing IT systems across the public sector overall, but it has also developed specific rules for managing IT systems in individual domains, such as healthcare, justice, or defense.

National governments may also need to define and disseminate best practices in IT project management. Public authorities struggle with large IT projects just as much as companies in the private sector do; the majority of these projects fail to meet budgets or schedules. Agile methodologies can help reduce project risks and ensure that outcomes meet user requirements. But public-sector institutions, with their formal hierarchies and bureaucratic cultures, often struggle to implement these new ways of working. National governments can help alleviate this problem by disseminating standard approaches for implementing agile in public-sector environments. The government of the United Kingdom, for example, publishes on its website extensive guidance about agile methodologies. It has also set up an “agile delivery community” for civil servants to exchange their ideas and experiences.⁷

National governments can furthermore help define guidelines for the delivery of core IT services. This includes creating standards for the use of end-user devices, software, and cloud infrastructure, as well as rules for procuring third-party technology services. Germany, for instance, is setting up a national private cloud service for its public-sector organizations. This will allow public authorities to take advantage of modern cloud infrastructure without having to share sensitive data with commercial cloud-service

providers, most of which operate in foreign countries. At the same time, the government expects significant savings from consolidating the 1,300 data centers and server rooms that exist in the national administration today.

Task 4: Facilitate change through legislation

An important way to accelerate the digitization of public services is to give formal legal status to aspirational goals, such as the mandatory digital provision of certain services or the “once only” collection of citizen data. But enshrining these principles as laws is not enough. National governments can help to formalize digital objectives by translating them into corresponding changes in administrative rules; a public authority, for instance, may need explicit permission to use digital signatures in certain transactions, which may necessitate complex rule changes. National governments could help by scanning existing laws to identify problematic rules and suggesting appropriate changes, while also ensuring the “digital readiness” of new rules. Denmark, for example, has set up a standing committee to manage this task. Membership consists of representatives from ministries and national public authorities, as well as regions and municipalities. The committee is chaired by the head of the central digitization agency. Most recently, it has trained its attention on the European Union’s General Data Protection Regulation, which takes effect in May 2018. This regulation harmonizes data-protection rules across the European Union and seeks to give individuals greater control over how data relating to them are being used. The committee has studied how the regulation can be translated into national law without creating unnecessary obstacles for digital innovation by public authorities.

Task 5: Incubate pilot projects and build critical skills

Top digital workers often steer away from jobs in government because of relatively low salaries, inflexible career paths, and bureaucratic work cultures. As a result, public authorities often depend primarily on resources from external service

providers; their internal capabilities remain weak. National governments can alleviate this situation by helping to incubate pilot digital initiatives, building critical skills in the process. A good example of this approach is the United States Digital Service (USDS). This unit of the White House comprises more than 200 software engineers, user-experience designers, and product managers who work with federal agencies to launch digitization projects. The USDS recruits most of its staff from leading technology companies for a limited “tour of duty,” emphasizing its public-service mission when advertising open positions. With assistance from the USDS, a number of federal agencies have created “lighthouse” success stories—for instance, a mobile app that helps borrowers navigate the complex repayment process for student loans. Over time, public authorities that work with the USDS might improve their internal capabilities, as teams draw lessons from the unit’s experts as they work alongside them.

Elements of a strong central digitization unit

Supporting the creation and management of digital public services is a politically challenging endeavor. It requires massive amounts of coordination and communication by numerous stakeholders across the public sector—not to mention significant resources to build a common IT infrastructure. Investments that politicians authorize today may pay off only after several years, perhaps after the leaders themselves are out of office.

It is therefore essential to establish a solid bureaucratic foundation for digitization efforts—lending some “administrative muscle” to a national digitization strategy. Our research finds that the countries with the highest levels of user adoption of digital public services have created central digitization units, wielding sizable staffs and resources, to perform the five tasks we have outlined. The Estonian Information System Authority, for instance, employs more than 130 people. The Danish Agency for Digitization has more than 200 staff. The leaders of such central digitization units can hammer out details, facilitate coordination with various

stakeholders across public authorities, and hold everyone accountable by using incentives and sanctions to keep digital initiatives moving forward. These units should have a stable mandate that lasts beyond the next election. They should be staffed with both technologists and bureaucrats, and they should have control over—or, at least, some influence over—a large share of government spending on digitization. Perhaps most critical for building a culture of innovation, leaders in digitization units should report directly to a strong minister who is publicly committed to digitizing the state.



Today's frontrunners in digital public services embarked on their transformation journeys because politicians linked the changes to an urgent national reform agenda. Denmark, for example, considered digitization a means to rein in the administrative cost of its welfare state and make it sustainable in the face of a global financial crisis.

Not all governments will feel an equally strong sense of political urgency. But one thing is clear: they can no longer be digital laggards without consequences. Citizens have come to expect great digital services from private companies. If they do not receive the same type of user experience from government, they may reduce their overall support for public institutions. For their part, companies facing increased administrative burdens because of outdated “analog” government services may perceive laggard countries as less attractive places in which to do business.

National governments' role in promoting digitization is clear; the potential for impact has been established. Now is the time to make it happen. ■

¹ Martin Lundqvist and Peter Braad Olesen, “From waterfall to agile: How a public-sector agency successfully changed its system-development approach to become digital,” March 2016, McKinsey.com.

² Our research sample is limited to ten European nations: Austria, Denmark, Estonia, France, Germany, Italy, the Netherlands, Poland, Spain, and the United Kingdom. The sample size is limited because there is currently no globally comparable data on user adoption of digital public services.

³ Bjarne Corydon, Vidhya Ganesan, and Martin Lundqvist, “Digital by default: A guide to transforming government,” November 2016, McKinsey.com.

⁴ Statistics about the X-Road, Republic of Estonia Information System Authority, ria.ee.

⁵ *Mehr Leistung für Bürger und Unternehmen: Verwaltung digitalisieren. Register modernisieren*, October 2017, Nationaler Normenkontrollrat, normenkontrollrat.bund.de.

⁶ For more, see *Act on Information Management Governance in Public Administration*, World Wide Web Consortium, w3.org.

⁷ Agile delivery, GOV.UK service manual, gov.uk.

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How to improve student educational outcomes: New insights from data analytics

The success of societies depends, now more than ever, on the ability of young people to thrive amid relentless change. Some countries, states, and municipalities have made great strides, but many still struggle. Educators continue to debate what matters and what works.

Emma Dorn, Marc Krawitz, and Mona Mourshed



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In a series of education reports, we took a data-driven approach to consider a few of the most active debates:

Do mind-sets matter? If so, to what extent? What teaching practices work best? Does education technology help? Our data come from the Program for International Student Assessment (PISA), administered by the Organisation for Economic Co-operation and Development (OECD). Since 2000, the OECD has regularly tested 15-year-olds around the world on mathematics, reading, and science. The most recent assessment, in 2015, covered more than half a million students across 72 countries. This assessment concentrated on science outcomes—which are therefore the focus of our analysis. What makes PISA so powerful is that it goes beyond the numbers, asking students, principals, teachers, and parents a series of questions about their attitudes, behaviors, and resources.

We applied machine learning and advanced analytics to identify factors that play a critical role in student achievement. We have published five regional reports to share these findings: on Asia–Pacific, Europe, Latin America, the Middle East and North Africa (MENA), and North America. Here, we summarize the two findings that were consistent across all five regions:

- Student mind-sets, such as motivation and self-belief, have greater impact on student performance than any other factor—and double the effect of socioeconomic background.
- The students with the best outcomes receive teacher-directed instruction in most or all classes, together with inquiry-based teaching in some classes.

Finding 1: Students' mind-sets matter much more than their socioeconomic background

It is hardly news that students' attitudes and beliefs—what we term their “mind-sets”—influence their academic performance. But how much? To

answer that question, we used a machine-learning and feature-discovery tool to identify the 100 most predictive variables—out of more than 1,000—from the PISA survey. We then sorted these into five categories: home environment, school resources and leadership, teachers and teaching, student behaviors, and student mind-sets.¹

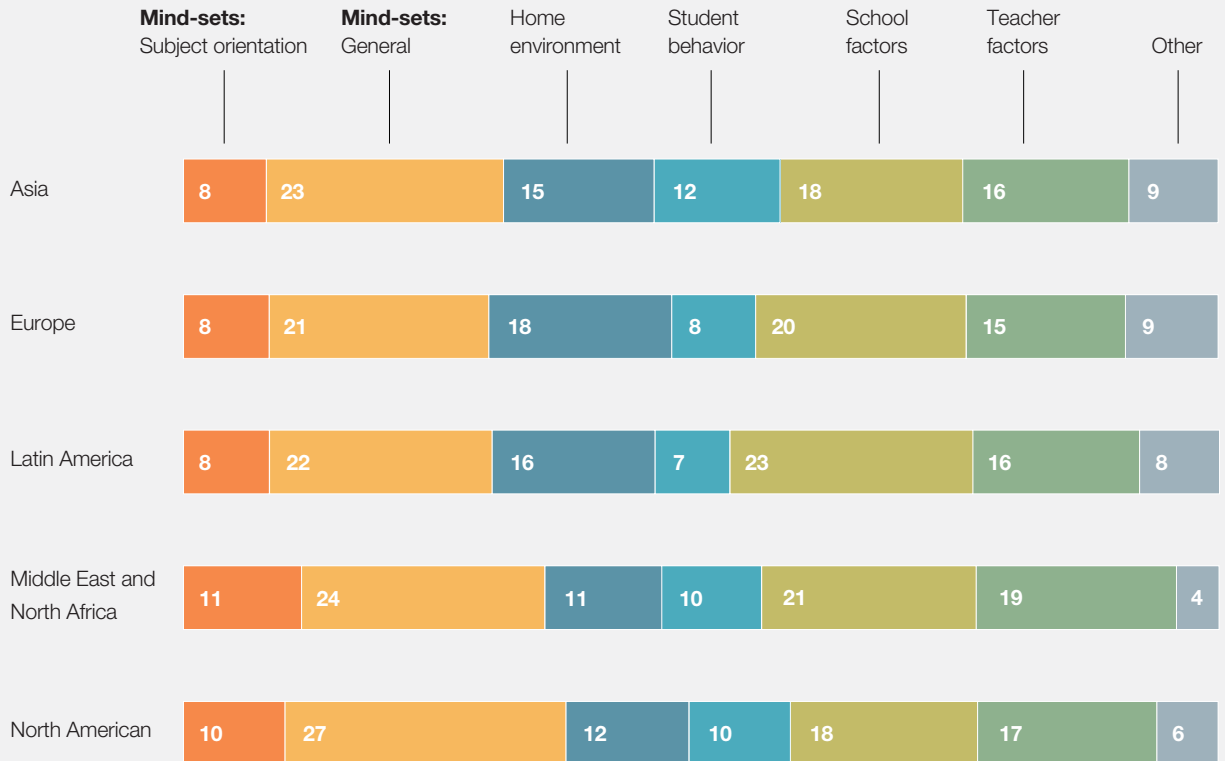
We separated mind-sets into two types: “subject orientation” and “general mind-sets.” Subject orientation refers to students' attitudes about science as a discipline (because that was the focus of the 2015 PISA); it is measured by the degree to which they agree with statements such as “I have fun learning science” and “I am interested in the universe and its history.” General mind-sets refer to a student's broader sense of belonging, motivation, and expectations—as measured by their agreement with statements such as “I feel like I belong at school,” “I see myself as an ambitious person,” and “If I put in enough effort, I can succeed.”

We then determined how influential each category was in predicting student performance. Our conclusion: after controlling for all other factors, student mind-sets are twice as predictive of students' PISA scores than even their home environment (Exhibit 1). This finding and its magnitude are consistent across all five regions—which amplifies its importance.

Several mind-sets emerged as highly predictive of performance in 2015. Top of the list was the ability to identify what motivation looks like in day-to-day life—including preparing for class, doing more than expected, and working to perfection. We call this “motivation calibration.” Students who scored high in this mind-set outperformed others by between 12 and 15 percent in PISA science tests, depending on their region. Students with high self-identified motivation (“wanting to be the best” and “wanting to get top grades”) also scored higher than those without—but by a lower margin of between 1 and 8 percent. Other mind-sets that were predictive of performance in 2015 PISA included instrumental

Exhibit 1 Mind-sets eclipse even home environment in predicting student achievement.

Predictive power by category of variable by region, % share



Note: Figures may not sum to 100%, because of rounding.

Source: McKinsey analysis

motivation (believing that school science will be useful for future career and life), a sense of belonging, and having low test anxiety. All of these mind-sets had a statistically significant impact on score, even controlling for socioeconomic status, school type, and location.

These findings are consistent with those of previous PISA tests. In 2012, for example, PISA asked about growth versus fixed mind-sets. Specifically, students answered questions about the extent to which they agreed that their academic results were fixed

(“I do badly whether or not I study”) or could be changed through personal effort (“If I put in enough effort, I can succeed” or “If I wanted to, I could do well”). Students with a strong growth mind-set outperformed students with a fixed mind-set by 9 to 17 percent, depending on their region.

It was particularly striking that several of the mind-sets we analyzed made the most difference for students either in low-performing schools or in lower socioeconomic quartiles. For students in schools with low average test scores, a well-calibrated motivation

mind-set is equivalent to vaulting into a higher socioeconomic quartile. In low-performing schools, students in the lowest socioeconomic quartile who are well calibrated perform better than those in the highest quartile who are poorly calibrated (Exhibit 2). This result was consistent across all regions.

Mind-sets, of course, are not everything. They cannot compensate for all economic and social disparities; in general, being richer rather than poorer remains a great educational advantage. But the PISA evidence shows that mind-sets matter a great deal, particularly for those living in the most challenging circumstances.

So far, the academic research on this subject is both nascent and predominantly US-based. Considering its importance, establishing how mind-sets can be shifted in a positive direction to improve student performance should be a priority globally.

Finding 2: Students who receive a blend of teacher-directed and inquiry-based instruction achieve the best outcomes.

There are two dominant types of teaching practices. The first is “teacher-directed instruction,” in which the teacher explains and demonstrates ideas, considers questions, and leads classroom discussions. The second is “inquiry-based teaching,” in which students are given a more prominent role in their

Exhibit 2 Having a well-calibrated motivation mind-set can be equivalent to leapfrogging into a higher socioeconomic quartile.

North America low-performing schools,¹ average PISA² science score, 2015

Bottom socioeconomic quartile students



Top socioeconomic quartile students



¹ Schools with average PISA score of less than 480 (serving 37% of North American students). Statistically significant controlling for socioeconomic status, school type, and location.

² Program for International Student Assessment.

Source: OECD PISA 2015; McKinsey analysis

Girls and science

Why don't more girls embrace careers in science, technology, engineering, and mathematics (STEM)? That is a question that educators, policy makers, and business leaders around the world are asking—and the data from the Program for International Student Assessment (PISA) can help answer.

Overall, there is not a meaningful achievement gap between girls and boys, who score similarly on the PISA science assessment. On average, boys score four PISA points (0.8 percent) higher, but girls outperform boys in science in 22 of the 72 countries where the PISA assessment was conducted. There are some more subtle differences, however. For example, girls and boys have very different expectations about future careers in science. Boys are more than twice as likely as girls to expect to work as engineers, scientists or architects; and girls are more than three times as likely to work in health professions.¹

Looking specifically at the predictive mind-sets highlighted in this article, we find that girls are slightly more likely than boys to have strong motivation calibration and to believe that their school science work will be useful in the future. But girls are also more likely to have high levels of test anxiety and are less likely to say they find a sense of joy in studying science. Our analysis

own learning—for example, by developing their own hypotheses and experiments.

We analyzed the PISA results to understand the relative impact of each of these practices. In all five regions, scores were generally higher when teachers took the lead. The more inquiry-based teaching was used, however, the lower the average PISA scores were. At first glance that looks like a damning verdict on inquiry-based teaching. When we dig deeper into the data, however, a more interesting story is

suggests that girls' higher anxiety, in effect, cancels out their higher motivation calibration and goes on to affect the choices they make later in life. There are distinct regional differences. In the Middle East and North Africa (MENA), for example, girls have more positive mind-sets on several dimensions, including various aspects of motivation, as well as a sense of belonging and joy in science.² In North America, girls are much more likely to show schoolwork- and test-related anxiety than boys: while 45 percent of boys say they experience test-related anxiety, 69 percent of girls do. This is a bigger difference than in any other region.

Girls have the building blocks, when it comes to academic outcomes and positive motivation mind-sets, for STEM careers. If interventions were made to decrease their sense of anxiety and increase their enjoyment of science, the outcome might well be more female STEM professionals.

¹ *Excellence and equity in education*, OECD PISA, 2015, Volume 1.

² In MENA, girls had higher levels of several positive mind-sets. Motivation calibration: 58% of girls versus 44% of boys were well calibrated. Self-identified motivation: 79% of girls and 69% of boys had high self-identified motivation. Instrumental motivation: 36% of girls and 29% of boys had high instrumental motivation. Sense of belonging: 42% of girls and 38% of boys had a strong sense of belonging. Joy in science: 68% of girls and 63% of boys had high joy in science.

revealed: the best results are achieved when the two styles work together. The “sweet spot” is to use teacher-directed instruction in most or almost all lessons, and inquiry-based teaching in some lessons. This pattern holds true across all five regions.

Across all regions, high levels of inquiry-based teaching without a sufficient foundation of teacher direction result in lower student outcomes. What differs across regions is the expected benefit from moving to the sweet spot from a purely teacher-

directed approach with little inquiry-based teaching. In developed school systems with strong performance on PISA overall, there is substantial benefit—for example, an increase of 14 PISA points in the European Union (Exhibit 3). In developing school systems with weaker performance, the benefit is much smaller—just one PISA point in MENA and two points in Latin America.

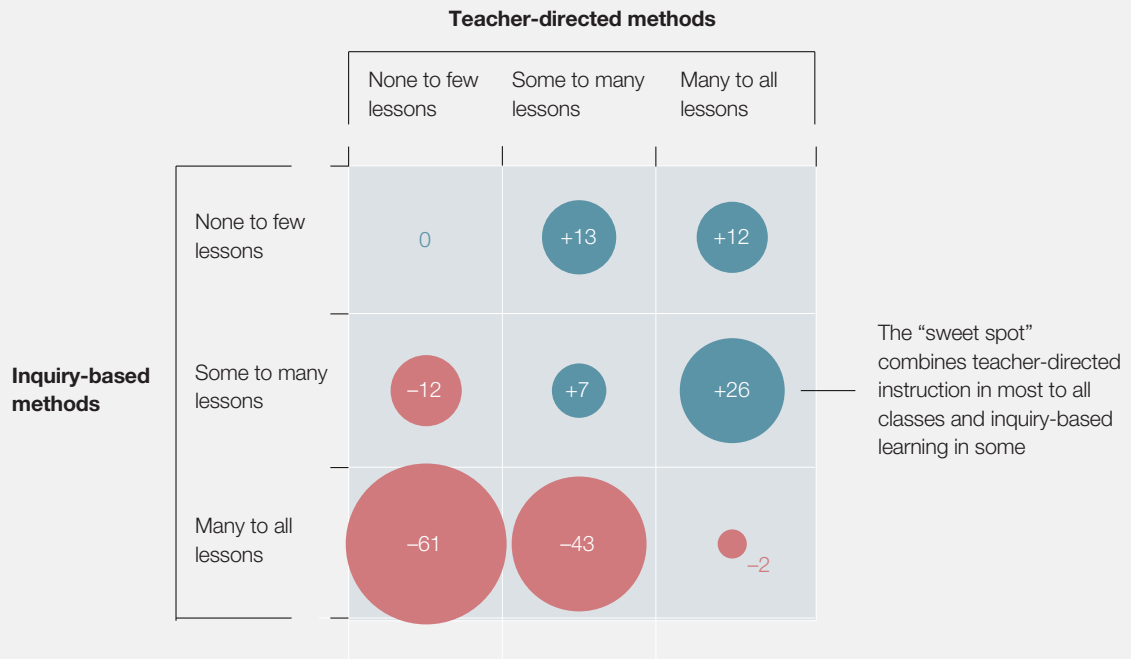
The benefits of teacher direction were also seen in our analysis of the role of information and

communication technology (ICT) in the classroom. Here we found that deploying ICT to teachers, rather than to students, works best. For example, adding a data projector to a classroom in Latin America has 30 times the impact on student scores as adding a student computer to that same classroom. Across all the regions that undertook the PISA student ICT survey, providing students with e-book readers, tablet computers, and laptops had a negative impact on test scores. These results evaluate only hardware, not software, and do not account for ongoing rapid

Exhibit 3 Students who receive a blend of teacher-directed and inquiry-based instruction have the best outcomes.

Point change in PISA¹ science score relative to baseline,²

Average score increase ● or decrease ●



¹ Program for International Student Assessment.

² Statistically significant expected change in score controlling for PISA’s index for economic, social, and cultural status, public/private schools, and urban/rural location for all quadrants except for teacher-directed and inquiry-based instruction in all classes (-2), which was not significant at 95% confidence level.

Source: OECD PISA 2015; McKinsey analysis

Some kinds of inquiry-based teaching appear better than others in improving student outcomes, and different practices work best at different frequencies.

evolution in technology. Even so, they support the finding that effective teacher direction is critical—both in technology and learning.

Given the strong support in educational circles for inquiry-based pedagogy, these results seem counterintuitive. We offer two hypotheses. First, students cannot progress to inquiry-based methods without a strong foundation of knowledge, gained through teacher-directed learning. Second, inquiry-based teaching is inherently more challenging to deliver, and teachers who attempt it without sufficient training and support will struggle. Better teacher training, high-quality lesson plans, and school-based instructional leadership can help.

It is also important to note that some kinds of inquiry-based teaching appear better than others in improving student outcomes, and that different practices work best at different frequencies. In almost all regions, explaining how a science idea can be applied has a positive impact on scores when done in some, most, or even all lessons (between 20 and 30 PISA points for most lessons across regions). In developed regions, having students spend time in the laboratory doing practical experiments and drawing conclusions from these experiments has an important positive impact when done in some lessons (30 PISA points in North America and Oceania, for example). But this has a negative impact when done too often, likely due to crowding out of other activities.

In developing regions, however, these laboratory-based practicums have either no significant impact

or a small negative one. We hypothesize that this is likely because developing regions may lack the equipment and teaching supervision to benefit from these practices. These school systems may be better off initially focusing on consistent quality teacher-directed instruction supported by lesson plans and teacher coaching. With that in place, systems can introduce targeted inquiry-based teaching, helping students to excel by giving them the experience of conducting and drawing conclusions from experiments.

School systems need to tread carefully in selecting inquiry-based teaching practices, however. Our analysis shows that there is a set of practices that have a negative impact on average student scores across almost all regions—even when applied in only some lessons. These practices include having students design their own experiments, asking them to do investigations to test ideas, having a class debate about investigations, and requiring students to argue about science questions.

We should emphasize that inquiry-based practices may bring benefits beyond improving student scores. Experiencing inquiry-based teaching increases students' joy in science significantly more than teacher-directed learning does (although it is important to note that teacher-directed instruction also has a positive correlation with more joy in science, just not as strong an impact). This matters because passion for a topic is linked to increased perseverance in studying. Inquiry-based teaching has a similar positive impact on students' belief that science is worthwhile for their future careers.

Overall, our analysis suggests that systems should aim to balance inquiry-based methods with sufficient teacher-directed instruction to ensure that teachers are able to explain scientific concepts clearly, and that students have sufficient content mastery to fully benefit from inquiry-based teaching. In school systems whose outcomes are currently poor, an even more directive approach may be appropriate as they drive improvement.

Previous McKinsey research pinpointed what school systems need to do to progress from one performance level to the next—from poor to fair, from fair to good, from good to great, and from great to excellent.² Our newest findings deepen those insights, highlighting the pedagogical choices that can best improve student outcomes—and shedding new light on the impact of mind-sets on those outcomes.

Even a survey as large and rigorous as the PISA assessment provides only some of the answers. Nevertheless, we believe that our findings provide useful insights to guide policy makers as they pursue their ultimate goal—improving the education and thus the lives of students all over the world. ■

¹ Each category was composed of several subvariables. For example, home environment included parent education and occupation, home and cultural possessions, language at home, and immigration status. Student behaviors included skipping school, activities before school, and use of information and communication technology outside school. School factors included class size, school size, school resource level and funding, and school autonomy. Teacher factors included teacher qualifications, teacher professional development, and teaching practices.

² See Michael Barber, Chinezi Chijioke, and Mona Mourshed, “How the world’s most improved school systems keep getting better,” November 2010, McKinsey.com.

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