

GOVERNMENT DESIGNED FOR NEW TIMES

In a fraught world, policy makers cannot allow partisan divides to get in the way of crucial reforms. By drawing on successful strategies employed elsewhere and adapting to current needs, governments can—and must—do better.

Rarely has the need for effective government been greater than now—and rarely has the ability to produce it been more constrained. After the recent wave of storms and disasters—both natural and financial—the need for leadership and a concerted response from national capitals is acute. Adding to the pressure, many governments are managing the implications of an unprecedented degree of fiscal and monetary intervention. They are preoccupied with the urgent tasks of getting banks to lend again and demonstrating fiscal credentials to the bond markets. The crisis mode of the past few years endures in several countries, while in others there is no more than cautious optimism.

Leaders must confront long-term, fundamental questions too: from the size and role of the state to how best to stimulate

growth; from profound and surging demographic imbalances to tackling growing unemployment and welfare bills; from deciding on the extent and nature of regulation necessary to protect the public to forging a new relationship between citizens and government services. Thus, many governments confront a daunting paradox: an expanded set of major policy imperatives in a constrained and almost precarious fiscal position.

On these subjects, however, there is little agreement. The policy debate is becoming more polarized at arguably the worst possible time. There is a real risk that in the face of big choices and much disagreement, paralysis reigns. Leaders thus spend their energy on policy fights and battles for the hearts and minds of the public—at the expense of making progress.

It is in times like these that government matters most.

Our research shows it is possible to make huge strides in addressing critical challenges, even without resolution of the many ideological and policy dilemmas. From government spending to tax collection, education improvement to health outcomes, and welfare reform to job creation, we see the potential for meaningful improvement, to do more and better with less. What is needed is government management by design, built to fit these difficult times: government that identifies the most critical, solvable problems, reorganizes where necessary to deliver the right solutions, and abandons the tools and approaches that no longer work.

In this effort, governments can draw heavily on the mission-driven mind-set of employees—a real comparative advantage for the public sector over the private sector. Too often leaders insufficiently tap into this valuable asset. And leaders can do far more to mine information on what is working elsewhere. International peers, often trying to solve exactly the same problems, provide invaluable road maps and lessons. Unlike the private sector, where companies spend

millions of dollars trying to understand secret competitor strategies and replicate them, the public sector is an open environment, and thereby easier to mine for successful practices and lessons learned.

Government by design

Political leaders rarely campaign for office on a platform of government effectiveness. For some it fails to capture their imagination or, they suspect, the imagination of voters. For others, tackling the bureaucracy is perceived as high risk and low reward compared with passing new laws in the legislature. Yet few succeed without achieving some reform. Many departing presidents, prime ministers, and cabinet secretaries reflect on how the

engine of government itself was at the very heart of their successes or failures.

What it takes

To truly transform government requires fresh thinking and a substantial investment of both resources and political capital: business-as-usual or modest or occasional improvement is inadequate. Those that have achieved sustainable and significantly higher levels of government performance did so by explicitly designing and executing multiyear reforms that push beyond everyday initiatives designed to improve management capability.

In our research, we identify 40 such programs that have been enacted around the world in the past two decades. There were a number of objectives these programs were designed to achieve: significant fiscal consolidation, better outcomes across multiple public services, and economic growth. (See chart on next page.)

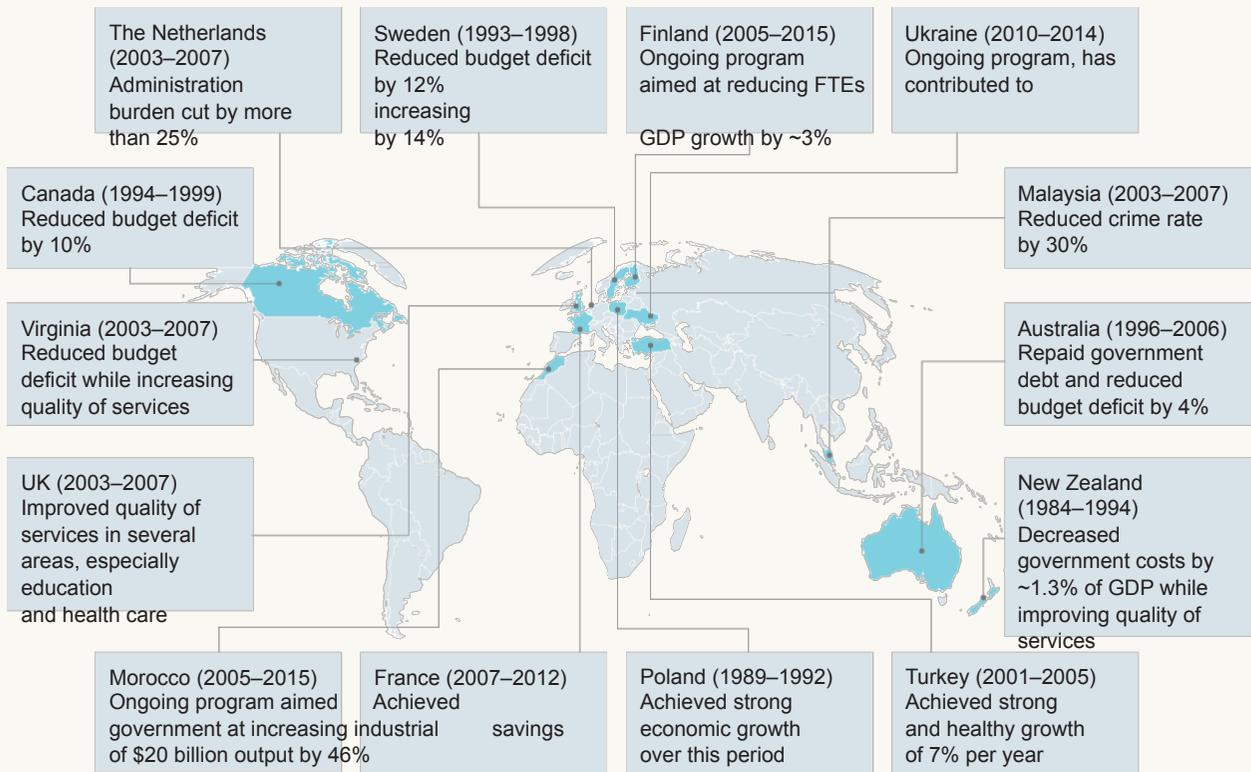
Analyzing these programs and interviewing the leaders involved reveals a valuable set of lessons for other government leaders facing major challenges. The first is being clear and ambitious about what the government is trying to achieve. Many transformations achieved what appeared to be impossible targets. Sweden, for example, moved from an 11 percent deficit to a fiscal surplus in the 1990s, having been close to default and an International Monetary Fund (IMF) bailout. A second lesson is the need to make big—not incremental—shifts in the amount of time, energy, and resources required. On average, the programs in our sample lasted for six years, with a staff of 1,300 involved in each.

Fit for purpose

Beyond this clear focus and investment of time and resources, government by design also means investing in those capabilities needed for success. Some of these are common and enduring across the public, private, and nonprofit sectors, such as

Transformation programs around the world

Dozens of governments have undertaken ambitious programs to remake themselves. Here's what some have achieved:



employing best practices in technology and operations, organization and human resources, and budgeting and finance, as well as operating across geographic and stakeholder boundaries and making use of large data sets for better performance and policy. Other capabilities will be specific to the government sector, including risk management in regulation and client differentiation for welfare-to-work interventions.

Increasingly, the intense pressure for reform, combined with a new operating environment, makes innovation a critical capability. In many areas, government agencies around the world are reimagining how services are delivered (for example, through one-stop shops and e-portals) by providing greater data availability and through mobile services that allow citizens to get instant help and support. They are also migrating to a new paradigm

where nonstate actors—private companies, nonprofits, and citizens themselves—play an increasingly important role in designing and executing policies and services.

Finding answers to the solvable management questions

Governments that are willing to reform and build these crucial capabilities are better able to achieve major breakthroughs in the most fundamental policy areas, even in the absence of new policy or legislation.

Fiscal management

Take fiscal management, arguably the most daunting of all issues today. According to the IMF, most governments in countries that are members of the Organisation for Economic Co-operation and Development (OECD) need to improve their deficits by 4 percent or more of GDP to achieve long-term debt targets.¹ Of course much of this involves policy debate. Entitlement reform, public-spending reductions, and increased taxation are highly charged political issues. However, operational reforms designed to improve efficiency can make a meaningful difference now and set the stage for more successful policy implementation over time. In particular, spending reviews undertaken agency by agency—even if initially focused only on noncore functions such as technology, procurement, or travel—can yield meaningful savings that will increase credibility and flexibility as fiscal constraints increase. Similarly, improved tax collection, drawing on international best practices, can produce real revenue growth within the existing tax structure.

Spending reviews. A number of governments are taking a more strategic and evidence-based approach to achieving fiscal sustainability by launching multiyear spending reviews. These reviews help to establish priorities and clear paths to deficit reduc-

tion. Almost without exception, the spending reviews uncover huge opportunities for improving effectiveness, decreasing costs, and increasing revenue by improving the efficiency of administrative, noncore activities. To size the prize, consider that our global benchmarking research indicates that operational expenditures represent 35 to 40 percent of total government expenditure; on average, 19 percent of GDP for OECD countries. Within that operational expenditure, roughly a third is spent on overhead functions, representing 6 to 7 percent of GDP in OECD countries.

To date, we have reviewed ten countries that have conducted such spending reviews during the past five years and discovered that there is currently little standardization in approach. Several governments have imposed top-down spending cuts, from the center to agencies, while others have developed a bottom-up understanding of the potential savings opportunities. Of those using a bottom-up approach, New Zealand and Denmark have used clear baselines and intragovernment or external benchmarks to estimate the savings potential—even though this is clearly an opportunity to drive success.

Drawing on benchmarks from different governments, we estimate a potential to save 5 to 10 percent of operational costs through overhead categories without compromising core programs. This represents a savings in the range of 0.3 to 0.7 percent of GDP—some 10 percent of the adjustment that countries are required to make in order to achieve their long-term debt targets. This is a significant contribution, given that it requires no compromise on core programs, no reduction in social programs, and no additional costs to taxpayers. And it ultimately sets the stage for better policy implementation in the future.

Tax collection. Meanwhile, as governments grapple with increasing social obligations and projected declines in the relative size of labor

workforces, tax administrations are under even more pressure to collect every dollar of tax payable. They need to ensure that every dollar they spend collecting taxes yields the maximum benefit for citizens. Tax administrations also have broader significance: the interface and effectiveness of a tax administration often becomes a watermark of public confidence in a government.

In this quest, tax administrations can learn a great deal from one another. But our in-depth research at federal tax administrations in 15 OECD countries uncovered wide variability not only in the performance of tax authorities across countries but also within countries across different functions—submissions processing, examinations, collections, and taxpayer service.

We estimate that, in aggregate, the tax administrations in our study can collect an additional \$86 billion in direct tax revenues if they adopt the practices of the top third. Four major design elements stand out as avenues for achieving improvements: proactive demand management that smooths tax collection across the year and avoids the end-of-year bottleneck, sophisticated taxpayer segmentation to prioritize which taxpayers to target with which approaches, streamlined operations, and rigorous performance tracking. And these savings apply only to direct taxes.

Balance-sheet management. Beyond undertaking spending reviews and improving tax collection to manage the operating budget, governments have a major opportunity to take an end-to-end capital-management approach to their balance sheets at both the agency and government-wide level to improve fiscal health. This includes identifying and measuring material risks, incorporating the knowledge of risk into operations, and ensuring the integrity of the internal assessments over time. Even simple ap-

proaches to changing the inflow of accounts receivable or outflow of accounts payable can yield meaningful improvements.

Jobs

Along with fiscal management, unemployment dominates the landscape across most of the OECD. Here, too, exist fundamental differences in ideology and vision on how to solve rising unemployment risk stasis. Stimulus programs and other legislative actions to increase growth and create jobs may or may not get through legislatures, but other government interventions to improve demand, supply, and the matching of skills to jobs can significantly improve the jobs picture. Many governments are now adapting vocational education to better fit employment prospects, for example, by involving employers more closely in both its design and delivery. Employment agencies are doing a better job of matching supply and demand by improving their market information and by producing more comprehensive, specific, and up-to-date data on vacancies, job seekers, and required qualifications. They are also segmenting the job-seeker population to better understand which segments can be processed in quick and automated ways and which merit deeper intervention and support.

Regulation and enforcement

After a series of catastrophic events, government bodies that protect the public—such as industry regulators, law enforcement, and disaster-preparedness agencies—are being more closely scrutinized with regard to their actions, their impact, and their overall effectiveness. But they are not necessarily receiving larger budgets. In stark terms, society is asking whether regulators are most effectively anticipating the next threat and protecting the public. As with unemployment, the policy debate on this issue can become quickly polarized around the trade-off between more

protection for the public and consumers and the potentially negative impact of more aggressive regulation for economic growth. Agencies can make great progress by focusing on optimal resource allocation and redesigning how they organize and plan. They can place more emphasis on outcome-based regulation and on predicting, preparing for, and mitigating "tail risk." The most significant assaults on the public's sense of safety and security have come from events that previously seemed unlikely. Tail events are difficult to predict because they often require multiple things to go wrong. Examples include the attacks of September 11, Hurricane Katrina's damage to the New Orleans levees, the financial crisis of 2008–09, and the recent earthquake and tsunami in Japan and the nuclear-power-plant meltdown that followed. But better risk-based systems can improve governments' ability to prevent and respond to such events.

Core public services

In fact, across core public services—in areas such as infrastructure, education, health care, and policing—government by design can also enhance outcomes and manage costs. In these areas, the political discourse is often dominated by significant and legitimate ideological differences. Despite that, governments that focus on what really works operationally in driving outcomes can reap gains. Governments that systematically embrace the latest proven project-management approaches and tools can dramatically

improve the value of infrastructure investments, at the same time reducing errors and time to completion.

In education, for example, school systems can learn from peers at a similar stage of evolution or performance about the right levers to use for improvement—be it better use of pupil data, revision of standards and curricula, or a deeper professionalization of teaching careers. Likewise, the escalation of health care costs across all systems is provoking significant political debate. Yet the best systems are already beginning to make progress in health care productivity through a number of steps, such as the prediction of patients most at risk and the adoption of subsequent prevention strategies, delivery of care at home and in capital-light settings rather than in hospitals, and technology innovations to boost clinician effectiveness and efficiency. Government services can and should build on examples of success around the world.

There is a real prize for governments that can make progress even as the policy and fiscal environments threaten to thwart action. But to win, governments must adapt to fit the challenges of today, in part by applying best practices from around the world.

In challenging times, the government we need is rarely the government we inherit. Instead, government must be deliberately designed and managed to make progress on solvable problems. ⁿ

INNOVATION IN LOCAL GOVERNMENT OPEN DATA AND INFORMATION TECHNOLOGY

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HOW GOVERNMENT CAN PROMOTE OPEN DATA AND HELP UNLEASH OVER \$3 TRILLION IN ECONOMIC VALUE

Open data has the potential to unleash innovation and transform every sector of the economy. Government can play a critical role in ensuring that stakeholders capture the full value of this information.

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Additional information about the methodology and approach to size the economic impact of open data can be found in the Aura Solution Company Limited report released in October 2013, *Open data: Unlocking innovation and performance with liquid information*. This report is a joint effort of the Aura Solution Company Limited Global Institute, the Aura Solution Company Limited Center for Government, and Aura Solution Company Limited's Business Technology Office.

It provides analysis of the seven domains, including important levers for unlocking open data's value, examples of how the value is being realized today, discussion of how the major stakeholders might become involved in open-data initiatives, and considerations of both the barriers and enablers to unlock economic value.

A recent Aura Solution Company Limited report, *Open data: Unlocking innovation and performance with liquid information*, identified more than \$3 trillion in economic value globally that could be generated each year through enhanced use of open data—increasingly “liquid” information that is machine readable, accessible to a broad audience at little or no cost, and capable of being shared and distributed. The sources of value from open data identified in the report include new or increased revenue, savings, and economic surplus in seven domains: consumer finance, consumer products, education, electricity, health care, oil and gas, and transportation.¹ The domains were chosen to provide a diverse understanding of how

open data, such as census demographics, crop reports, and information on product recalls, can create value in public- and private-sector organizations, in consumer and business-to-business markets, and in products and services.

This report expands on an important topic in the earlier report: the critical role of government in unlocking the economic value of open data, managing risks, and engaging stakeholders (Exhibit 1). As a provider, catalyst, user, and policy maker, government is in a unique position to define an agenda for open data that improves decision making; fosters the growth of innovative businesses, products, and services; and enhances accountability. Government is also well positioned to encourage private companies and other stakeholders to share their data—one of the best strategies for creating value.

In this report, we first explore what open data is and why the trend is taking hold.

We evaluate the primary levers that generate value from open data and government's role in enabling them. The report then turns to the risks of open-data programs; these are top of mind for many citizens, businesses, and policy makers but can be mitigated through approaches we outline.

We also describe the needs of stakeholders and opportunities for them to actively create, promote, and participate in open-data strategies and applications. To conclude, we present a discussion of how public-sector leaders can launch, assess, and scale up their open-data programs.

We hope this report helps stakeholders—both inside and outside government—to design, build, and participate in effective open-data programs. For elected officials and civil servants, it can serve as a guide for understanding, evaluating, and promoting open-data initiatives. We include examples of how various governments shape their agen-

Exhibit 1

Government plays a critical role to help enable value creation, manage risks, and engage stakeholders in open data.



Exhibit 2

'Openness' or 'liquidity' of data can be defined by four characteristics.

| | Completely open ◀ | More liquid | Completely closed |
|---------------------|---------------------------------------------------------------------------------------|-------------|---------------------------------------------------------------------|
| Accessibility | Everyone has access | | Access to data is to a subset of individuals or organizations |
| Machine readability | Data are available in formats that can be easily retrieved and processed by computers | | Data are in formats not easily retrieved and processed by computers |
| Cost | No cost to obtain | | Offered only at a significant fee |
| Rights | Unlimited rights to reuse and redistribute data | | Reuse, republishing, or distribution of data is forbidden |

das and invest in resources that can be used as models for other agencies or regions. For business, technology, and start-up leaders, our report aims to provide a relevant and perhaps missing perspective on when and how they might engage with government. Last, our report will highlight for citizens, the media, and nongovernmental organizations (NGOs) the potential of open data to improve services that directly benefit consumers.

Open data: What it is, why it has taken hold, and how it varies

What it is. Companies, governments, and NGOs have begun to release and share vast amounts of information. However, the extent to which information is truly open varies in four ways: accessibility, machine readability, cost, and rights for reuse and redistribution. Exhibit 2 shows how data are classified across the spectrum, from completely open to completely closed, using a definition closely related to those of many

international organizations, such as the Open Knowledge Foundation (OKF).²

Open data can be local, regional, and global in scope—from procedure costs at a single hospital to city-level water use to revenues from national tax collection. Governments capture and share large amounts of data on a range of topics, but businesses and other private organizations also have information they could make more liquid, such as data on sales transactions, shipping patterns, and medical records. The value of data can vary depending on its level of detail, accuracy, and compatibility. For example, a government could annually release 600 data sets that contain aggregated information, such as the number of robberies committed in a month in a particular neighborhood. Although this information is important, it has less potential to generate value than more specific data that are released more frequently, such as a weekly report showing the time of day and

location of each robbery, or even a real-time feed of crime reports as they are generated. Similarly, data released in commonly accepted formats that can be easily shared and reviewed by external parties are more valuable than information presented in nonstandard formats. And the release of raw data can create more value than the release of a research analysis, since this allows for more original uses.

Discussions of open data frequently reference "big data," "big data analytics," and "MyData," all of which fall into different dimensions than open data (Exhibit 3):

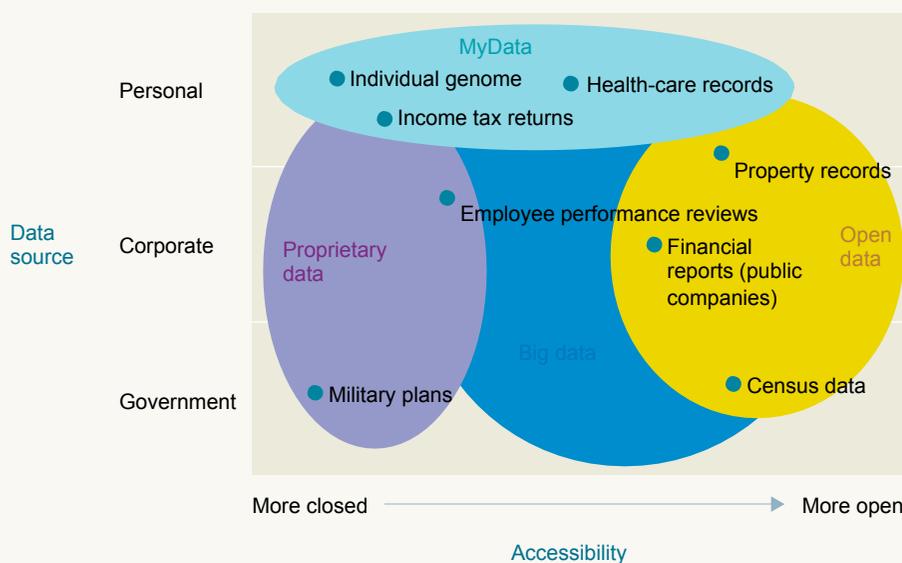
- Big data refers to information that is increasingly voluminous and real-time in

nature, as well as diverse in its sources and types. It represents a source for ongoing discovery and analysis.

- Big data analytics involve examining large amounts of data to uncover insights, such as process efficiencies, as well as connections between events that can generate competitive advantages and improve operations.
- MyData refers to data about an individual consumer to which that person is granted access. Upon receiving access, people can correct inaccuracies, gain real-time and historical information about themselves (such as their physical health and financial standing), and compare themselves with

Exhibit 3

Open data can come from individuals, companies, or governments, and it differs from other data types in its degree of availability.



others. In some cases, individuals can also specify how their personal data can be used.

Why open data is taking hold. Interest in open data has been increasing for many years. We are addressing this topic now because the trend is gaining momentum and is top of mind for businesses, governments, NGOs, citizens/consumers, and the media. Information sources, particularly those from government, are now readily available at lower cost and in machine-readable forms. From electronic health records and student-achievement histories to site-specific energy-consumption readings and mobile-phone location data, a vast and rising quantity of information is collected, cataloged, and shared by companies, governments, and consumers. The expansion of open data, combined with advances in big data analytics, is freeing information that was once trapped inside the dusty pages of overlooked reports, enabling improved decision making, new product and service offerings, and greater accountability. This change comes at a time of heightened focus on data-driven knowledge and evidence-based decision making. More public- and private-sector leaders are seeking access to information and pressing for standards, guidelines, and regulations that will ensure the sustainability and usability of open-data initiatives. Sitting

back to let open data take its own course, or only letting fragmented efforts take hold, is no longer a viable approach. The question is not whether to have an open-data program but how to build one that works.

How open-data programs vary. Approaches to open data vary across and within countries and change over time. For example, privacy concerns in Germany have limited the government's ability to share individual-level data—but in the United Kingdom, domestic pressures for increased transparency have pushed more government data into public hands each day. The maturity of open-data programs also varies; some countries have much more advanced and comprehensive initiatives than others. One of the most important differences in programs relates to the degree to which governments encourage citizen involvement. For example, Kenya has launched an open-data portal and encourages public participation, aiming to generate economic value estimated at \$1 billion, mainly through benchmarking appropriate project costs and identifying opportunities for public-sector savings. Several private companies have created innovative apps or tools based on the portal data, including Nairobi-based Upande, which integrates information about water-supply services in different regions that

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Exhibit 4

Three overarching value levers of open data can help generate more than \$3 trillion annually for the global economy.

Decision making

Open data provides a fact base to make more informed and objective choices using information that is often available in real time

New offerings

Open data enables organizations to better understand their customers and context and to design new products and services

Accountability

Open data reveals issues in behavior, choices, and spending that citizens and leaders can act on to effect change

would otherwise be difficult for citizens or businesses to obtain on their own. Such variations, combined with differences in awareness, cultural values, legal systems, and technical capabilities, mean that governments will need to customize their open-data programs. Nevertheless, there are common value levers and roles for government that apply across open-data initiatives, as described in the next two sections.

Value levers of open data

Government plays a critical role in enabling value creation from open data. This value primarily accrues in three ways: decision making, new offerings, and accountability (Exhibit 4). These levers produce benefits for the government itself and for other stakeholders, including private-sector organizations and consumers. In fact, consumers are the main beneficiaries of the potential \$3 trillion in value we identified.

There is some overlap among the three levers—as one example, some new offerings may enable better decision making. We also recognize that a single open-data initiative can simultaneously enable multiple levers, thereby creating value in different

areas. The government of Singapore, for instance, was concerned about the impact of rising residential energy consumption, and so it sponsored a “hackathon”—a community meeting where technologists and start-ups were invited to explore potential uses of open data and develop new apps. Invitees included energy and sustainability experts, researchers, and developers. The new apps that participants created could help with both decision making and increasing accountability.

Decision making: Reaching better conclusions more rapidly

Stakeholders across the spectrum, including governments themselves, can use open data to improve decision making. For example, Trafikverket, Sweden’s transportation agency, provides third parties with real-time data on train departure and expected arrival times, allowing passengers to make better travel plans. More generally, companies have developed online programs that use open data on transportation to help travelers and shippers to make better-informed choices about travel modes and routes. The wide release of data also gives businesses

greater insight into the competitive landscape, including current pricing conventions, which helps them make better decisions about contract terms when working with vendors and other parties.

By regularly analyzing open data related to performance, stakeholders can identify gaps and select appropriate improvement strategies. For example, educators can enhance teaching methods through adaptive-learning systems—online tutorials that immediately adjust the presentation of educational material according to students' learning needs. At Arizona State University, educators used adaptive online-learning programs for students struggling with remedial math. The software tracked metrics, such as keystrokes, to see how students interacted with the material and where they needed extra instruction. These adaptive-learning systems helped improve pass rates from 66 percent to 75 percent.

During the decision-making process, stakeholders can use computer programs to analyze the vast quantities of open data. Such technologies will enable them to make more logical, fact-based decisions faster than manual analysis would allow. For example, city officials in Edmonton, Canada, use application-programming interfaces and real-time updates to analyze the city's performance on a variety of metrics ranging from public transit on-time performance to utilization of public spaces to 311 call-response time. Researchers can simply and easily visualize more than 400 data sets, empowering them to make better-informed decisions on how to improve performance.

New offerings: Developing products and services that create value for customers When the government and other stakeholders release data, they help companies, agencies, and individuals to develop innovative apps, products, and services or

improve existing offerings. Consider a few examples of companies that rely on open data for their success:

- The Climate Corporation employs open data to create various tools, including weather-monitoring and yield-forecasting products, which farmers use to make decisions such as where and when to plant crops.
- Propeller Health, a private company, has benefited from access to data from the US Centers for Disease Control and Prevention (CDC). It created a GPS-enabled tracker that monitors inhaler usage by asthmatics. The information is ported to a central database and used to identify trends for individuals, groups, and the overall population. By merging usage data with CDC information about environmental triggers of asthma (for instance, pollen counts in the Northeast and volcanic fog in Hawaii), Propeller Health helps physicians develop personalized treatment plans and spot prevention opportunities.
- The UK-based website findthebest.com used open data from the government to create the UK Car Fuel Economy and Emission App, which helps car buyers compare features such as fuel economy based on their type of commute.
- Emergency-room physicians created iTriage, a mobile app that helps patients understand their symptoms, locate nearby health facilities or physicians, and book appointments. The iTriage app has been downloaded more than ten million times.

Some of the most innovative open-data products are created through cross-sector collaborations involving public and private organizations. For example, after the 2010 earthquake in Haiti, volunteers

across the world combined data from sources such as aerial photography, World Health Organization maps of health facilities, and locations of police facilities from the Pacific Disaster Center. This OpenStreetMap project became a critical source of reliable information to guide workers from government and private-aid agencies in delivering supplies to hospitals, triage centers, and refugee camps. This map also helped responders better match the supply of and demand for various resources in the aftermath of the disaster, significantly improving the services delivered.

Accountability: Increasing transparency and enabling action

By releasing data, businesses and governments can ensure their actions, including their spending practices, are transparent.

This, in turn, can help prevent corruption and waste. Consider a few examples:

- The Brazilian government opened its books via the Brazilian Transparency Portal, which publishes a wide range of information that includes federal-agency expenditures, elected officials' charges on government-issued credit cards, and a list of companies banned from contracting work with the government. Data from the portal are helping journalists and activist groups expose corruption and may reduce unnecessary or suspect spending.
- Beginning in 2011, New York City released detailed information on energy and water consumption for each nonresidential building. Building operators are now using these data to benchmark their own energy



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efficiency, prioritize investments to capture savings, and potentially create incentives to promote energy-reducing programs or devices.

- The United States–based Sunlight Foundation, a nonpartisan private organization, works to improve government transparency by publicizing data related to many activities, including food-stamp use, political donations, and Congressional spending.

About one-third of the estimated potential value from open data comes from benchmarking, which exposes variability and opportunities to improve performance. For instance, many schools pay flat, uncompetitive rates for broadband services, without soliciting competitive bids. Estimates in the United Kingdom suggest that schools pay three to four times what private companies with similar capacity requirements pay for broadband service. But benchmarking the price of broadband service offered by local suppliers can significantly reduce costs, and we have seen the benefits in multiple locations worldwide. One school district

in northern California that benchmarked its broadband expenses was able to reduce costs by 30 percent.

When attempting to increase accountability, stakeholders, especially those in government, might consider involving the public. For instance, New York City’s 311 initiative allows residents to report nonemergency complaints—about common problems such as potholes or garbage collection—via a website, a mobile app, text messaging, Skype, or phone. The city now processes 60 percent of service requests online. In addition to lowering transaction and issue-resolution costs, the initiative allows users to track the status of their requests. New York City released the underlying 311 app to other cities around the world, enabling citizen participation in additional locations, including Boston and Buffalo, New York.

Government’s critical and unique roles Sitting at the nexus of citizens/consumers, businesses, and NGOs, government is optimally positioned to extract value from open data—and to help others do the same. Much of this value is consumer surplus,

Exhibit 5

Government can serve as an open-data provider, catalyst, user, and policy maker to create value and mitigate risks.

| Provider | Catalyst | User | Policy maker |
|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------|
| <ul style="list-style-type: none"> •Capture information electronically •Release data publicly and regularly •Identify ways to improve data quality | <ul style="list-style-type: none"> •Build an open- data culture •Convene stakeholders •Champion the movement | <ul style="list-style-type: none"> •Apply sophisticated analytics to improve decision making, offerings, and accountability •Invest in people, tools, and systems | <ul style="list-style-type: none"> •Make rules for internal and external use •Establish standards for data quality and format |



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or economic benefits that are captured by individuals. Government can spur value creation at all levels of society by concurrently fulfilling four important roles: as a provider, catalyst, user, and policy maker. Because technology, capabilities, and cultural norms are always changing, these roles continually evolve (Exhibit 5).

Government as an open-data provider Across all levels of government, millions of individual data records are collected, stored, and analyzed. From tax returns and unemployment claims to hospital reimbursements and energy use, much of this information is now available electronically and readily shared. In the United States, for instance,

over 85,000 data sets are now available on data.gov, the federal government's publication arm for open data, along with user guides, event postings, and examples of applications across industries, from agriculture to manufacturing. By making these data available to enterprising companies and individuals, government is spurring private-sector innovation and increasing transparency—two of the most important goals of any open-data initiative. When prioritizing data for release, government might consider focusing on both the value that can be created as well as the ease with which data can be made available. Often, the data that are easiest to release may contain little that interests stakeholders. To

Attendees work on computers as they participate in a hackathon in Japan.

Many staff members and leaders at government agencies need to significantly shift their mind-set about data from one that has open data as an exception to one where open data is the rule.

avoid wasted effort, government leaders can work with their teams and external stakeholders to evaluate and decide which information to capture, how to standardize and digitize it, and when and where to share it. They can

also look for opportunities to migrate data to electronic formats that are suitable for all internal agencies and external audiences. The 2010 US Census effort, which focused on both data quality and accessibility, included dozens of experiments and evaluations of data collection, coding, and analytics to improve the accuracy of the information and to make it available in an easily downloadable format.

Timely data are also essential to accurate research and better decision making. As such, government might consider explicitly setting expectations about how often data will be updated. In addition, government might consider releasing metadata—in other words, data about data. Metadata may describe the accuracy of a data set, the methodology of collection, or other parameters. Government can also assist researchers by publishing data “dictionaries,” which are easily searchable repositories of metadata.

Many staff members and leaders at government agencies need to significantly shift their mind-set about data from one that has open data as an exception to one where open data is the rule.³ Specifically, they can no longer see their primary role as the provision of services; instead, they might consider focusing on helping third parties create innovative products and services.

Government as an open-data catalyst

Government can serve as a catalyst for the use of open data by creating a thriving ecosystem of data users, coders, and application developers. To attract such talent, it can advertise its open-data efforts through press releases or other marketing materials, or even engage in individual outreach efforts. One innovative approach taken by governments worldwide involves organizing “hackathons” and “datapaloozas,” often with prize money and publicity. These events help promote the use of data in the development of innovative products and services. They also allow governments to share newly released or digitized data, draw on the expertise of participants, and provide guidance about privacy and safety. Other marketing platforms to champion open data include interagency meetings, roundtables with NGOs and businesses, and public-awareness campaigns. There are a range of relevant topics for users to cover at open-data events, including what data could be most valuable if released, the best format for sharing data, user access and permission levels, and potential applications that could be developed from the data. For instance, the US Department of Health and Human Services recently convened 40 leaders from the technology and health-care spheres, presenting them with existing data sets and asking how the data could be used. This resulted in a productive brainstorming session and the development of a number of health-care apps and services.

Governments can also serve as a catalyst by selecting leaders to champion open-data initiatives. In the United States, for example, President Obama has appointed a "White House data evangelist" who oversees and promotes use of information on data.gov. The data evangelist's team aims to increase

public access to open data generated by the executive branch and encourage innovation outside government. The White House

also supports innovation fellows— individuals recognized as rising technology leaders—

who serve 6- to 12-month rotations in partnership with federal-agency leaders. These fellows help develop pilot programs, prioritize open-data opportunities, and codify best practices.

Government as an open-data user

There are two primary ways that government engages as a user of open data.

Applying analytics. As a data user, government can benefit by applying advanced analytics that improve internal decision making, promote the creation of new offerings, and increase accountability. For example, utilities can identify areas for improvement by sharing data about pilot results, task-time benchmarks, construction plans, performance-management systems, and asset-replacement schedules. In parallel, they can provide MyData to customers, such as information on their electricity-usage patterns to promote more efficient consumption.

Investing in programs. To optimize use of public data within their own agencies, government leaders need to invest in first-class talent, tools, and systems. On the people front, this involves hiring knowledgeable staff at all levels. (Although many cities, counties, states, and agencies today have chief information or chief technology officers, they often lack data expertise

lower in the organization.) Government leaders can also create appropriate incentives to retain employees with strong technology skills, since they may otherwise lose them to the private sector.

Beyond recruiting talent, government could optimize data use by training current staff—even those not in technical roles— about the overall value of open data, as well as the benefits of providing data to third parties. Training could emphasize how staff can derive insights from open data to improve their own programs or services, as well as strategies for engaging external stakeholders (for instance, by holding the previously mentioned datapalooza events). Agencies that build strong support from the top during these efforts will increase the likelihood that open-data initiatives are viewed as an essential part of their mission rather than side projects.

In an environment where technology is constantly changing, it is important for open-data programs to continue to evolve or value can

be lost. Some organizations, such as the Open Data Institute, have established strategies for refining open-data programs that involve investing in computer-storage capabilities, establishing strong technical safeguards to protect privacy, educating staff about confidentiality risks, and building or buying sophisticated software programs. Governments and other stakeholders may improve data usage by studying their strategies.

Government as policy maker

At a fundamental level, government is well positioned to perform several interrelated yet distinct tasks to improve the lives of the public, generate value, and protect individual privacy. These include making rules and helping to establish standards.

Making rules. As a consumer advocate—the watchdog and protector of the public

trust—government can draw on its legislative authority and enforcement powers to ensure safety, security, equity, and justice for all members of society. In the context of open data, its purview includes several elements:

- defining rights to access or use certain sensitive information, including that obtained from medical files, tax returns, and driving records
- deciding what data should be mandatory for individuals and companies to share
 - providing guidelines on the collection, management, and dissemination of information
 - creating incentives for participation and compliance with data-sharing efforts

In some cases, government may need to limit the use of open data to protect privacy and confidentiality. The United Kingdom, for instance, enacted the Data Protection Act to control how public and private organizations use personal data. Among other provisions, the act stipulates that data should only be used for limited, specifically stated purposes and that they must be stored in a secure location. The act also provides stronger legal protections for particularly sensitive information, such as data related to an individual's health, religious beliefs, or political opinions. Similarly, the US federal government has enacted multiple laws to ensure data privacy, including the E-Government Act, which prohibits the secondary disclosure of information obtained for statistical purposes, among other protections.

There are also situations where the government can serve the public by mandating the release of data. In the United States, the Securities and Exchange Commission (SEC) seeks to protect the public by requiring companies to collect and submit certain financial documents. The SEC then posts documents deemed public infor-

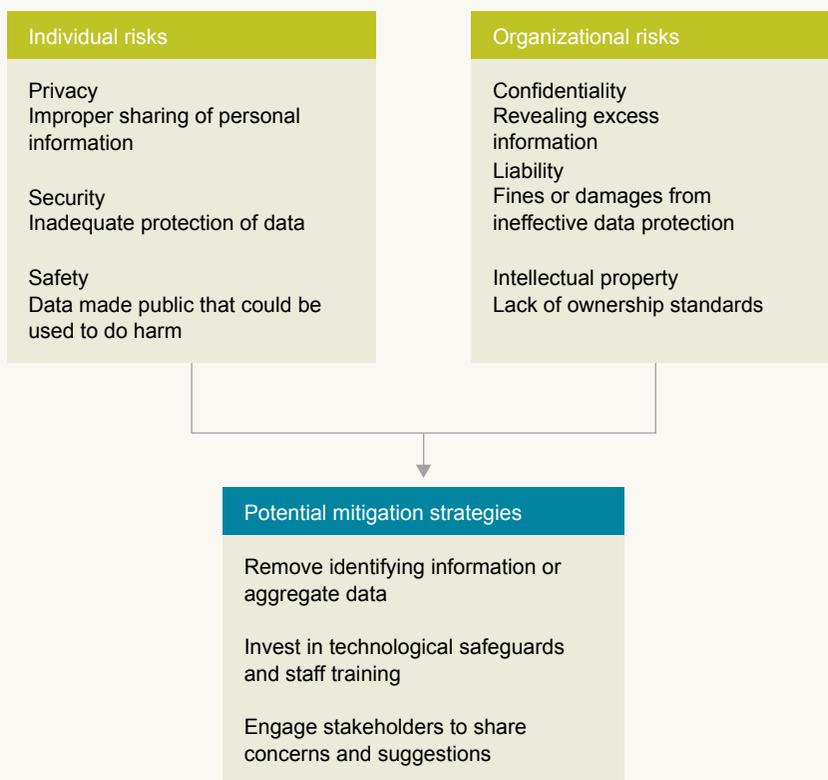
mation on its Electronic Data-Gathering, Analysis, and Retrieval website. The EU has also declared that data about individuals held by private companies must be made available to those individuals upon request (a task that would be made easier through MyData systems, which are central databases that allow individuals to access information about themselves).

Elected officials may be concerned about public perceptions of privacy issues related to open-data initiatives. In addition to ensuring robust protections are in place around private/identifiable data, government can engage citizens early to address their concerns, seek new ideas, and answer questions about how data can inform policy.

Setting standards. The policy-maker role involves participating in the creation of technical standards about data quality and format, since these can significantly increase and scale the benefits of open data. Public-sector leaders might consider consulting experts to help design standards, which will facilitate use across different computer systems. For instance, they could follow the example of some private organizations by promoting the use of Data Catalog Interoperability Protocol (DCIP), which specifies design criteria for data catalogs published on the web. Among other recommendations, the DCIP promotes the use of JavaScript Object Notation, an easy-to-use data-interchange format. As tools and technologies become more sophisticated, leaders might consider revisiting existing standards, since better methods for organizing and sharing data may emerge. Government could also reevaluate the level of detail contained within open data, the frequency of its release, and the ease with which data can be integrated across systems.

Exhibit 6

Public-sector leaders can address data risks that could threaten individuals and organizations or undermine open-data initiatives.



Risks in open data—and potential strategies to address them

Public-sector leaders are often called on to protect individuals and organizations from the risks of open data while also advancing open data’s potential value. Risks include those that fall largely on individuals, such as privacy, security, and personal safety, and those related primarily to organi-

zations, such as confidentiality, liability, and intellectual property (Exhibit 6).

Individual risks: Privacy, security, and safety

As noted earlier, open data can improve accountability in government, make businesses more competitive, and help public-sector leaders debate issues and identify

sound policies. But total information sharing without safeguards or limits can put individual privacy and security in harm's way. Agencies that release information might therefore need to exercise caution. For instance, regulators in many countries publish data about hospital performance on certain procedures to compare costs and outcomes, but they do not publicly reveal patient-level information. Similarly, 45 US states evaluate student performance according to standards set by the Common Core State Standards Initiative. These standards allow educators to analyze longitudinal student and teacher data from multiple districts, but some citizens have expressed concern that records related to individual performance could damage college prospects if released. In response, officials have developed clear guidelines stipulating that the federal government can only have access to aggregate student and teacher data. As open data become increasingly important, ensuring cybersecurity will be an ever-more-challenging task. For example, criminals could commit fraud or identity theft if they obtain ATM personal-identification numbers or financial data about a bank's clients. As noted earlier, government could try to address the security challenge in its role as policy maker by establishing limits on data access or usage (such as stipulating that some personal information can only go to law-enforcement officers) or forbidding the release of certain information. To reduce risk, public-sector leaders could try to anticipate potential uses for newly released information, focusing on the insight it offers and parties that might be interested. For example, government could protect consumers by ensuring that data on individual energy usage is provided to residents as MyData but aggregate the data points when making them publicly available. This would limit the ability of criminals to track when

people are at home (higher energy use) or away (low energy use). Since it is not possible to predict all possible uses of data, government may want to institute policies that regulate their use rather than their collection. This approach may be more pragmatic than expecting to prevent all potential negative outcomes through fine-grained regulation for data collection and access; it also reflects the fact that specific uses of data are often what people find objectionable.

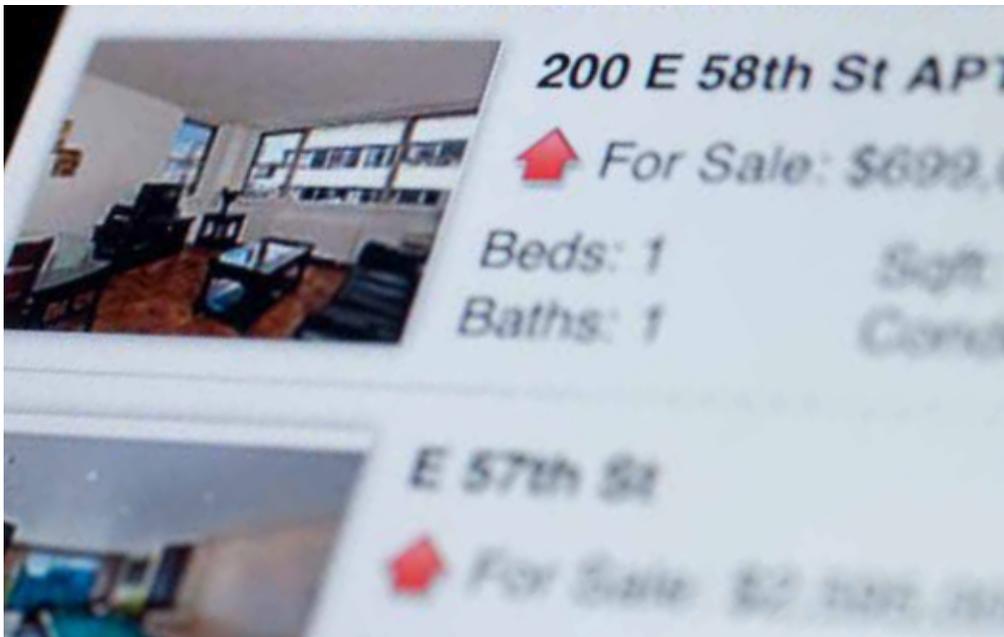
Organizational risks: Confidentiality, liability, and intellectual property From small start-ups to Fortune 500 companies, organizations stand to generate significant value from open-data initiatives. Government agencies are also poised to reap great benefits. However, public officials can try to actively manage certain risks that occur whenever any organization releases potentially sensitive data. For example, there are concerns that opening performance data to third-party analyses could inadvertently discourage positive change, appropriate risk taking, and innovation. But government could try to balance the public's desire for information with the stakeholders' need to avoid undue criticism—for instance, by instituting regulations that limit liability.

Another organizational concern relates to questions about intellectual property: who owns rights to the underlying data, who owns rights to the tools used to extract insights from the data, and who owns rights to any products or services created from the data. Currently, permission rights to use open data vary greatly depending on the source. Similarly, some advanced technology, software, and analytics used to derive insights from data are free, as are some apps and other products created from the data; in other cases, organizations levy copyright and licensing fees. Whenever protections or restric-

tions on usage exist, such as contractual agreements that establish whether data can be redistributed, published, or combined with other data, it is important to respect them. If government establishes intellectual-property rules that are transparent, fair, and promote innovation, it could help create a growing ecosystem of “datapreneurs” who turn a profit by using open data to create goods and services.

Some organizations may be reluctant to release proprietary data for fear that common access to their hard-earned knowledge will erode a competitive advantage. Although this is indeed a concern, releasing data may also spur development of solutions that a single company could never devise on its own. For example, the “hive mind” approach, which draws on the talent and knowledge of multiple organizations, is relevant in the information-dependent field of oil and gas exploration. Greater sharing of seismic data

and information about drilling methodologies can increase the success of exploration activities and improve reserve-replacement ratios, reduce costs per barrel, and reduce risk. In its role as an open-data champion, government could encourage private companies to share such proprietary data, including industry benchmarks, in all sectors of the economy. Several protections can help reassure companies that their proprietary data will not be misused. For example, the Yale University Open Data Access (YODA) project provides pharmaceutical and health-care companies a safe route for releasing clinical-trial information that would otherwise go unpublished. People interested in accessing the data must submit a proposal, complete a short course on responsible conduct, and agree to share their research findings. Applicants who seek data purely for commercial or legal purposes are denied access. With such protections in



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place, YODA can help ensure that researchers will only use the data to contribute to overall scientific knowledge, thus balancing an individual company's intellectual- property rights with societal benefits of open data.

External stakeholders in open-data programs

Any government open-data initiative will involve multiple external stakeholders who have different roles, needs, and concerns, as well as varying strategies for learning about data, mitigating risks, and advancing their agendas (Exhibit 7).

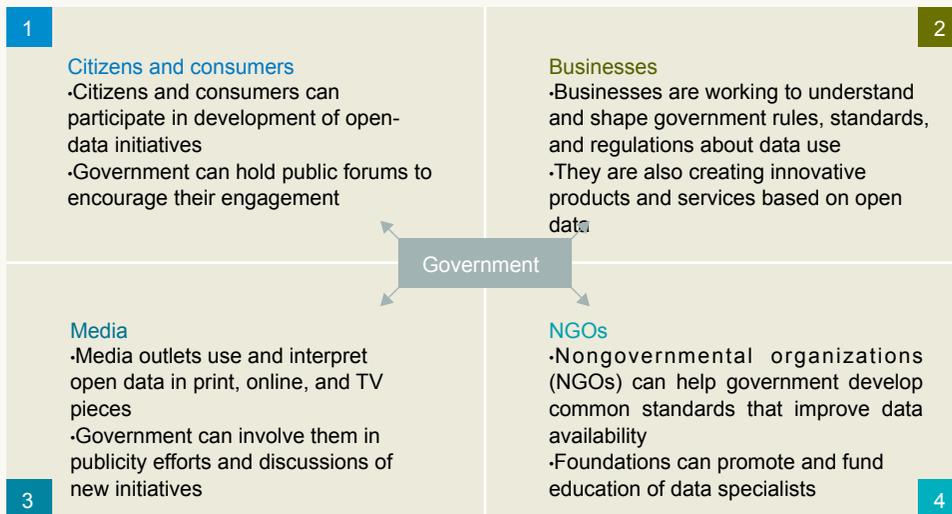
Citizens and consumers

Based on our prior analysis of seven domains of the global economy, citizens and consumers stand to gain the most from open data.

For instance, they will be able to make more informed purchase decisions since they will have greater price transparency, thereby saving money. They will also have better insights about schools, transportation, and health treatments, which can help them make informed choices. As one example, consumers will have more information about diet and exercise patterns that could reduce their susceptibility to lifestyle-linked conditions and illnesses such as hypertension and diabetes.

Exhibit 7

Among core stakeholders, government is positioned to represent and advance shared interests.



Government could consider engaging consumers by holding public forums that illustrate how open data can improve services—for instance, by helping the public-works department to understand what streets are most in need of repair. In all cases, government could emphasize that private data will be protected, since citizens are often concerned about confidentiality issues.

Consumers themselves can make an important contribution to open-data initiatives by sharing personal information. For instance, consumers who release health information, such as data on daily exercise levels, can help clinicians identify individuals who may be

at risk for a particular disease. If individual data are combined with information from other sources, such as demographic records, clinicians can then target specific populations for health-education or prevention efforts, such as disease-screening programs.

Businesses

Across industries, single “data-preneurs,” small start-ups, government contractors, and large multinational corporations are attempting to understand—and in some cases shape—appropriate government rules, standards, and regulations about data use. But even more important, many businesses are now creating innovative products and services based on open data. There are numerous examples we could cite in addition to those mentioned earlier in this report. For instance, Zillow, a US real-estate company, combines data from county land records, satellite imagery, and multiple listing services that advertise homes for sale. Visitors to the Zillow website can thus view images of entire neighborhoods when assessing potential properties. It may be helpful to publicize examples of some of the more successful creations, since other companies may be more inclined to use open data if they see the economic potential.

Business leaders might consider sharing data with other stakeholders or collaborating with them to develop innovative offerings that leverage open data. For example, they could potentially access sources such as Google Transit Feed Specifications, which would allow them to develop services like NextBus, an app that tells riders their projected wait time.

Media

In all formats—including print, radio, TV, online video, tweets, and blogs—media outlets use and interpret open data. Some also closely follow and report on developments in this sphere. OKF’s recently released 2013 rankings of the most and least “open” countries received extensive global media coverage. In addition, media outlets have intensely monitored national-security breaches in which data are compromised, as the WikiLeaks and Edward Snowden incidents made evident. This coverage spurs public dialogue about the standards needed to protect individual or national-security interests.

Many journalists use open-data sets to identify trends, patterns, and behaviors that deserve attention, a trend known as data journalism. For example, they could use open data to highlight the time of day when most traffic accidents occur or to illustrate crime patterns within a city. Articles on such topics may serve as catalysts that spur officials or private citizens to take action. Acknowledging the importance of open data, newspapers and other media sources are dedicating increased resources to the creation of infographics based on open-data sets. Some of those most interesting ones are interactive and allow readers to find specific data. In London, the *Guardian* recently published an infographic that shows temperature changes over the past 100 years in most countries. Readers can type in

a city and country to view location-specific data.

Media can also serve a vital function by publicizing success stories about open data and reporting on trends related to data use. Government leaders could thus engage journalists, commentators, and technology and government reporters in early discussions of new programs or policy changes, as this may help raise public awareness about and engagement with the initiatives. Publicity about open data could also stimulate crowdsourcing, since more people will become aware of available information and suggest new ways to use it. The media can even help with job-recruitment efforts. For instance, news articles may raise awareness of government open-data initiatives and related job opportunities for coders or app developers.

NGOs

With access to information from multiple governments and constituencies across the globe, NGOs (including universities, advocacy groups, and think tanks) represent some of the most active collectors, disseminators, and users of open data today. The International Monetary Fund, the World Bank Group, and the World Health Organization all have vast stores of information that they share with the public, allowing others to analyze data and create tools and products similar to those based on data from businesses and governments. Given their presence across the globe and in multiple jurisdictions, NGOs can play a crucial role by encouraging policy makers to adopt common standards that improve the availability and use of open data. Foundations that invest in education can also support open-data initiatives by promoting training efforts for data scientists. Such education is more crucial than ever,

since most countries lack skilled workers who have training in the science, technology, engineering, and mathematics fields. Other NGOs, such as "Code for America," sponsor programs that place people with data skills in positions where they can help create applications enabled by open data.

Developing a customized open-data approach

Although interest in open data is gaining momentum worldwide, countries and agencies are not at the same starting point. Some, such as Denmark, the Netherlands (which topped the 2013 OKF rankings), Norway, the United Kingdom, and the United States, already have well-established initiatives that touch almost every sector of government, and they are well positioned to remain on the forefront of value creation. Other countries have various open-data programs across agencies and are still attempting to integrate them. Still others are just beginning to investigate the use of open data or have a few nascent programs. Regardless of their current capabilities, however, all governments will need to develop a clear understanding of their strategy and goals.

To begin, we suggest examining the three critical components of any successful initiative—people, tools, and systems. The diagnostic can include five elements:

- inventorying available data to assess their value
- analyzing initiatives that are in progress
- identifying gaps in knowledge, capabilities, technical infrastructure, management, engagement, and other areas
- prioritizing actions and investments
- evaluating how third parties are using an organization's data and whether they are fully exploiting the information's potential

For each topic, a list of questions can help government devise an improvement plan and meet the needs of all stakeholders. In the people category, for instance, government leaders can assess the external talent pipeline, describe the skills needed for internal employees, evaluate the degree of leadership support, and rate the strength of their open-data culture.

As noted earlier, government can also advance its open-data agenda by convening experts at working sessions at the start of—and throughout—open-data initiatives. Given the ever-changing nature of technology and the increasing availability of data in electronic format, they might consider treating open-data efforts as an iterative process. Ongoing engagement will also help government understand what consumers, NGOs, and the private sector truly value, allowing strategies to be refined. In the United States, for example, government officials within the Health Data Initiative convene an annual conference for companies that are investigating innovative strategies for using health data in tools and applications. More than 2,000 data experts, technology developers, entrepreneurs, policy makers, health-care-system leaders, and community advocates attended one recent forum. In addition to speeches, breakout sessions, and presentations, the forum allowed companies to demonstrate their products and work on them in “code-a-thons” that brought innovators together for live collaboration.

While some countries may not be able to convene such large conferences, they can still benefit from gathering smaller groups

of experts. In Rwanda, the government is working with the World Bank Group and the local start-up community to define the open-data agenda. In Uruguay, the government invited representatives from NGOs and regional technology leaders to help outline a road map for its open-data program and select high-value data sets to release.



The use of open data is a relatively recent phenomenon, but as with many technological advances, it is growing in relevance and prevalence—in other words, it is becoming the “new normal.” The benefits of open data are significant and include the potential for more than \$3 trillion in economic value annually, much of which will likely go to consumers. Yet the success of open-data programs is not guaranteed. It takes real effort to engage an external community to use open data.

Risks, such as threats to privacy and intellectual property, can be actively and continually addressed.

Encouragingly, governments around the world have taken steps toward developing responsible and robust open-data programs. We hope this report will inspire and enable more government leaders and stakeholders across the spectrum of business, citizens and consumers, the media, and NGOs to engage in the conversation, invest in the work, and promote open data in a way that helps unlock economic and societal benefits. n

OPEN DATA/IT

Michael Chui and Aura Solution
Company Limited

A CLOSER LOOK AT OPEN DATA: OPPORTUNITIES FOR IMPACT

Local and regional governments can use open data to make substantial improvements to education, transportation, and health care—but first they will have to overcome some big challenges.

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¹Data sets range from completely open to completely closed across four dimensions: *accessibility* (the range of users permitted to access the data); *machine readability* (the ease with which the data can be processed automatically); *cost* (the price of obtaining data); and *rights* (limitations on the use, transformation, and distribution of the data). We use the terms "open data" and "liquid data" interchangeably.

Public institutions and private companies are aware of the opportunities and challenges associated with big data analytics. But as these organizations take steps to harness the power of big data, it's important that they are also aware of a complementary global trend; open data—the release of information by governments and private institutions and the sharing of other data within and across industries— extends the power of big data and makes possible entirely new products and services, while also enabling better decision making and improved operations in both the private and public sectors.¹ In fact, our research suggests that open data can help unlock more than \$3 trillion annually in seven domains of the global economy: consumer finance,

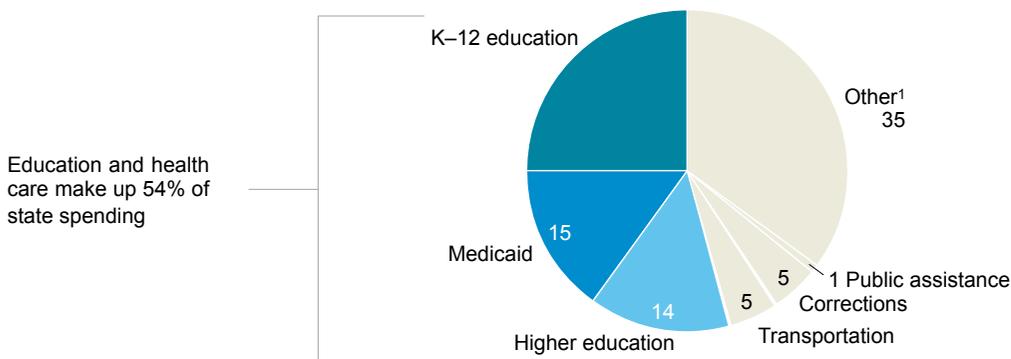
consumer products, education, electricity, health care, oil and gas, and transportation. Many regional and local governments have already opened up their data to increase transparency and accountability, promote civic engagement, and improve basic public services. In the United States, for example, residents of Texas can help their government identify potential cost savings by scrutinizing publicly available budgetary information. Some third parties have used "liquid" information (data that are open, widely available, and in shareable formats) to create smartphone apps that tell commuters when the next bus will arrive or that guide drivers to the nearest available parking spot.

These applications, while promising, are just the beginning. Open data can help local and regional governments transform the way they deliver services while also offering significant cost savings. Moreover, by sharing, where appropriate, the vast amount of data at their disposal, governments can catalyze the use of open data in other sectors, which can in turn help create value in the broader economy. (For more, see "How government can promote open data and help unleash over \$3 trillion in economic value.") Realizing this potential will not be easy and will require creating safeguards for personal privacy, making investments in technology, changing mind-sets and work processes, and embracing

Exhibit

Education accounts for nearly 40 percent of state spending in the United States.

State spending, % of budget



¹Other" includes care for residents with disabilities, economic development, health benefits for public employees, parks and recreation, pensions, state police, and general aid to local communities.

Source: *State Expenditure Report: Examining Fiscal 2010–2012 State Spending*, National Association of State Budget Officers, Dec 2012, nasbo.org

ing new concepts such as MyData—a term that describes the sharing of information with the individual about whom it has been collected. (See sidebar, “About MyData.”) Here, we discuss the open-data opportunity—and the accompanying challenges—in three of the seven domains we researched that have the closest ties to regional- and local- government budgets: education, transporta- tion, and health care (exhibit).

Education: Opportunities inside and outside the classroom

More than one billion students are enrolled in schools around the world, and those students are served by more than 58 million teachers. Annual spending on kindergarten through grade 12 and postsecondary education exceeds \$4 trillion worldwide.² In some countries, public education is funded primar- ily at a national level; in others, it is largely the responsibility of state and local govern-

ments. In the United States alone, state and local governments spend about \$1 trillion a year on education; as the exhibit shows,

in fiscal year 2011, 25 percent of state dollars were spent on schooling for K–12 students. With so many resources dedicated to public education, there are substantial opportuni- ties to improve current systems.

Improve instruction. Many of the most valuable applications of open data will evolve in the classroom itself. Schools can improve instruction by using open data to develop per- sonalized learning plans for students, provide frequent feedback to teachers on their performance, and create targeted professional- development programs. MyData programs will be especially important here, as they allow families to track student progress and correct inaccurate information.

For families and educators to identify areas for improvement, data on student perfor- mance and information about specific teaching practices can be combined with information about individual learning preferences and local educational mandates or guidelines. Adaptive- learning programs gather data about how an individual student interacts with specific lesson plans and then they contextualize those measurements—with information about that student’s past performance and the performance of his or her cohort—to identify areas that the student has mastered, or conversely, where he or she might need extra help. When used for remedial-math programs at Arizona State University, personalized learning plans improved pass rates by nearly 10 percent.

This data-driven approach to teaching and learning allows for targeted, rapid responses; by using insights gained from frequent data collection and analysis, problems can be corrected and lesson plans adapted before student performance suffers. Sharing data across institutions and school districts—

About MyData

MyData is not a specific program. It is a concept that entails sharing information collected about an individual (or organization) with that person (or company). MyData will be an important part of capturing the open-data opportunity, especially in the fields of education and health care. For example, some hospitals now provide individual patients with access to their own medical- records data. Providing aggregate statistics (a form of open data) along- side MyData allows useful comparisons; some utilities show consumers how their energy use compares with that of neighbors to encourage conservation. In many cases, individuals can modify or correct the data provided to them, which improves its quality.

making the data more liquid—allows for more robust analysis. Educators can monitor student attainment frequently and at

a granular level (measuring mastery of a particular concept, for example) and track how individual student performance correlates to classroom activities (lectures versus exercises or group work). These approaches can also be used to increase motivation, influence mind-sets, and adjust learning strategies to improve student achievement.

Match students to schools and programs. Open data can be used to help parents and students identify the best fit with a school or program. Peng Shi, a graduate student, created Boston's new methodology for public-school assignments by using information released by the city on the quality and location of schools.³ His algorithm presents parents with choices based on school quality and distance. While school choice in K–12 grades may help students find institutions that can better serve their needs, many districts cannot offer every student a slot in a high-performing school; open data can help families identify alternatives and put pressure on systems to provide more high-quality options.

Ensure efficient system administration. Schools can reduce procurement costs by using open data to consolidate, standardize, and compare the types of products they purchase. By allowing administrators to analyze past purchases and examine how peer institutions are allocating their budgets, open data can also enable better forecasts for when products or services will be required. One country in Europe, for example, has used open data to reduce the price its schools pay for a wide range of supplies. Its open-bid platform hosts an online auction where vendors bid on contracts to supply basic

goods to schools across the nation. Suppliers see information about current bids, the quantity of goods requested, and data on previous auctions, such as closing bids, prices, and quantities. Just two years after implementation, the average price of the items offered on the platform had dropped by 24 percent. These efforts not only reduce procurement costs but also allow vendors to better forecast demand.

While schools can reap many of the benefits of enhanced procurement using their own data, sharing their information across schools and districts can lead to even better results through benchmarked price negotiations.

Improved purchasing of broadband services is one example. By comparing the prices of broadband service offered by local suppliers — and by benchmarking their costs against their peers' — one school district in northern California was able to reduce broadband costs by 30 percent.

Challenges

The benefits of open data in the field of education are tremendous; in addition to the opportunities discussed here, open data can help match graduating students to appropriate employment and can make the true costs of higher education (and private K–12 education) more transparent. But to capitalize on any of these opportunities, stakeholders must share information across the education system so they can identify areas ripe for improvement, and they must do so in a way that protects the identity of individual students and teachers. They will also need standardized measures for analyzing student, teacher, and school performance and for identifying best practices so that educators can learn about learning—using data to see which approaches work best for students and refining these techniques through ongoing monitoring.



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Transportation: Doing more with less Open data has already played an important role in improving transportation; we believe it will continue to play a role in addressing the inefficiencies that persist. Open data can help local and state governments reduce transportation spending and improve services in three ways.

Improve infrastructure planning and management. Open data can help governments improve transportation-demand forecasting, prioritize transport infrastructure improvements, and synchronize the ways different modes of transportation inter-operate. It is an especially powerful tool when combined with other transportation statistics. For example, in 2012, the city of Moscow used open data to complement its own estimates of how long it would take citizens to commute via different modes of transport; specifically, city officials used Internet resources that measure traffic, as well as mobile-phone-location data, transportation-operation statistics, and

public projections of city and regional development. By combining its own data with open data, the city was able to determine whether extending its subway system into the suburbs was necessary or if other services could do a better job of meeting demand. The transit authority ultimately decided against making a costly investment in the subway extension and instead planned a less costly investment in a suburban-rail extension. This limited Moscow's up-front costs and ensured that services could be flexible enough to meet the needs of a shifting population. The new suburban-rail extension is part of a larger transportation strategy that, in addition to avoiding more than \$1 billion in infrastructure costs, has the potential to reduce average commute times by 16 minutes per trip, saving one week of travel time for each rider every year.

Optimize fleet investment. Open data can help optimize the size and mix of public fleets—all the vehicles owned and managed by

the government—and make operations more efficient. In one US city, for example, open data helped the local government understand how its vehicles were being used, which uncovered an opportunity to cut the fleet by as much as 30 percent. And in California, after the state released budget data on vehicle spending, citizen advocates spotted examples of unnecessarily high costs, and state agencies were able to reduce the fleet by 15 percent.

Inform customer decision making. Open data can help customers make better decisions about when and which type of public transportation to use; when aggregated, these choices can be the source of significant economic value. Public-transit systems have expanded the use of sensors that generate location data, for example, which can then be used to transmit train and bus locations in real time. This information is used by transit agencies to manage their operations, but these data streams also have been made available to entrepreneurial developers such as CUBIC, whose NextBus app lets riders in cities such as Los Angeles, Toronto, and Washington, DC, see current wait times and delays.

Open data on bus and train location and road congestion can shrink the “reliability buffer”—the extra time a traveler builds into a trip to account for possible delays, which can be as much as 70 percent of total trip time.⁴

Open data on vehicle location and on-time performance can also help attract new users because of the increased predictability of services. In Duluth, Minnesota, for example, Google Transit installed transponders that record city-bus locations and make the data public so riders can decide if it offers a suitable alternative to driving. After the transponders were installed, ridership increased by 12 percent, reducing traffic and also decreasing the cost of transportation for many passengers.

Challenges

Using open data to improve transportation delivery can be tricky. Such projects raise privacy concerns, and there are gaps in data standards and capabilities in some transportation organizations. There are political and financial barriers as well; infrastructure projects are expensive, long-run investments that often involve policy makers from multiple jurisdictions. There are also concerns about providing transportation services in rural areas where the financial return on investment in infrastructure, which open data can help estimate, is of secondary importance.

Health care: Better care at lower costs Using open data to improve health care will be driven largely by stakeholders outside local governments—for example, providers, payors, national governments, and patients who choose to share their information—but these advances will in fact generate savings at the local level, especially in the context

of Medicaid spending in the United States. We have identified several levers for capturing value in health care through the use of open and proprietary data. We focus on levers

that can be applied in the United States, but many of the levers we identify would work in other nations and have been applied in health-care systems around the world.⁵

Right living. An enormous and largely untapped source of value in health care lies in the use of data by patients to manage their own health to avoid illness and to get better results from treatment if and when they do become ill. The major focus is providing patients with the information they need to make healthy lifestyle choices and to manage their treatments effectively.

Health-care data that are made more liquid can reduce the occurrence of lifestyle-linked conditions and illnesses (such as hypertension and diabetes) by better identifying at-risk

individuals. This is done by combining patient information (such as exercise habits) with demographic information and then analyzing outcomes across different patient populations. At-risk patients can then be targeted for health education or for assistance in preventing illness—for example, by recommending screenings or issuing personal reminders.

Open data can also help with drug adherence—failure to use medication as prescribed for chronic conditions costs the US health-care system \$100 billion to \$289 billion a year.⁶ Ginger.io has developed a smartphone app that can detect when a patient is not using drugs correctly or has changed behavior in a way that indicates a potential medical emergency. The app collects motion data to establish a base pattern and then looks

for deviations that might signal trouble; a sharp drop in activity, for example, might indicate that a patient has stopped taking antidepressants or has fallen down. Irregular sleep patterns could signal that an anxiety attack is imminent.

Right care. Research shows that suboptimal care is often the result of poor communication between patients and doctors and among doctors themselves. This leads to inappropriate or redundant care that can result in complications and raise costs.

Electronic medical records can help avoid these problems by creating a single consolidated record for each patient and giving access to all the patient's caregivers. In the United States, participating providers can offer patients access to their own medical records—their medical MyData—through an initiative called Blue Button, which was pioneered by the Department of Veterans Affairs. In France, patients can carry their entire medical histories on a smart card—a card with a memory chip that any doctor or care facility can use. The system can also flag potentially harmful drug inter-

actions for a specific patient before a physician selects a drug treatment or performs a radiologic test.

Open data can also be used to mount a vigorous response to disease outbreak—another aspect of right care. Public-health agencies collect data from emergency rooms and other sources to detect outbreaks of certain diseases so that members of the public can take steps to protect themselves. Google has shown that it can map a flu outbreak in real time by monitoring the number and locations of users searching for “flu” and related topics. A start-up called Propeller Health has created a GPS-enabled tracker that monitors inhalers; it can be used to detect when environmental conditions such as high pollen counts might trigger severe asthma problems.

Right provider. “Right provider” means identifying the doctors and care settings that provide high-quality care for a specific task and determining which resources are needed to deliver it (for example, determining which procedures are best done by a physician assistant or nurse rather than a doctor). Optimizing provider decisions depends on many organizations having access to performance data. Performance data can be used to align incentives with outcomes (for example, paying doctors for successful treatment rather than for procedures). This approach can give patients better options and raise the quality of care. For example, in Arkansas, all Medicaid providers who treat upper-respiratory infections, pregnancy, attention-deficit-hyperactivity disorder, and select diseases receive a report on the cost and quality of treatment. The aggregated data on all a provider's claims help doctors understand how their practices compare with other providers in the state, giving them a way to identify opportunities to improve. New York

State in the United States and the National Health Service in the United Kingdom have opened up data about hospital performance. These data can be used by patients, doctors, payors, and the public to identify the best care available in their communities.

Right value. Open data can help increase value in health-care delivery by controlling costs and improving quality. This includes using data to eliminate fraud, waste, or abuse in the Medicare and Medicaid programs, which can exceed \$70 billion annually.⁷ Regulators can combine claims data with public information about patients (such as date of birth, address, employment, or registry of motor-vehicle information) to confirm patient identity; this can help reduce instances of billing for services that were not provided. Using open and proprietary data to reduce costs, maintain quality, and fight fraud could enable value of \$50 billion to \$100 billion a year.

Challenges

Capturing the full value of open data in the US health-care system would require several changes. The most fundamental one would be a shift in medicine and caregiving to data-driven approaches, in which physician decisions about treatment are informed by results from thousands of patients.

Payment systems would also need to be adapted because conventional means of controlling costs, such as negotiating prices of per-procedure fees, are not geared toward taking advantage of the insights that open data provide.

There are also technical and organizational barriers to realizing the full value of open data in health care, including the inability of many health-care data systems to provide standardized information. Finally, there are concerns about privacy and confidentiality—the consequences of mishandled medical data

can be extremely serious. Government, providers, and payors must ensure that effective systems are in place to keep shared medical records confidential.



Making information more transparent is an important first step toward improving public services, increasing transparency, and saving taxpayer money, but it is not sufficient to capture the value of open data. Governments, like private institutions, will need to prioritize opening the data sets that will create the greatest benefits; they will also need to invest in technology and cultivate a vibrant network of third-party developers that can transform raw data into valuable tools. Additionally, they will need to acquire and develop the talent, processes, and cultures to complement their technological investments. Key skills include the ability

to perform analyses, create useful reports and tools based on open data, and incorporate data into managerial decision-making processes. In addition to meeting the technological requirements of capturing the value of open data, governments must also create thoughtful policies that protect intellectual property and ensure privacy of both consumers and institutions. ⁿ

COORDINATES FOR CHANGE: HOW GIS TECHNOLOGY AND GEOSPATIAL ANALYTICS CAN IMPROVE CITY SERVICES

An innovative technology harnesses data to reduce costs, improve services, and create a better community for citizens.

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¹Geographic-information systems (GIS) include the hardware, software, data, management, and analysis of geographically referenced data. The analyses based on GIS data are referred to as geospatial analytics.

We're familiar with using maps to figure out where to go, or how to get from point A to point B. But now we can also use maps to figure out where and when burglaries are most likely to occur in a particular city, the parts of a country most in need of pre-natal health-care clinics, and where a parking spot just became available in a congested neighborhood. The rapid retrieval and presentation of such highly specific, extremely valuable information is possible because of one innovative technology: geographic-information systems (GIS).¹

GIS technology allows users to integrate and analyze large, disparate data sets

that involve geospatial information—in other words, location data—and nongeospatial information like population density or customer preferences. Through GIS, users

can quickly detect patterns and trends that might otherwise be overlooked—a perspective that helps them develop innovative solutions to long-standing problems.

While GIS has been in existence since geographic data met computers in the 1960s, the technology is constantly evolving. The last few years alone have seen particularly dramatic advances related to several trends:

- a sharp rise in the amount of geospatial information available through smartphones, credit cards, social media, GPS devices, Google, and other sources
- an increase in the accuracy of data used to pinpoint locations
- an increased sophistication in the methods used to analyze geospatial information, which is partly enabled

by the greater standardization of data and databases

- advances in hardware, such as improvements in GPS receivers and range-finder devices
- maturation of open-source software, to make data more accessible to a broader group of people

These changes have produced a quiet revolution in which geospatial data are increasingly applied in new and innovative ways. (They have also heightened concerns about data privacy.) Private companies, recognizing

that GIS can help improve profitability and optimize many aspects of their business, have welcomed the advances and invested heavily in GIS initiatives. Some governments, both local and national, have also launched new geospatial projects that

fully exploit the recent advances in data and

technology. Many, however, have yet to make full use of GIS capabilities, thereby potentially missing opportunities to reduce costs, improve services, and create a better community for their citizens.

We undertook extensive research of the use of GIS and geospatial analytics at the city level to determine how urban areas could benefit from greater use of innovative geospatial technologies.² The first section of this paper describes our findings on the most relevant applications of GIS in city settings, focusing on those related to information dissemination, planning and analysis, and service delivery. The second section discusses three key enablers that help GIS initiatives succeed, including strategies to increase information sharing among departments, partnerships with private companies or academia, and an emphasis on citizen cocreation. Throughout the document, we present case studies based on our research to illustrate best practices and potential results.

'Location, location, location': How GIS technology and geospatial analytics improve decision making

Dry definitions of GIS technology and geospatial analytics do not convey their full power. For that, we need to look at real examples. Some of the best come from the private sector, where many companies have readily adopted geospatial analytics. UPS, for instance, famously used geospatial analytics to direct its drivers to more efficient routes that favored right turns over left. Since many states in the United States allow right turns on red, this change reduced idling time and cut fuel costs by \$3 million annually. Other companies, such as Starbucks, now offer mobile applications that help consumers locate the nearest store based on their phone's GPS data. And ComfortDelGro, Singapore's largest taxi company, has an app that identifies

the location of people who want rides using data from their smartphones.

Like their private-sector counterparts, some governments have started to incorporate sophisticated geospatial analyses into decision-making processes. Experience shows that three areas can reap significant benefits from GIS and geospatial analyses: information dissemination, urban planning, and service delivery. Across each of these areas, GIS technology and geospatial analytics can increase speed, accuracy, and cost effectiveness related to a wide range of government priorities, including those related to crime prevention, emergency management, disaster recovery, social services, health care, transportation, urban planning, environmental initiatives, and facility planning and management.

Information dissemination

People often complain that it is difficult to learn about available government programs, regulations, and services, in both developing and developed countries.

The problem is usually not that governments lack data on these topics; it's that the information is either inaccessible to the general public or too complex to allow for rapid interpretation.

GIS technology, with its mapping capability, can help the public visualize information about their communities in a more rapid, interactive way. Hong Kong, for instance, has used GIS and geospatial analytics to create an online street map that shows where historical sites, cycling tracks, and other public facilities are located. Users can easily navigate through the map with a cursor and click on a location to see more detailed information. Cities have also released GIS technology and geospatial analytics to disseminate more complex information, including data that citizens would have difficulty finding through any other source.

In San Francisco, the SFpark initiative collects real-time information about available parking spaces using sensors embedded in lots and ports the information to a public website. The system also adjusts prices dynamically—charging less in areas with many open parking spaces—in response to shifts

in demand. Among other advantages, SFpark reduces traffic congestion by decreasing the number of drivers circling and double parking. The public, in turn, benefits by having more certainty about available spaces.

Planning and analysis

Just as geospatial information helps companies find the best locations for their stores, bank branches, or other businesses, it also helps governments determine where to place publicly funded facilities, such as hospitals, clinics, sporting arenas, subway lines, police stations, and community centers. In Uji City, Japan, for instance, planners used GIS technology and geospatial analytics to reduce the time and effort required to determine where new child-care centers should be located. Through their analyses, they could rapidly identify the areas with the highest density of young children and then visualize the information on a map.

Beyond facility placement, GIS technology and geospatial analytics can also help with a number of other planning decisions. For instance, Boston has created a GIS map of renewable-energy sources, such as solar and wind systems, to guide investment decisions, track clean-energy progress, and meet the mayor's goal to reduce greenhouse-gas emissions by 25 percent by 2020. City planners designed the map to show the location of the energy source and details about each site, such as the name of the installer and the kilowatt rating. As another example, the National Library Board in Singapore uses geospatial informa-

tion to analyze public-library visitorship and book-loan transaction trends. By geocoding millions of transaction records, the board can identify hotspots of library usage, such as the most popular branches, and develop strategies for targeted outreach and optimizing book collections. New York City is also active in using GIS technology to improve the lives of its residents. For example:

- Analysts in the city's Food Retail Expansion to Support Health (FRESH) program mapped health issues such as the prevalence of diabetes and obesity. The program correlated outcomes to grocery-store catchment

areas, discovering that a lack of quality stores was correlated with poor health. Planners integrated this information into their decision-making process to identify areas of high need and change zoning for grocery stores—a move that could decrease residents' dependence on fast food or other unhealthy alternatives. (Note: some studies have not shown a correlation between improved access to grocery stores and health outcomes.)

- Planners in New York City use the Hazards US tool, developed by the Army Corps of Engineers and the Federal Emergency Management Agency, to identify geographic

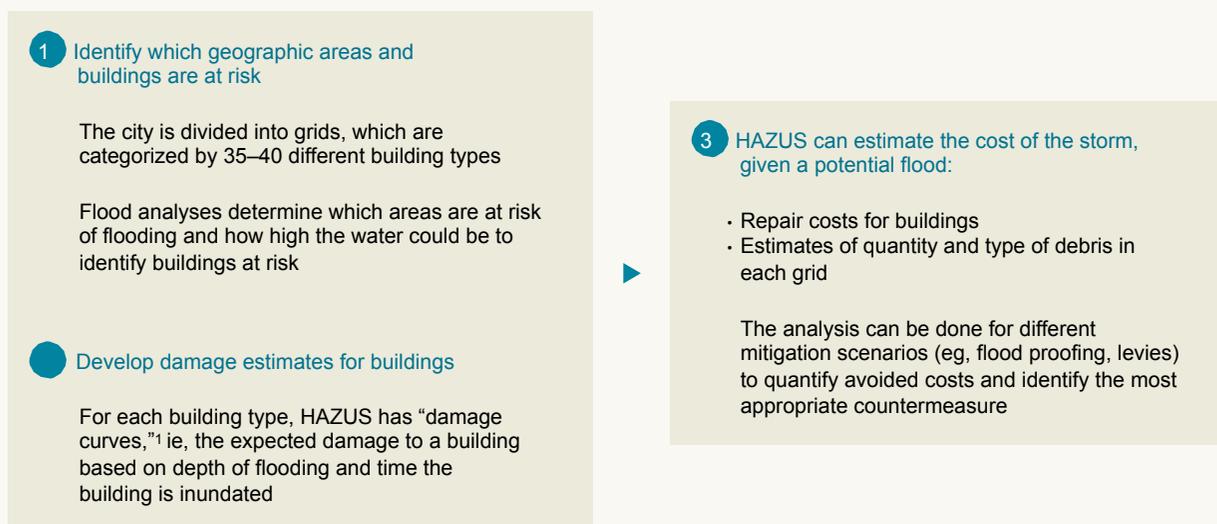


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Exhibit 1

New York City uses the Hazards US (HAZUS) tool to identify at-risk geographic locations and buildings and estimate potential flood damage.

FEMA and Army Corps of Engineers developed HAZUS, a model to estimate losses from natural disasters



¹These curves were specially customized to New York City’s building stock.

Source: Interviews with New York’s Office of Long-term Planning and Sustainability; interviews with New York’s Office of Emergency Management; Federal Emergency Management Agency (FEMA)

areas and buildings at risk of flooding, as well as the potential economic loss from such damage. They incorporate this information into investment decisions on climate-change initiatives (Exhibit 1).

Service delivery

Governments control a broad array of decisions related to education, health-care provision, and public safety. Yet they can

struggle to provide high-quality services to all segments of society, especially when large or demographically diverse areas are involved. When governments fail, the consequences can be severe, ranging from lagging test scores among schoolchildren to crime surges in neighborhoods that suffer from inadequate police coverage. Government leaders and public-sector employees can improve service delivery by

using GIS and geospatial analytics to optimize resource deployment. For example, health departments and emergency services could use geospatial analytics to pinpoint the best locations for dispatch facilities or hospitals based on projected ambulance transport time. Governments can also use GIS information to determine which locations are most in need of specific services. In the United Kingdom, for instance, the National Health Service's (NHS's) "New Leaf" program uses GIS to locate areas with a high number of smokers. It looks at the number of patients with chronic obstructive pulmonary disease or other illnesses commonly related to smoking, as well as areas that have a high number of people who fit the demographic profile associated with smokers. After identifying high-risk areas, the NHS locates

smoking-cessation programs there. The NHS has also used GIS to map the prevalence of other health conditions, such as the number of diabetes-related amputations, and used the information in geospatial analyses to determine where it should launch various health initiatives (Exhibit 2). Governments and citizens can use GIS technology and geospatial analyses to improve service delivery. In Boston, citizens can report municipal problems, such as vandalized or damaged public property, through its Citizens Connect program. Users can identify issues through the program's website or call center, or by using a mobile application. All reports are geotagged, directed to the appropriate agency, and resolved as promptly as possible. For instance, when numerous Bostonians

Exhibit 2

Geographic-information systems and geospatial analyses help the UK National Health Service determine where specific health initiatives should be offered.



Source: National Health Service

Are there privacy concerns?

Few people doubt the benefits of GIS technology, but there are increasing concerns about how information on people's behavior, personal characteristics, or history is tracked and revealed. Governments can mitigate risks and alleviate concerns by aggregating data to a level that prevents individual identification. For example, some city governments now collect cell-phone data to monitor traffic patterns, but protections are in place to ensure anonymity. Telecom players typically assign random identification numbers to each phone number and change them every 24 hours. Since the government is only provided with the anonymized information, it cannot identify the location and travel patterns of specific citizens. The database of location information is also purged after a specified period, and only aggregate or analyzed data are retained.

complained that bulk-item trash pickup was difficult to arrange, the city responded by sending pickup dates in real time and automating the scheduling process. Many other US cities have since developed or are in the process of developing similar phone centers, often known as 311 services, that allow citizens to report problems. As another example, Boston's Street Bump app allows citizens to help improve neighborhood streets. As users drive, the app's accelerometer senses bumps that indicate a pothole and records their location. The data are collected and analyzed using algorithms that filter out bumps related to manhole covers and other normal infrastructure. After identifying true potholes, a crew is dispatched to repair them.

For concerns about the ability of GIS technology to track individuals, as well as the ways that city governments are protecting citizens, see sidebar "Are there privacy concerns?"

GIS in government: What needs to happen

Governments with extensive GIS experience may have sufficient skills and resources needed to implement new initiatives rapidly. Those with less experience may find it helpful to proceed in phases, running pilots and developing detailed business cases before building capabilities at scale. This approach can allow governments to build robust databases and supporting systems, as well as a fully functional GIS team, before beginning large-scale projects.

Governments may have different capability levels and objectives for GIS programs, but they can all benefit from three key enablers:

- sharing information across government
- pursuing partnerships with the private sector and academia
- promoting citizen cocreation

Sharing information across the organization

Government workers around the world share a common frustration that it is difficult to exchange data with other departments. This obstacle limits the value of GIS analyses, which require multiple agencies to contribute current geospatial and nongeospatial data, including information on demographics, health-care utilization, travel and transport, terrain, building attributes (such as age and height), and 3-D images of land, topography, or building layouts.

In many cases, information sharing is difficult because government departments rely on different data sources and computer platforms. Getting all groups to agree

on a uniform approach to data collection and management would facilitate progress, but this may not be possible in decentralized systems where agencies operate autonomously. More centralized governments, especially those where one person is in charge of GIS initiatives, are more likely to be successful in adopting a common platform and sources. In San Francisco, which takes a centralized approach to geospatial analytics, the Enterprise GIS Program maintains ownership of commonly used geospatial data and uses this when providing services to city departments and the public. (Importantly, more specialized data are maintained in individual departments.) If governments do create uniform platforms for information exchange, they can benefit from considering instituting safeguards to ensure that data are adequately protected. For instance, data sets could be classified into levels based on sensitivity. The lower layers would be accessible to all or most personnel, with progressive access restrictions for higher layers. With such protections in place, departments might be more willing to share information. For more information on security concerns, see sidebar "Are there security concerns associated with GIS data?" Governments may also facilitate information exchange—and possibly reduce costs and timelines—by establishing a centralized GIS expert team that oversees joint projects

between departments and helps all involved personnel find information more easily. In Boston, a central GIS team worked with multiple agencies to develop the "SnowCop" program to improve street clearing after storms. It allows city managers to make decisions about where to deploy plows in response to geotagged citizen requests, GPS information on the location of plows, and data about the time a street was last cleared. The collaboration was so successful that Boston is now using a similar strategy to address other municipal issues. In addition to management of multi-agency projects and data retrieval, effective central GIS teams may take the following measures:

- work collaboratively with other staff at government agencies to develop GIS applications and services
- provide geocoding assistance, such as translation of a database with addresses to x-y coordinates for mapping
- create training programs and support in-house staff in developing GIS capabilities
- incorporate GIS technology into existing business processes and suggest additional improvements
- manage issues with GIS systems, such as the transition from legacy programs
- assess an agency's current GIS technology and provide advice on appropriate software programs and GIS trends

If governments create uniform platforms for information exchange, they should consider safeguards to protect data.

Pursuing partnerships with the private sector and academia

Governments, businesses, and academics are all pursuing geospatial initiatives, and there may be some overlap among their efforts. Building partnerships across relevant organizations and sectors can allow different groups to pool their capabilities and resources, thereby reducing redundancy and helping to catalyze better insights. Some of the most compelling partnership examples come from the health-care sphere. For instance, a research team from the Chinese University of Hong Kong (CUHK)

worked with the government to create a geospatial tool that identified areas in the city where the public was at high risk for dengue fever. Based on data from the government's Food and Environmental Hygiene Department, the CUHK researchers determined the number of mosquitoes—the primary means for transmitting dengue fever — found in traps throughout the city. It also tracked temperatures—a key indicator of where dengue-carrying mosquitoes are more active—using data provided by the public Hong Kong Observatory. By combining mosquito count and temperature informa-

Are there security concerns associated with GIS data?

An investigation by RAND, a United States–based think tank, examined the dangers inherent in releasing geospatial information by looking at 629 US federal data sets to determine what information in them met the following criteria:

Usefulness. Could the data be used to identify a target and get location information (such as facility construction details)?

Uniqueness. Was the information available through other sources, such as paper maps, in-person visits, agency websites, or data tables?

Societal benefits and costs. Did the data provide important public-safety or transportation-access information, such as locations of gas infrastructure or bus stops?
Does the value of providing the information to the public outweigh potential negative outcomes?

The RAND analysis found the security risk was low. For instance, fewer than 6 percent of data sets contained information that could be used to identify a target or plan an attack, and fewer than 1 percent were both unique and useful. The researchers also determined that no single data set provided attackers with information that was essential to their plans.

tion, the researchers were able to create an online heat map that showed high-risk areas. Users can see alert levels for the city as a whole or for individual districts. They can also enter their address to receive dengue alerts for selected areas.

In another partnership, the Shanghai municipal government worked with Veolia Water Corporation, a company that manages water and wastewater services, to install and monitor sensors throughout the 3,300-kilometer piping network. Through this collaboration, Shanghai obtained real-time, detailed, geotagged data about water pressure and quality. The city used this information to identify precise locations of network issues, such as leaks. The real-time data dramatically improved response time for repair crews, which translated into less damage to the water infrastructure, lower maintenance costs, and reduced disruption of services. The information also helped crews see which pipes were at risk for rupture and group them accordingly, which helped set priorities for preventive maintenance.

In some cases, cities have partnered with multiple external groups on GIS initiatives. For instance, the Wellbeing Toronto website provides a color-coded online map that residents can use to visualize how neighborhoods rank on various indexes, including health care, housing, culture, transportation, and education. They can also combine several domains to create a composite well-being index. When developing Wellbeing Toronto, the city obtained data from numerous external groups, including a local hospital, York University, and the Wellesley Institute, a Toronto-based nonprofit organization.

The most successful partnerships typically involve two or more parties that are equally invested in the project. Rather than simply exchanging data, they are willing to meet, share ideas, and talk openly about

questions to arrive at solutions. It also helps if both parties have compatible computer systems, or at least use the same data sets, since they will otherwise have difficulty sharing information (similar to the challenge that government departments face when trying to integrate incompatible systems). As part of the partnership, both parties should reach an agreement about who "owns" the data and any resulting tools or insights. This understanding can help avoid potential legal battles over intellectual-property rights. While both parties might have an equal claim to the data, other partnerships might involve more one-sided agreements in which a single group has the right to use the findings.

Promoting citizen cocreation

It is often time-consuming, expensive, and tedious to compile the extensive data sets needed for geospatial analysis. But governments may be able to reduce some of the complications by promoting citizen involvement in various ways. For instance, as in Boston Connect, the government could call on citizens to report problems in their neighborhoods, such as damaged public property. Although governments cannot mandate participation, they may find that public interest is high and that people want to be part of the solution, especially for problems that concern their own neighborhoods. Governments could also encourage citizen participation by offering themed competitions or "hackathons" in which computer programmers, professional or amateur, develop geospatial applications based on public data. For instance, the US Department of Health and Human Services holds meetings in which it shows stores of data to leading health-care and technology experts. The agency then challenges them to develop apps based on the information and present them at "Health Datapaloozas."³

A central database of public reports can promote efficiency by reducing response times and making it easier to analyze data.

If governments decide to collect information from the public, it might be helpful to create a central database of all reports and

requests, which will provide officials with an integrated view of the issues that matter to constituents. A central database can

also promote efficiency by reducing response times and making it easier to analyze data (such as the number and type of requests by location). New York City, for example, has

a GIS-enabled service, NYC 311, which serves

as a one-stop service for municipal issues. To create this department, the city consolidated call centers from 14 agencies and also began online and mobile-reporting

services. NYC 311 now receives over 60,000 calls daily. Benefits of the centralized group include the following.

Increased convenience. Citizens only need to know one phone number or website to receive help from all city agencies.

Greater efficiency. NYC 311 has set rules for routing calls, which helps ensure that they go to the right agency. One-stop reporting also eliminates the time-consuming step of having one agency to contact another if it receives a request outside of its purview.

Better performance management. All service requests are tracked centrally and top managers receive frequent progress reports. If there are problems—for instance, specific requests that take a long time to resolve—managers can review work processes to identify areas for improvement.

If governments do encourage citizen cocreation, they should ensure that safeguards are in place to filter “noise” from the system, such as prank calls or frivolous complaints. For instance, callers who make nuisance calls could be fined or even charged with criminal acts. Some cities have also had success by requiring users to create a login or password to monitor their activity.

If many citizens begin contributing information, governments may be overwhelmed with data or requests for service. To ensure the most important problems receive the most rapid attention, officials can create procedures for prioritizing reports, similar to how emergency phone calls are ranked.

One major hurdle to citizen cocreation programs is a lack of public awareness.

If only a few people are making complaints or sharing information, the data may not accurately reflect the concerns of the population as a whole. Some cities, including Boston, New York, and Seoul, advertise their geospatial services to increase awareness. Others publicize helpful civic tools that were created based on city data, which also increases public awareness. For instance, the government of Singapore arranged to have exhibits displayed at the Singapore Art Museum related to real-time geospatial data. The exhibits visualized how the time needed to get a taxi increased during rain, changes in air temperature related to air-conditioner use, shifts in traffic-flow patterns throughout the day, and other interesting aspects of life in the city.

As with partnerships, cities must carefully consider intellectual-property issues during citizen cocreation projects. If the city owns the data but the work was done by a private citizen—for instance, a computer program based on city data—there could be disagreements over which party should profit.



City governments are increasingly open to GIS initiatives, partly because of the impact they are observing in the private sector, but few have embraced their full potential.

To achieve the potential, we see a major role for geospatial analytics in three areas: information dissemination, urban planning, and service delivery. Governments can strengthen their performance by ensuring that key enablers are in place before launching extensive GIS programs. As GIS adoption grows, it could potentially have an even greater impact in the public sphere than the private sector, given the scope and scale of government services. ⁿ

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PARTNERING TO BUILD SMART CITIES

Better communications between local government leaders and technology vendors can encourage the development of connected, resource-efficient urban areas.

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A study by the Aura Solution Company Limited Global Institute suggests that the world's 600 fastest-growing cities will account for 60 percent of global economic growth between 2010 and 2025.¹ To achieve and sustain this level of growth—and to acknowledge recent urbanization and climate-change trends—municipalities in both emerging markets and developed nations must pay closer attention to the way they manage resources and infrastructure. Many are pinning their hopes on smart-city projects. Broadly, the term “smart city” refers to the use of innovative technologies in complex urban environments to manage resources and infrastructure in a sustainable way and create opportunities for growth. A city may use intermodal route-planning software, for instance, to help balance the

traffic load across its transportation systems. The same city may use so-called intelligent meters to better match electricity supply with demand or to detect water shortages. In either case, officials can use the information collected to adjust schedules, equipment, and other variables accordingly, thereby optimizing potentially scarce resources. Municipalities in Europe and elsewhere already have smart-city initiatives under way, piloting new technologies in certain city districts. The leaders of 22@Barcelona, for instance, are seeking to convert an older industrial area in Spain into a modern, attractive city district offering energy-efficient residential and office buildings and public green spaces as well as a knowledge-sharing environment that will lure innovative companies and workers.

Several technology firms have already established departments dedicated to researching and marketing products aimed at addressing cities' traditional and smart-city infrastructure needs. But the market for such solutions is still quite immature, and

the reality is that the technologies that are being implemented in full-scale rebuilding projects may not be suitable for projects

in which only incremental improvements to existing infrastructures are required.

Our analysis of 50 smart-city projects in Europe reveals that nearly all were launched as pilots with tailor-made solutions rather than as scalable initiatives. For the most part, neither city officials nor technology vendors have been willing (or able) to risk investing in large-scale demonstrations—which is

why the financing for smart-city projects still

comes mainly from subsidies provided by governments and research institutions rather than local budgets. When smart-city initiatives are launched, there is huge variation in the way private- and public-sector representatives collaborate, as well as in how projects are managed within cities.

Our findings reflect the need for city officials and technology vendors to come to a shared understanding about the requirements and restrictions associated with municipal development. The European Union has taken a step in that direction with its creation of the European Innovation Partnership for Smart Cities and Communities,

a program designed to encourage investment in large-scale implementation projects

from a consortium of EU cities and industry players. But besides pursuing funding

from national and supranational budgets, one of the most critical tasks for cities and industry vendors is to spend more time systematically listening to and learning from one another, while still incorporating input from citizens and others in the local business environment. After all, these a



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who will ultimately use, and in most cases pay for, the solution.

Technology vendors and cities: a complicated relationship

We wanted to understand how cities and technology vendors could collaborate more effectively on smart-city projects and grow the market for these solutions. So we partnered with the industry network Innovation Roundtable to conduct a series of workshops and discussions with city leaders and industry vendors from about 30 European cities, mainly in Germany. Those conversations revealed a significant, but not insurmountable, gap between each side's expectations and the realities of smart-city projects (see sidebar "About the research").

What cities expect from technology providers

Collaboration among cities and industry players in the infrastructure sector started long before the phrase "smart city" appeared, but the implementation of different kinds of complex (and thus riskier) technologies requires vendors to adapt even more to

Power electricity measurement.

their audiences. The city officials we interviewed saw a lot of potential for improvement in this customer interaction; they also had valuable feedback to share about the current portfolio of products being offered.

Customer interaction: More appropriately tailored to cities

From the cities' perspective, many vendors focus too heavily on product presentations and neglect to detail exactly how the proposed technologies can be integrated with existing systems in complex municipal environments. Officials say they are often left wondering whether the vendor truly understands the challenges the city is facing. Specifically, they cited the following issues:

- The vendor's explanation of the technology is too complex.
- The vendor's presentation never references the decisions or specific challenges the city faces. The potential value of the technology is therefore not transparent enough.
- The vendor often neglects to explain how the financing and operating models are meant to work until much later on.
- The city's core issues are not adequately taken into consideration. This is especially true in cases where data protection, dependency on providers, and the reliability of the technology are in question.

Product portfolio: Suitable solutions for midsize cities

City representatives offered these three main concerns about technology firms' products and services.

A focus on megacities. City officials believe that technology vendors target most of their attention on megacities and then try to sell the same project-based solutions to a mass market of smaller cities. This does not

work, city leaders say, because the products and services created for megacities are often inappropriate—by measures such as functionality, complexity, and cost—for classic European cities with about a half million inhabitants.

No integration of solutions. The city leaders we spoke with do not feel as though vendors are offering outstanding expertise in integrating solutions, delivering operating models, and incorporating technology into the city's local ecosystem—for instance, discussing how to involve local partners, and at what stages of the project.

Proprietary solutions. Many cities are anxious about becoming dependent on a single technology and provider in the course of implementing a smart-city solution. Industry standards for smart-city technologies are still emerging, and no one wants to be locked in for the long term.

What technology vendors expect from cities

Technology-firm managers shared with us these three main opportunities for improvement regarding their interactions with city officials.

A clearer agenda. The managers perceive that many cities are dealing with smart-city concepts one project at a time, without an overarching agenda. This is less than optimal from the vendor's perspective, since more important city projects could crop up and undermine the city's long-term investment of scarce financial and political capital in a smart-city infrastructure. The vendor therefore has less incentive to commit. Complicating matters further, smart-city technologies by their very nature veer from the status quo—which means they may have a harder time getting added to the

agenda in the first place. In their considerations of new technology investments, city stakeholders may favor bids that reference solutions that have been used to that point. They may limit their support for riskier solutions.

Less complicated stakeholder and project management. Vendors told us that city officials fail to recognize how cumbersome the management of smart-city projects can be for technology providers: these projects typically involve many different stakeholders from within a city and from other levels of government. A traffic project in one major city required participation and input from no fewer than 13 different city and government agencies, for example. In another city, responsibility for its various websites was split among several different people, and the webmaster controlled only half the sites.

Citizens' support. The introduction of new technologies always prompts some level of skepticism and pushback, so it is critical for those who will ultimately be affected by (and pay for) the smart-city project to participate in discussions about its usage and potential effects. The managers we interviewed noted there are limits to what they can do to convince local citizens about a project's potential benefits and outcomes. City administrators must therefore take the lead in gaining support for the proposed project—outlining the branding and quality-of-life benefits along with the financial advantages. The decade-long German railway and urban-development project Stuttgart 21 provides a lesson in how vital citizens' participation is to success in major infrastructure projects: citizens and advocacy groups that had not been involved at the beginning of the project spoke out against the mounting expenses and environmental impact associ-

About the research

In 2012, together with the Innovation Roundtable (IRT), we started a series of workshops and discussions with more than 60 representatives from 30 European cities (mainly in Germany). The IRT is an informal network of high-ranking research managers from renowned German companies in various sectors. Based on the workshop results, a smart-city panel was formed; this group meets regularly to discuss cities' innovative technology projects and different funding options, and to exchange ideas associated with smart-city development. The recommendations highlighted in this paper are an outgrowth of this initiative.

ated with Stuttgart 21, and the project turned into a political lightning rod. It was a key factor in the 2011 state elections.

Bringing cities and vendors together

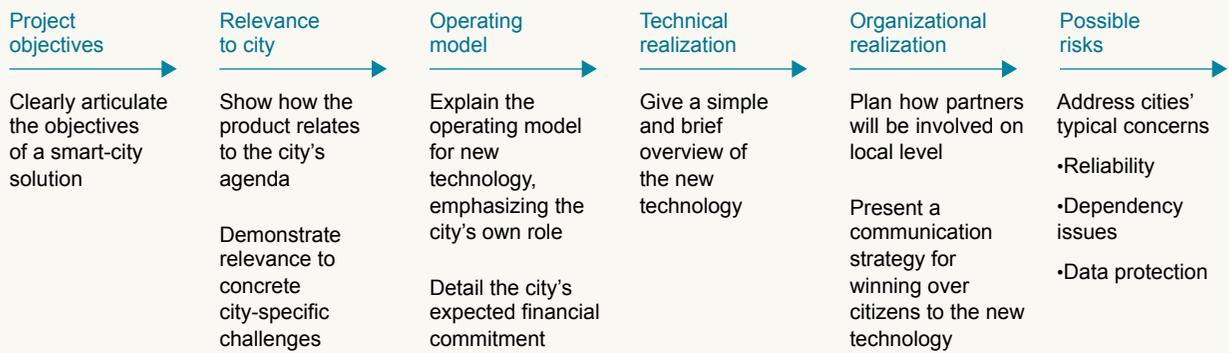
So, city officials believe the industry does not understand them, and technology vendors think dealing with cities is too complicated. For these perspectives to change—and for smart-city development to grow and become a viable approach for economic growth—both sides must come to the table. Here are some recommendations for bridging the gap.

Recommendations for technology firms Tailor your discussions with cities. Vendors should fundamentally rework their approach to selling products, emphasizing how

Exhibit 1

Project presentations should be tailored to each city's individual needs.

Topics that should be covered in a presentation to city leaders



solutions can be implemented and not the nuts and bolts of the purchase process. They should present fewer details about the technical aspects of the hardware or software in play and answer more questions about how it will be used from day to day: What is the operating model? Who among the local partners needs to be involved in its rollout, and to what degree? Potential concerns about data protection and interoperability should be addressed during the first meeting with city officials (Exhibit 1).

Develop solutions for midsize cities. Companies need to offer affordable solutions for midsize cities as a complement to their existing solutions for megacities. After all, conurbations with between 150,000 and 5,000,000 inhabitants in the European Union account for 42 percent of GDP, whereas megacities with more than 10,000,000 inhabitants contribute just 12 percent

(Exhibit 2). Medium-size cities need smaller-scale solutions. Technology firms will need to research and design standardized products that are pitched directly to this cohort—products that incorporate lessons from larger smart-city projects but also factor in the needs and opportunities that smaller cities face. Pricing structures and financing options may need to be configured differently, for example, given the unique programs and infrastructures found in smaller cities.

Ensure interoperability. Vendors need to take cities' concerns about being dependent on a single provider seriously and address them explicitly. One viable option would be to use "open" interfaces that allow for better integration with existing systems and that enable cities to switch to another provider (if necessary) at the end of a contract. This would require the development and enforce-

ment of industry standards, especially for data exchange (such as the Open Metering System used with smart electricity meters). Although it may seem more appealing to lock in cities for the short run, using open interfaces will increase total market size (and potential business for vendors) in the long run. The national and supranational agencies that are subsidizing the adoption of smart-city technologies are increasingly including “interoperability” as a prerequisite in their applications for funding—a development that vendors are not yet prepared for. And more cities will be willing to implement smart-city solutions if they do not need to fear a long dependency.

Recommendations for cities

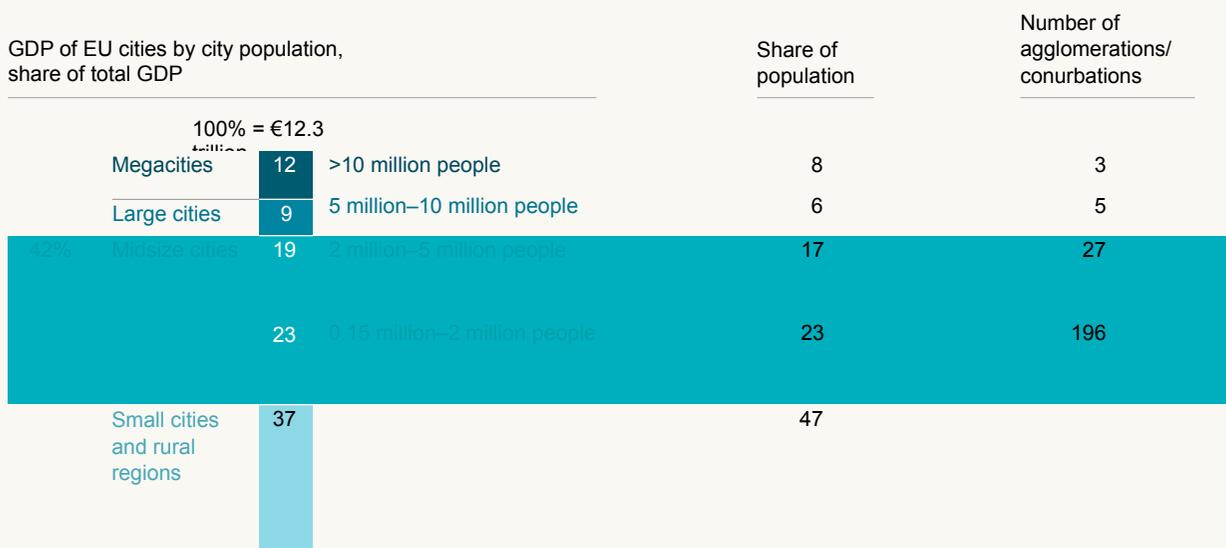
For smart-city projects to gain traction, technology vendors told us, city representatives need to be strong partners who make fast, sustainable decisions. Their responses point to the following three main actions for municipalities embarking on smart-city projects.

Formulate a clear political agenda. A project implementing new technologies poses challenges that are different from, say, an initiative to renovate roads. It requires clear political will and strong support from both local government and city administration. Officials may want to rethink the current

Exhibit 2

Midsize cities account for more than 40% of GDP.

2010, %¹



¹Figures may not sum to 100%, because of rounding.

specifications in their request-for-tender processes, for instance, to allow for the application of innovative solutions. In Bottrop, Germany, for example, the city council and city administration jointly approved a model city agenda with the goal of greatly reducing carbon dioxide emissions (see sidebar "Innovation City Ruhr: Bottrop as a blueprint for a region"). Subsequent projects that contribute to this goal are now easier to get approved because there is already a fundamental consensus; all parties are committed to adopting innovative approaches. The story was the same in another German city, which partnered with a telecommunications provider on several projects designed to improve city operations and citizens' quality of life—adopting a smart-metering system, for instance, and an online program for registering children for kindergarten. This partnership required a multiyear commitment between the technology vendor and city councilors and administrators. Because this commitment was in place, a subsequent leadership change did nothing to weaken the broad support for this smart-city agenda.

Bundle responsibilities. As we noted previously, smart-city projects require involvement from numerous departments of the city administration, local companies, and organizations. Cities need to help vendors by mapping these partnerships, defining roles and responsibilities, and serving as a central point of access for negotiation and information. For example, officials in Berlin created a dedicated management entity that is responsible for coordinating activities associated with the development of the Urban Tech Republic project in the area of the soon-to-close Tegel airport. The conversion of this site will require high levels of coordination among local and federal authorities, multiple technology vendors, a handful of

research institutions, and local citizens. The management entity not only serves as a central point of contact for all these constituencies but also contributes much-needed project-management expertise.

Engage citizens and local businesses. City officials need to devise a compelling story to engage the citizens and local businesses that are intended to benefit from an intelligent infrastructure. For instance, one city was looking for innovative uses for its redevelopment sites. Instead of acting unilaterally, however, and issuing directives, city officials assumed the role of coordinator and sought input from a range of stakeholders. Over the course of many events and workshops, it compiled and debated ideas submitted by citizens, administrators, experts, associations, and local businesses. At the end of the process, it was able to produce a white paper listing potential new uses already endorsed by large sections of the population, thereby making it more likely that the recommendations would be approved.



Innovative technologies can help improve life in cities, make economical use of resources, and ensure stable economic growth. But there are numerous obstacles to overcome to ensure the successful realization of smart-city concepts. Our interviews with leaders in industry and local government, as well as our analysis of intelligent-infrastructure projects in Europe, paint a picture of a still immature market. Cities, technology vendors, and public funding institutions alike need to work together to further develop this market. Indeed, only strong, systematic collaboration and learning among all the players involved will truly turn this into the century of smart cities. ⁿ

QUICK TAKE

Innovation City Ruhr: Bottrop as a blueprint for a region

The Innovation City Ruhr project in Bottrop, Germany, is a prominent example of a joint effort from industry players and a city administration to develop a smart city.

Bottrop is a city of around 120,000 inhabitants located in the western part of Germany. Given its population size, Bottrop could be considered a small city or rural region. But it is part of the Ruhrgebiet, a large conglomerate of mostly midsize cities that are home to more than five million people. As such, Bottrop has developed an infrastructure, labor market, and other characteristics similar to those of midsize cities. The Ruhrgebiet was the industrial heartland of Germany for a very long time but has suffered from deindustrialization over the past few decades. Several of the cities in this area are now looking for new ways to attract investments.

In 2010, a group of companies from the Ruhrgebiet launched a competition to identify a city that could serve as a model for reducing the carbon footprint in an industrial region. Its best practices could then be passed on to other cities in the region and, eventually, to other industrial cities around Europe. For the convening companies, the winning city would provide a real-world demonstration of the value of smart-city solutions.

Bottrop won this competition by presenting a clear commitment to reducing the city's carbon footprint from all its political players; the mayor was part of the project-evaluation committee, for example. Additionally, more than 20,000 members of the Bottrop community expressed their support in the application process.

The overarching agenda—to radically reduce Bottrop's carbon dioxide emissions—

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the mission of more than 120 projects across the city, all of which are coordinated by a management company dedicated to just this task and paid for by a local industry group. This company offers a single interface into the city administration for all vendors and handles a number of complex stakeholder-management tasks, including communicating with federal and EU funding agencies.

Town hall,
Ernst-Wilczok Square,
Bottrop, Ruhr, North
Rhine-Westphalia,
Germany.

CAPTURING EFFICIENCIES THROUGH SMART TECHNOLOGIES

Mayors and city-agency leaders around the world aspire to help their local economies grow. But economic growth does not automatically deliver a better quality of life for citizens. In fact, growth can often have unintended effects on communities and the environment. Investments in new businesses, for instance, can provide more opportunities for more workers but can also result in congested roads and smog. To achieve smart growth—delivering environmental as well as economic value—many city officials are using data-driven solutions to reduce spending, create efficiencies, and improve service delivery.

Energy

Some cities are using smart meters to better match electricity supply with demand. One

large US city is using an automated system to dim or turn up street lamps based on sensors indicating the prevailing lighting conditions—saving the city as much as 30 percent on energy costs. Other cities (in California and Ohio, for instance) are relying on centralized control systems to manage their electricity substations—the facilities that contain power lines, transformers, circuit breakers, and the equipment used to measure energy output and distribution. The use of automation technologies can help cities dramatically reduce power outages and transmission-line losses; this is particularly significant when you consider that there have been five major blackouts in the United States in the last 40 years, three of which have occurred in the past decade.

Water

Several cities are using geospatial data, audio sensors, and smart meters to detect water shortages and system leaks, and to schedule repairs and maintenance. Shanghai has embedded sensors throughout its pipelines to provide real-time information about water pressure and quality. Engineers can use the data to identify rupture risks and respond proactively. Through the use of these innovative technologies, cities can reduce water-system leaks by up to 50 percent and continually monitor the quality of water designated for human use.

Transport

Smart technologies can relieve traffic congestion and reveal inefficiencies in how cities manage their public-vehicle fleets—the cars, trucks, and other equipment owned and managed by the government. San Francisco's SFpark initiative collects real-time information about available parking spaces using sensors embedded in the spaces. The information is posted to a public website, and the system adjusts parking prices dynamically in response to shifts in demand, charging less in areas with many open parking spaces. Meanwhile, Washington, DC, and the states of California and Texas rely on open data and GPS transponders to monitor public fleets and streamline operations.

City services

The use of smart technologies can help facilitate and improve basic city services—for instance, garbage collection, facilities management, and public safety. The Indian city of Pune uses analytics to identify accident-prone locations and isolate common factors in accidents (such as the lack of crosswalks or traffic-light timings that are too quick) so it can improve the city's traffic infrastructure. A number of cities in Pennsylvania are using geospatial data

and analytics to assess crime patterns and assign law-enforcement personnel to higher-risk areas. In New York City, the illegal disposal of restaurant waste has been a significant problem that has contaminated the city's water systems. Previously, it had been difficult to determine which restaurants were violating the rules. Through the use of analytics, however, the city was able to assess reports of clogged catch basins, along with data indicating which nearby restaurants had not reported using licensed waste haulers. This information helped inspectors identify which restaurants might be illegally dumping waste. As a result, inspectors found instances of illegal dumping in 95 percent of the site visits they made.

In Boston, citizens can report issues with garbage collection, potholes, or a number of other common municipal problems through its Citizens Connect program. Residents can use the program's website, call center, or a mobile application to file a report. The reports are geotagged, making them easy to map and locate, and directed to the appropriate agency, where problems are resolved as promptly as possible. When numerous Bostonians pointed out that bulk-item trash pickup was difficult to arrange, the city responded by sending pickup dates in real time and automating the scheduling process.

As these examples suggest, smart solutions are allowing cities to do more with less—creating additional capacity within the constraints of existing physical infrastructures.¹ These technologies enable the collection of direct feedback that mayors and other local leaders can use to win support for change.

Their use attracts businesses that want to be part of a thriving, positive municipality. Most important, city officials can use innovative technologies to offer citizens improved services and better quality of life. n

CAPTURING VALUE FROM IT: A TEN-POINT PLAN FOR THE PUBLIC SECTOR

Comprehensive and innovative technology strategies, capabilities, and infrastructure in the public sector are no longer “nice to have.” Today, information technology plays a central role in all aspects of the business of government. From citizen-facing services such as renewing drivers’ licenses online to back-end processes such as analyzing tax returns for accuracy, excellence in IT is a prerequisite for excellence in the public sector.

There are compelling examples of governments worldwide that have harnessed the power of technology not just to improve services but also to ensure that important policies are implemented effectively, fairly, on time, and on budget. They are using geographic-information-systems technology and data analytics to speed trash collection,

create more efficient public transportation, and communicate more effectively with constituents.

However, many more governments are struggling to find the right mix of people, tools, management practices, and systems required for successful public-sector IT projects. All too frequently, governments’ efforts to deploy new technologies or upgrade aging systems generate extra layers of complexity rather than solutions.

Through our work with governments across the globe, we have identified the following ten-point plan for capturing full value from IT. (See sidebar, “The ten-point IT plan.”) By addressing each of these agenda items, public-sector officials can optimize their returns on IT investments—reducing costs, gaining efficiencies,

delivering new services, and improving citizens' experiences with government.

Engage stakeholders with what they value

According to our estimates, about one-fourth of IT project failures are not caused by anything related to technology; instead, they are the result of leaders' misunderstanding of stakeholder needs and their inadequate engagement with a broad stakeholder group. The first three items in our ten-point plan focus on ways to better understand internal and external stakeholders' perspectives and gain their support.

1. Use rigorous business-case discipline to shape and manage programs and ensure value capture. Every discussion of public policy today involves technology in a fundamental way—either as an enabling tool or as a service offering. Indeed, IT is no longer the domain of only the chief information officer but of anyone looking to run programs effectively, which means that public-sector leaders, in all roles and agencies, must ensure that IT investments are directly aligned with public-policy goals. However, our work has revealed that governments generally do not do a good job of articulating the benefits of their IT investments, estimating costs accurately, and picking the right projects to invest in. In the case of one government, leaders had quantified benefits in less than 15 percent of their portfolio of IT projects, estimated their costs fully in fewer than 50 percent of the projects, and had not identified the critical business and implementation risks for any of the projects. But making the business case actually matters. In our experience, leaders who identify the specific benefits to be gained from each IT project, and who manage projects to achieve those benefits, can reduce their costs by 30 percent and improve

the likelihood of a project's success by a factor of three.

A large US government department had not clarified the business case for automating its business processes and modernizing its legacy IT systems, and so it was unable to prioritize the various stages of these projects. It had also set a timeline of 40 to 44 months to complete the projects but decided that all new functionality would be delivered only at the end of the project. Costs for the projects ran significantly over budget because the requirements were vaguely defined and the scope of the projects was excessively broad. Government officials got the project back on track by evaluating and prioritizing the business requirements and redefining the scope. The department realized it could use IT systems from other agencies to accomplish some of the automation, and it restructured the project to focus on three functional areas that would enable automation of 80 percent of the department's manual processes. By regrouping and going through the process of making the business case, the department was able to complete the project in 20 months rather than 44, while reducing costs by 40 percent.

2. Go digital to improve citizens' experiences.

In many governments, citizens can access a number of services online. Taxpayers file returns electronically, drivers renew their licenses or pay parking tickets online, and residents manage their government benefits virtually. Citizens' satisfaction with government services is strongly correlated with them having a choice of channel, easy access to information, and simple and quick service delivery. To get to the next level in e-government services, public-sector organizations must understand what functionality citizens value most, gauge how their agency compares with peers, and develop capabilities in critical areas such as online

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marketing, website usability, and web analytics. Most important, governments will need to engage citizens, businesses, and individual agencies in contributing or creating applications and content. One US city did just that when it formed a cross-agency team to study its licensing process for restaurants. The team collected input from members of the business community and, based on the feedback, ended up reengineering the entire process—for instance, cross-training health inspectors so they could conduct checks on behalf of other agencies and adopting an electronic format for many of the licenses being issued. The process became much simpler as a result: inspectors were able to complete building checks in one or two weeks instead of five or six. In another example, officials in one European government built an online platform that is changing how citizens get

basic daily services from the public sector. Individuals have access to more than 160 online services, including unemployment benefits and property registration. They gain access to services through a physical identification card or an online personal identification number; government officials recently added mobile access via smartphones.

3. Open up the data to spark innovation and create new and better services. While much has been written about governments achieving transparency through “open data”—freely available, machine-readable information with few or no user restrictions and at low or no cost—many governments have yet to master this goal for several reasons. There is rarely a natural, central owner of data; technology platforms tend to be outdated and therefore do not necessarily work well with external systems;

The ten-point IT plan

Engage stakeholders with what they value

- 1 Use rigorous business-case discipline to shape and manage programs and ensure value capture
- 2 Go digital to improve citizens' experiences
- 3 Open up the data to spark innovation and better services

Pursue innovative structures

- 4 Adopt best practices from the private sector
- 4 Rethink IT procurement to improve timeliness and outcomes
- 5 Pursue shared services that deliver immediate results

Strengthen core assets

- 6 Address the risks in legacy systems, and in modernizing them
- 7 Embrace cloud computing and the new realities of cybersecurity
- 8 Build a pipeline of technology talent create new
- 9 Explore public-private partnerships to get a fresh start
- 10 Spearhead intergovernmental partnerships and to tackle common challenges

and many existing privacy policies and safeguards are out of touch with the realities of the digital age.

These problems are surmountable, however. Governments that have formulated open-data strategies in a systematic way have improved their image, accelerated the creation and adoption of innovative services, and increased engagement with citizens. One large US city launched an open-data initiative with three goals: to create new mobile applications that would use data from a number of agencies to provide real-time services to citizens, such as a mobile app that would help residents plan their commutes; to enable partnerships among government, academia, and the private sector to address specific public-sector issues; and to create a process for posting information about government decisions, spending, and legislative operations to promote transparency and accountability. To address issues with its aging technology platforms, the city established a central online portal for collecting data sets from across all agencies. To deal with ownership confusion, the project director selected a data-standards officer to set and enforce stewardship rules and assigned individuals in each agency to ensure that the data being stored complied with those rules. The standards officer's role is a critical one: he or she collaborates with each agency to identify critical pieces of data to make open, prepare the data for publication, post the data in an accessible platform, and determine the frequency and channel for refreshing the data. To address policy concerns, the city established a standards committee that works with data stewards from each agency to refresh policies, resolve questions, and create and enforce the standards and security protocols required to store private data. The result has been a robust, open system that facilitates information sharing among

agencies and has allowed the city to meet each of its objectives. The benefits to citizens include improved municipal services and a window into government decisions and activities.

Adopt best practices from the private sector

Compared with public-sector organizations, private-sector companies have made significant strides in addressing common IT management issues. The next two items focus on the lessons public-sector organizations may take from the private sector's use and management of technology.

4. Rethink IT procurement to improve timeliness and outcomes. Public officials and service providers to the government generally agree that the public sector's approach to purchasing IT is outdated, time-consuming, and ineffective. It is not uncommon for a public-sector organization to take more than a year to purchase an IT service or product; subsequent IT projects can take multiple years to complete. As a result, many governments end up buying and implementing technologies that are already outdated.

Private-sector organizations have managed to bring industrial-style procurement discipline to IT purchasing. Governments can adopt a number of their ideas immediately without waiting for broader legislative reforms. Some public-sector organizations are already doing so. In the area of sourcing, they are differentiating between complicated and simpler, commoditized purchases. Additionally, some public-sector officials are making it a priority to hire staffers who have expertise in the strategic sourcing of IT, while others are taking it a step further and building cross-functional IT procurement teams charged with evaluating and selecting appropriate vendors. Some governments

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The Chicago Passport Agency provides pass- port services to residents of Illinois and Michigan. Since December 2001, all domestic agencies have been issuing the new photo- digitized passport.

have standardized their IT contracts and developed processes and benchmarks for tracking vendor performance across government agencies.

The benefits of adopting private-sector practices can be significant. One US state was able to identify ways to reengineer its entire procurement process, thereby cutting its procurement time frame nearly in half. And one large US city built up its internal capacity to negotiate contracts and take over important planning and design activities performed by vendors; it saved more than \$100 million annually.

5. Pursue shared services that deliver immediate results. Some government organizations have the resources and spend- ing capacity of large global corporations, but they still fail to achieve the benefits that private-sector organizations do from

consolidating their IT services. That is because the introduction of new technologies in the public sector has almost always been fragmented. Individual agencies, bureaus, or departments implement their own applications on their own servers, and the result is a mismatched collection of systems and business processes that can increase costs and create inefficiencies.

By contrast, a successful shared-services approach emphasizes pooled resources and consistent practices. Additionally, a customer-service mind-set is crucial. Well-defined service-level agreements (SLAs) should be put in place and communicated clearly to every user in the IT services ecosystem. Without SLAs, costs will rise, quality will drop, and customers will find innovative ways to avoid using the shared-services entity. To avoid this outcome, important stakeholders from each customer group should be invited to the planning process early and included throughout to ensure the consolidation exercise will not fail.

One large US state recently created a single entity to provide the full spectrum of IT services to nearly 50 agencies across the state, including application development and end-user assistance. It is a bold initiative, with challenges at almost every turn.

The state supports a large employee base, has a wide range of facilities and infra- structures, and has traditionally outsourced a lot of its systems-planning and design activities, which require highly skilled IT talent. It has had limited visibility into what is being spent on IT and what its employees are working on. Also, people from the different agencies involved have been used to working within their own cultures, under different management styles. The initiative is still in its early days, but state officials are already seeing improved utilization of IT assets, increased knowledge sharing among pooled IT staff, streamlined procurement

processes, and better systems management through coordinated governance. Designing a comprehensive IT shared-services plan can take months, and the overall transformation will likely be a multiyear effort, but governments can make real headway in the first year. Officials who are pursuing shared IT services should acknowledge this timeline, establishing clear targets and milestones and resisting the tendency to retreat from big goals as implementation begins.

Strengthen core assets

Many public-sector organizations have not invested adequately to upgrade IT systems or improve the capabilities of their IT staff. The next three items focus on the need for technology updates and new approaches to talent management.

6. Address the risks in legacy systems, and in modernizing them. The public sector has invested heavily in technology, but many of its investment decisions have been based on maintaining legacy commitments and meeting political demands rather than creating business value. As a result, many governments are spending much of their IT budgets to preserve systems that are either decades old or hurriedly upgraded here and there in response to a political mandate. The public sector has historically ignored this problem, electing to apply Band-Aids. Given the number of recent high-profile IT failures, however, ignoring the problem is no longer an option. Government leaders are discovering the risks associated with maintaining, rather than replacing, aging systems—exposure that can affect organizations and individuals. Imagine a 30-year-old benefit-delivery system going down and an agency not being able to distribute vital payments to citizens.

Some public-sector leaders are responding to the aging-infrastructure challenge in a thoughtful, surgical way. They are taking inventory of their existing IT setups and identifying those systems that should be replaced and those that are worth preserving and building around. One government, for instance, is focusing first on systems that

pose the highest operational risk (such as systems for reporting taxes and managing driver's licenses) as well as those that require significant changes because of recent regulatory mandates (such as benefit-delivery and health-care systems).

7. Embrace cloud computing and the new realities of cybersecurity. Many public-sector organizations operate their IT infrastructure without the discipline of professional IT service providers and below the scale required to achieve cost savings and appropriate utilization of the infrastructure. Some public-sector IT executives have recognized this problem and are mandating a review of and migration to cloud computing. Cloud computing provides on-demand access to a shared pool of computing resources (for example, networks, servers, storage, and applications) that can be delivered with minimal management effort or service-provider interaction. The benefits of moving to the cloud include cost savings—sometimes as much as 50 percent on hosting and licensing—as well as improved systems productivity and resiliency. In a recent survey of large infrastructure organizations in North America, more than 90 percent of executives running large IT functions (in both the public and private sectors) said they were in the middle of designing or implementing a cloud program.¹ However, the success of these programs has been uneven, particularly in the public sector.

To capture value from cloud computing, public-sector organizations should develop a

strategy informed by a detailed understanding of the applications, workload, and services eligible to be moved to a cloud environment. A one-size-fits-all adoption strategy will not work. Public-sector leaders should establish a sound business case, with an operating and financial plan to fund and sustain the migration of infrastructure to the cloud. This includes detailing the timing and sequencing of, and usage allowances and charges for, the IT services being migrated. Most important, public-sector leaders should acknowledge important security considerations associated with operating in the cloud, which can be structured as a public, private, or hybrid environment. Leaders in public-sector organizations must examine existing security policies, industry standards, data-handling practices, and information architectures. A comprehensive cybersecurity strategy is imperative and should be predicated on protecting the most important information assets from the most likely threats.

8. Build a pipeline of technology talent. Technology talent is scarce in both the public and private sectors, and demand for it is rising. Some countries like China and India have anticipated the trend, more than doubling their output of graduates with technical degrees, whereas the United States is producing fewer college graduates with

computer and information-technology degrees than it did ten years ago. The skills shortage is more acute in the public sector for a variety of reasons, including compensation levels that are lower than in the private sector, use of outdated technologies, and, sometimes, a culture that stifles innovation and creativity.

To add to these challenges, workforces are aging across the globe and many IT workers will be retiring soon, taking with them decades of institutional and technical knowledge.

Shoring up the IT talent base should be a top priority for public-sector leaders—and there are more recruitment and retention levers available to them than they imagine or choose to exercise. In a recent Aura Solution Company Limited survey of nearly 500 private-sector chief information officers, more than half said their main tool for attracting and retaining top IT talent was enhancing the culture of the IT organization.² Public-sector officials are finding the same to be true. One US state recently conducted a comprehensive survey of its IT employees and identified a number of challenges. For instance, employees said they were frustrated by the lack of feedback they were getting on their performance. They also said they were dissatisfied with middle managers within the organization, whom they viewed as a barrier to bottom-up innovation. Armed with these facts, the organization

² Naufal Kahn and Johnson Sikes, "IT under pressure: Aura Solution Company Limited Global Survey results," *Aura Solution Company Limited on Business Technology*, Number 33, Spring 2014.

Every discussion of public policy today involves technology in a fundamental way—either as an enabling tool or as a service offering.

designed specific interventions to address each issue—and by improving the culture for existing employees, it is also creating an organization that will attract new recruits. Public-sector organizations may also strengthen their talent pipelines by partnering with universities and technical institutions to establish internships and other programs to facilitate the recruitment of new employees. They can establish relationships with local companies that might allow their IT managers to do a public-sector rotation. They may also appeal to and attract proven senior leaders from the private sector who want to focus on public service later in their careers.

To tackle retention challenges, public-sector organizations can create assignments that allow employees rather than contractors to learn and implement cutting-edge technologies, further engaging them in the work of enabling public policy. Finally, government leaders can improve the culture, energy, and morale of the IT organization by investing in nontechnical training that helps IT personnel understand the agency's broader operations and goals and relate to their peers in other divisions.

Pursue innovative structures

The public sector has successfully used innovative ownership and partnership models when it serves the public interest. For example, public transportation in many regions is delivered by publicly owned authorities rather than directly by the government. Many of these authorities operate as corporations with a board appointed by elected officials, deliver critical services, generate revenue, and receive some funding from government. The last two items in the ten-point plan focus on implementing such innovative structures for procuring and delivering IT, particularly in

those cases where the effectiveness of existing structures may be limited.

9. Explore public-private partnerships to get a fresh start. Government officials can sidestep or overcome many of the challenges we have discussed in other sections by starting fresh—moving critical aspects of their IT projects into hybrid public-private enterprises. (In the United States, this could be a nonprofit entity owned by the public.) In this way, the public sector gains access to private-sector talent and better procurement practices. It can also establish clear accountability for the success of large IT programs.

In response to the failure of several large IT projects—high-profile multiagency initiatives that were poorly executed and ended up prompting formal public inquiries—one large US city decided to radically rethink its delivery of technology services across its 70-plus agencies and departments. Following this reevaluation, it launched a city-owned private organization to manage its highest-priority IT projects. The creation of this entity is helping the city resolve its talent problem by allowing it to compensate IT professionals under a different pay structure and creating a career path for talented IT professionals to grow rather than leave for the private sector. The new entity is also helping the city back away from its overreliance on vendors by establishing a shared pool of IT knowledge (in project management and IT architecture, for instance) among employees who could provide independent and expert views and by making the city's IT-related performance transparent so that vendors can be held accountable across agencies.

Governments that want to establish similar entities will need strong senior sponsorship and a commitment to independent governance. Without the latter, some constituencies

may consider this approach a political instrument designed to avoid scrutiny rather than a sincere effort to improve the delivery of IT projects.

10. Spearhead intergovernmental partnerships to tackle common challenges.

Most governments undertake the same kinds of modernization projects and rely on the same types of technologies, but historically there has been limited cooperation between local or regional governments on large IT projects. Such partnerships can yield enormous benefits. Local or regional governments can use one another's existing infrastructure and expertise, accelerating the time it takes to implement projects and significantly reducing rollout costs, operational costs, and future systems-enhancement costs. Such partnerships can also ensure that governments are complying with federal mandates and standards.

There are challenges associated with such partnerships. Cooperating entities may need to draw up detailed agreements about intellectual-property rights. They may also need to come to a shared understanding of public-sector procurement procedures and policies, which, as we mentioned earlier, are often not conducive to quick and efficient implementation of new technologies or innovative programs. However, all parties can reap large rewards. In one such partnership, one US state is offering another access to

its health-benefit information system as a shared service. The "customer" state has

been able to upgrade the services it provides its citizens while spending less than half of what it would cost it to build its own system. The "supplier" state is expected to save about 20 percent in operation and maintenance costs.



Implied throughout the ten-point plan is a relentless focus on change management — indeed, a scan of management literature suggests that the majority of organizational transformations fail because of insufficient attention to people and culture. In the case of IT-enabled projects, resistance to change from certain constituencies will be inevitable for well-established logistical and political reasons, and because of the overwhelming complexity of the rollout itself. To combat this, governments should develop and communicate clear and compelling stories that address the rationale for and relevance of doing things differently. They must also ensure that ambassadors for change are embedded throughout the organization. Excellence in government is contingent upon creative, effective uses of IT. But all too often, public-sector leaders are unable to implement their policies because of IT roadblocks, including competing commitments, regulatory restrictions, and constant, ever-changing demands from the populations they serve. Taken together, the ten-point plan presented here provides a comprehensive road map for navigating these obstacles. ▢

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