

BIG DATA AND ANALYTICS

A RESEARCH REPORT FROM
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A photograph of Tom Schenk, Jr. and Brenna Berman standing in front of a large sign for the City of Chicago. Tom Schenk, Jr. is on the left, wearing a dark suit and a blue tie. Brenna Berman is on the right, wearing a light-colored, textured blazer. The sign behind them features the word 'CHICAGO' in large green letters and 'CITY OF' in white letters on a red banner. The background is slightly blurred, showing the interior of a building.

**Driving Performance
and Improving
Decision-Making**

Wyoming was able to cut Medicaid patient ER visits by 20 percent by identifying frequent users of hospital ER services and directing them to more appropriate health care options.



INTRODUCTION

THE POWERFUL COMBINATION OF BIG DATA AND ANALYTICS

Stories touting the benefits of big data and analytics can be found across the spectrum of state and local government. For instance, when it comes to health and human services (HHS), states are using data analytics to reduce the number of Medicaid patients who seek routine care in hospital emergency rooms (ERs). Wyoming was able to cut Medicaid patient ER visits by 20 percent by identifying frequent users of hospital ER services and directing them to more appropriate health care options.¹ Police departments are using predictive analytics to head off crime. And transit agencies are analyzing data streams from location devices on public buses to better regulate where the vehicle should be on a particular route at a particular time, improving services for customers while enhancing operational efficiency. Other jurisdictions are collecting data sets from a variety of activities and running the information through an analytics program to boost performance of public works crews.

Government's experience with big data and analytics is just getting underway. While the public sector is well equipped to collect data and is doing it more and more, it is still learning how to share data to improve the quality and scope of what gets analyzed. This report sheds light on the technology requirements for big data and the governance necessary to make sound judgments based on analytics — including the benefits, challenges and real-life examples of implementing big data analytics initiatives. 🌐

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DATA DEFINED

WHAT ARE BIG DATA AND ANALYTICS?



It's important to understand how big data and analytics are defined because the terminology can be confusing. After all, government has been collecting large amounts of data for some time and has been analyzing the data it collects to one degree or another. So what are big data and analytics?

The most commonly used definition of **big data** describes it as high-volume, high-velocity and high-variety information that requires new forms of processing to enable enhanced decision-making, insight discovery and process optimization.²

When it comes to volume, think in terms of the terabytes of data that are now flooding Medicaid systems, sensor-driven cities, criminal surveillance systems and state revenue programs, to name a few examples. Velocity refers to the speed at which data is generated as collection systems and sensors become more sophisticated, driving the need to analyze the data more quickly. Variety refers to the fact that modern data collection systems contain both structured and unstructured data, such as images, video and transactional information.

Open data, or data that is available to everyone to use and republish without restrictions, is expanding rapidly at all levels of government. While its full impact is still unclear, most experts agree that open data goes hand-in-hand with

big data and will help remove time and resource constraints as members of the public and third parties analyze published data sets. Open data and its advocates can provide government with additional resources in a way that wasn't previously possible.

Analytics is sometimes confused with business intelligence, but they are different.

Business intelligence (BI) involves gathering, storing and providing access to data through applications such as decision support systems, query and reporting, online analytical processing, statistical analysis and forecasting. BI identifies patterns in data that was collected in the past while data analytics looks to what is done with it in the future. **Big data analytics** can involve vast amounts of structured and unstructured data, which helps government leaders use sophisticated algorithms to drive decision-making. These algorithms can predict behavior (predictive analytics); analyze program integrity to identify problems, such as fraud and abuse; or evaluate policy changes before they are implemented (known as rapid cycle evaluation).

When combined, big data and analytics are about discovering new patterns and correlations. Ultimately, it's about understanding trends and their impact on the government enterprise and the public it serves.³

Data and Analytics Explained

Big Data: Traditionally described as high-volume, high-velocity and high-variety information.

Big Data Analytics: Usually involves large quantities of structured and unstructured data and uses sophisticated algorithms to drive decision-making.

Predictive Analytics: Algorithms that help analysts predict behavior or events based on data.

Open Data: Information available to everyone to use and republish without restrictions.

Business Intelligence: Involves gathering, storing and providing access to data through applications.

DATA DRIVEN

BIG DATA AND ANALYTICS AT WORK

For a number of years, the use of big data and analytics in government has been more hype than reality. However, in 2012, the Obama Administration launched a \$200 million program to investigate the use of big data in five federal agencies.⁴ In 2013, Gartner predicted that by 2020, analytics will reach 75 percent of potential users, making the technology central to the reinvention of government and business.⁵ And in 2014, Johns Hopkins University launched the first graduate degree program in government analytics to meet the growing demand for people with both quantitative skills and an understanding of public policy.

These separate news items point to a significant increase in the use of big data and analytics in the government sector. It would be premature to call the use of the technology widespread in state and local government, but

there are strong signs of adoption taking hold. Forty-five percent of state and local IT leaders say they have data management and use policies in place, according to a recent survey of state and local government IT executives conducted by the Center for Digital Government (CDG).⁶ And they expect to see a range of benefits from big data and analytics, with 66 percent saying they will deliver more informed decision-making.

The benefits of big data analytics can be found in a number of high-impact government services and operations, such as HHS, transportation, policing and customer service. It's also beginning to deliver promising results in some not-so-obvious areas, such as workforce development, where analytics can be used to identify potential job seekers in a geographic location. States and localities are also mining data within their enterprise resource planning (ERP)

The primary benefit of data analytics according to state and local government decision-makers is:



SOURCE: CDG DATA AND ANALYTICS SURVEY, 2015



Brenna Berman, Chicago Department of Innovation and Technology Commissioner and CIO, helped institute a program that uses data to identify health code violations to mitigate foodborne illnesses.

systems to make better decisions affecting finances, payroll and human resources.

Another promising government use for big data analytics is in cybersecurity. Platforms that combine big data with traditional security methods can be used to protect an agency's information assets by helping to predict possible threats.

Health & Human Services: Sharing Data for Better Results

One of the biggest challenges in the field of big data and analytics is data sharing. It's a problem that is impacted by technical and political barriers. "There are often turf battles — people want to control access to the data they have collected," says Jennifer Bachner, Ph.D., director of the Master of Science in Government Analytics and Certificate in Government Analytics at Johns Hopkins University.⁷

In state government, HHS represents more than 40 percent of overall spending.⁸ It's a massive part of what state government does and is an example of how data sharing and analytics can improve performance and outcomes if applied in the right way. One state that is discovering this is Indiana.

Indiana's 2016-17 budget includes more than \$13.5 million for improving prenatal care for the state's youngest and economically challenged moms, including a new smartphone app that will help them find doctors, remind them of appointments and link them to transportation services.

These funds are a direct result of a statewide analytics-driven initiative to reduce infant mortality. Crunching data from five agencies and four public sources — covering everything from finances to criminal histories — Indiana discovered young mothers enrolled in Medicaid who rarely visit a doctor during their pregnancy account for almost half of infant deaths in the state.

"We found the largest factor we can influence as a government entity is getting those mothers to attend prenatal visits," says Indiana

CIO Paul Baltzell. "If we can get them there, we maximize the opportunity for success."⁹

In addition to reducing infant deaths, the state expects to save money because infants born to the highest-risk mothers also tend to face health challenges. Nearly 60 percent of low birth weight infants in the state are born to Medicaid recipients. Although these babies comprise just 5 percent of all Medicaid births, they account for 35 percent of annual Medicaid infant expenses.¹⁰

"If we can get mothers to 10 prenatal visits and the babies are born at a normal birth weight, the actual cost to Medicaid in their first 3 years of life can be reduced by hundreds of thousands of dollars," says Baltzell.

Efforts like Indiana's will become more common as public officials seek greater value from health care spending. But perhaps the biggest push for analytics adoption in the HHS space will come from the nation's largest health insurer: the federal government.

U.S. Health and Human Services Secretary Sylvia Mathews Burwell, speaking at a health data conference in Washington, D.C., said sophisticated data use will play an important role in curbing Medicare and Medicaid spending while improving the effectiveness of treatment purchased with those funds. Data sharing and analysis are cornerstones to the agency's effort to pay health care providers based on patient outcomes instead of individual procedures, she noted, and the shift will trigger changes for the health care industry and state agencies that run Medicaid programs.

"At HHS we've set ambitious goals to move Medicare and Medicaid toward payment models where providers are paid for how well, rather than how much, they care for patients," Burwell says. "And we're working with partners across sectors to find solutions that will deliver these results at improving health care delivery in many ways."¹¹

The shift toward data analytics can be seen in recent moves by the agency's Centers for Medicare & Medicaid Services (CMS). In late 2014, CMS



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created an Office of Enterprise Data and Analytics and appointed its first chief data officer. The new office is charged with using the agency's vast data resources to guide better decision-making and ensure HHS data is accessible to health consumers and innovators.¹² In 2015, CMS announced it would offer unprecedented access to its digital archive, the nation's largest repository of health data.¹³

Applying Analytics to Local Public Health Issues

At the local level, cities and counties are using analytics to improve community health. For example, Chicago's analytics platform uses data sets pulled from the city's open data portal to predict which of the city's 15,000 restaurants are most likely to expose patrons to foodborne illnesses. The information is provided to the Department of Public Health each morning and guides the efforts of the department's 30-person inspection staff.

The new approach helps restaurant inspectors visit the riskiest establishments first, says Tom Schenk, Jr., Chicago's chief data officer. A comparison between old and new inspection methods conducted in early 2015 found that the analytics-driven approach enabled inspectors to discover critical violations an average of seven days earlier.

"We're able to find risky restaurants and critical violations earlier," he says. "So we're reducing the amount of time patrons are exposed to these risky conditions."¹⁴

The initiative examines a range of variables — including how long a restaurant has been open, the length of time since its last inspection, its history of critical violations, nearby garbage and sanitation complaints, and the average high temperature three days prior to inspection — to produce a risk score. After a year of development and testing, Chicago implemented the initiative citywide in January 2015.

Chicago Department of Innovation and Technology (DoIT) Commissioner and CIO Brenna Berman says activities like these will expand in health-related areas and beyond as



Enterprise Thinking Can Lead to Success

Chicago's restaurant inspection program and Indiana's infant mortality project are both part of enterprise-wide analytics initiatives — and that's an important part of their success.

Chicago's Chief Data Officer Schenk says the city's restaurant inspection initiative is part of an overall data strategy that combines open source software, a centrally managed open data portal, and partnerships with the business and academic communities. Through one of those partnerships, data scientists from a large Chicago-based insurance company donated time to help develop the restaurant inspection code. Once the open source code was finished, it was posted online and made available to other cities. Because the application code and restaurant data are publicly available, anyone can see how the project works and contribute improvements.

"We have a very active civic developer community, and there's a small team of them right now trying to do this better than us," Schenk says. "If they're able to make improvements, they can submit that back to us, so we benefit from that collaboration."

In Indiana, the data analytics initiative is backed by an executive order from Gov. Mike Pence, which compels state agencies to share data with the Management and Performance Hub (MPH) — a collaboration of the governor's office, the state budget office and the IT department that runs the statewide analytics program. With support from the governor and budget director, the MPH brings valuable resources to analytics projects. For instance, the organization hired a lawyer with experience in both technology and government policy to help alleviate agency-level data-sharing concerns, an issue that's particularly important when handling sensitive HHS information.

The MPH lawyer worked with agency counsel to interpret privacy laws and other statutes, and when necessary, sought permission from federal agencies to use data sets in new ways. "At times our agency counsel just needed someone who could talk the legal-speak to help them work through issues," CIO Baltzell says. "And our counsel was 100-percent focused on this, so he could do a lot of the legwork and make the case for what we were doing."

the city seeks to use limited resources more efficiently. “We’ll leverage the model we’ve developed for restaurant inspections for other types of city inspections,” she says.¹⁵

Due to initiatives like these, data analytics will continue to play a critical role in controlling health care costs, strengthening medical care, and improving community health and safety.

Program Integrity: Analytics to Fight Fraud, Waste and Abuse

Use of data analytics may be nascent in many government program areas, but it’s well established as a fraud fighter. In government, there may be no clearer return on investment for new technology than when it’s used to boost tax compliance or root out abuse of public assistance programs.

State revenue departments routinely report capturing millions — sometimes even billions — of dollars in revenue by using data matching and analytics technology to spot fraud and improve tax compliance. One 2014 survey of more than half of the nation’s state revenue departments found nearly all of them were using these technologies to close the gap between taxes owed and taxes paid — and many were upgrading their analytics capabilities to further strengthen collection efforts.¹⁶

States have also implemented analytics to reduce fraud and abuse in programs such as Medicaid and unemployment insurance, often saving millions of dollars by ensuring these benefits go to those who qualify for them.

At the local level, cities and counties use analytics to more accurately assess properties and improve property tax collections. They’re also deploying analytics to fight everything from child care assistance fraud to abuse of disabled parking permits.

Improving Tax Compliance, Fighting Fraud

California is one of many states using sophisticated data techniques to collect taxes the

“Early indications from the Department of Revenue and GDAC suggest additional investment in data sources will enhance the department’s ability to determine identity theft.”

John Correllus, Director, North Carolina Government Data Analytics Center

government is rightly owed. Better audit selection and smarter prioritization of collection activities are part of the five-year tax modernization project led by the California Franchise Tax Board (FTB). Known as the Enterprise Data to Revenue project, the initiative includes a new enterprise data warehouse that’s accessible to all of the FTB’s existing systems.

The project launched in 2011 and is being deployed in phases until the end of 2016. In 2014, the FTB announced the initiative had collected \$1 billion in extra tax revenue and it’s expected to pump an additional \$1 billion annually into the state’s coffers once it’s completed.

“Most of the \$1 billion came from noncompliant individual and business taxpayers, so people that are behind in their taxes,” says Denise Azimi, FTB public affairs officer.¹⁷ “People make mistakes in their tax returns, too, so that’s either detected when we’re processing the returns, when we see errors or during a later audit. In California, we estimate the tax gap is about \$10 billion a year, and that’s simply defined as the difference between what people voluntarily pay and what they legally owe.”

North Carolina is adding advanced data analytics to its existing programs to address another serious problem for tax agencies: the filing of fraudulent tax returns. Tax refund fraud, where individuals steal a taxpayer’s identity and then file a false tax return, has exploded during the past 10 years. Between 2008 and 2012, IRS data shows more than 500,000 taxpayers had their identities stolen by thieves who filed

fraudulent tax returns and collected millions of dollars in undeserved refunds.¹⁸

North Carolina's Government Data Analytics Center (GDAC) is working with the state's Department of Revenue in a pilot that provides additional data sources to assist in identifying fraudulent activities. Among other things, GDAC is leveraging data, such as death records, so the Department of Revenue can integrate this information and add advanced analytics to discover potential stolen identities.

"Early indications from the Department of Revenue and GDAC suggest additional investment in data sources will enhance the department's ability to determine identity theft," says John Correllus, GDAC director.¹⁹

As in most other technology areas, cloud-hosted services are having an impact on solutions for fraud, waste and abuse. Commercial data and analytics services now make it easier for states and localities to tap into vast public records resources and employ sophisticated analytics techniques.

Florida and Georgia are among a growing number of states using third-party data services to screen tax returns against various public records databases — both to spot fraudulent tax filings and increase collections.²⁰ The technique is proving to be quite effective. Georgia says its data service stopped more than \$30 million in tax fraud in the first 2 years of operation. Florida says third-party data matching coupled with a broader analytics initiative boosted tax revenue collection by \$66 million in fiscal year 2013.

Local governments are using analytics to improve tax collection as well. For instance, Florida's Miami-Dade County deployed an analytics-based solution to uncover \$5 million in unpaid property taxes. The county targeted improper use of a tax break known as the homestead exemption, which is available in many states. Under Florida law, taxpayers can claim a homestead exemption on their primary residence to reduce their property taxes. But it was tough for Miami-Dade

The Fight Against Fraud

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An analytics-based solution helped Miami-Dade County uncover **\$5 MILLION IN UNPAID PROPERTY TAXES.**



investigators to track whether homeowners had claimed another primary residence in a different Florida county or another state.

"We'd need an army of investigators to go nationwide and pull all the information," says Lazaro Solis, deputy property appraiser for Miami-Dade County. "It would be like a needle in a haystack."

The county's analytics solution solves that problem by scouring public records databases nationwide to uncover potentially fraudulent exemptions. Before its adoption, county investigators typically relied on tips from citizens and other sources to find tax cheats, but just 25 to 30 percent of those leads resulted in a violation. Adopting analytics dramatically improved the odds.

"With this software ... we're seeing results in the neighborhood of 80 to 90 percent," Solis says. "Although the final determination [of fraud] is made by a human being ... their time is much more productive because the leads from the system are of higher quality and have better results."²¹

Protecting Social Benefits and Taxpayers

Analytics and data matching also help states and localities fight benefits fraud. Improper payments from assistance programs cost taxpayers billions of dollars each year and divert resources from citizens who are truly in need.

Take unemployment insurance fraud, for example. According to a report released in 2013 by the Federal Reserve Bank of St. Louis, fraudulent unemployment insurance payments cost the nation \$3.3 billion in 2011.²² The U.S. Department of Labor says the fraud rate for unemployment insurance varies by state, but can be as high as 7 percent.²³

Now states such as Iowa and New Mexico are using technology to fight back. Iowa Workforce Development (IWD) deployed a cloud-based service to analyze incoming unemployment claims using a combination of predictive modeling, data mining, geospatial and search engine technologies.²⁴ The service also incorporates machine learning to recognize new fraud methods over time.

IWD processed 190,000 unemployment claims in 2013 and paid out more than \$400 million in benefits in 2012 and 2013. The new analytics service, deployed last year, helps the agency spot fraudulent claims before payments are made. IWD investigators receive results in a dashboard-style interface, where anomalies or patterns are flagged for further examination based on potential fraud risk. Leads are prioritized to show the most serious cases first.

“We take those hits and we have fraud investigators go out and verify a case independently,” says Gary Bateman, CIO for IWD. Now the same analytics platform is being offered to cities to crack down on the fraudulent use of disabled parking placards, which carry a high street value in large municipalities where parking is at a premium.²⁵

In New Mexico, identity verification and other data tools cut unemployment insurance fraud by about \$10 million, or 60 percent, in 2013. The improvement stems from an integrated unemployment tax and claims systems launched earlier that year. The new system matches information from employers and claimants to reduce fraud, and to detect and recover improper payments.²⁶

As analytics tools and data services mature, states and localities will continue to adopt these

technologies to safeguard public benefits, strengthen tax collection and protect taxpayer dollars. Governments are obligated to ensure the integrity of these programs, and often the business case for data matching and analytics will be too compelling to ignore.

The Big Impact of Analytics on Crime, Prevention and Safety

Intelligence-led policing is nothing new. Placing pins on maps to visually track different types of crime has long been a tactic used by police departments, and ledgers filled with information about felonies is the original system for officers to research potential connections between illegal events. While this can be traced back many decades, technology has automated these tasks and provides new, more efficient means for public safety agencies to gain insight into the valuable data they have to solve crimes and improve decision-making.

In the 1990s, the New York City Police Department deployed the CompStat computer-driven management model to map crime and deploy officers to problem areas. It was credited with reducing crime by up to 60 percent in the city, and the use of data and geospatial analysis to gain insight into illegal activity proliferated in communities throughout the U.S. Today these initiatives take on various forms from dashboards filled with numerous data sets to GIS-based maps that are used internally and available to the public.

“It’s very common for policing agencies to collect their data electronically and have some analytical capability,” says Jim Bueermann, president of the Police Foundation and retired chief of the Redlands, Calif., Police Department.²⁷ Web-based systems, for instance, have opened the door for agencies to use data-driven tools; they tend to be inexpensive and help democratize the data.

In a national effort to encourage police departments to make better use of their



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information, the White House launched the Police Data Initiative in May 2015.²⁸ The 21 participating cities will use open data to build community trust, while also improving police departments' internal accountability and operations through data analysis. Both goals aim to increase transparency and accountability — public data sets will allow citizens to view the information and make their own decisions about police activities, but it's the latter goal that Bueermann predicts will dramatically increase in the coming years.

While he says the use of analytics at the tactical level will continue, he predicts analytics will have a huge impact on the strategic direction of public safety agencies in the future. For example, police departments can analyze social media to get a better feel for public sentiment and help them augment the response to an event if community members misperceive police actions. In addition, to improve internal accountability, analytics around officer performance will begin to take center stage through the concept of an early warning system. "This is the ability to use data to develop a profile of officers that need some intervention,"

Bueermann says. Components of the early warning system — sick leave, accidents, number of resisting arrests, etc. — can be potential red flags, indicating when it may be necessary to intervene with an officer.

Analytics around officers' use of force is another area that can potentially help a department make strategic changes. Theresa Reno-Weber, chief of performance and technology for Kentucky's Louisville Metro Government, says this is an element of the White House's Police Data Initiative, in which Louisville participates. "Is there anything within the data that we can analyze and validate to help us understand, intervene and provide assistance to officers to eliminate inappropriate use of force incidents before they occur?" she asks. "It is extremely valuable if the data can help us help our officers avoid a situation we know they don't want to be in, and as a community we don't want them to be in."²⁹

Wearable technology and body-worn cameras will also provide analysts with granular data, down to the individual level, that can feed strategic policing decisions. While body cameras and



The Los Angeles Police Department has used predictive analytics to reduce property crime by as much as 12 percent in one neighborhood.

the video they record are relatively new to many jurisdictions, they will provide a huge amount of information that may one day aid policing in real time. “What can we get software to do in the future that helps analyze the social interactions between police officers and citizens, not only in an after-the-fact perspective but in real time?” asks Bueermann.

Improving Citizen Safety

New York City’s Police Commissioner William Bratton, who introduced law enforcement to CompStat, saw predictive analytics as a way to anticipate gang violence, burglaries and thefts when he was chief of police in Los Angeles in 2008. In 2011, the L.A. police used predictive analytics to cut property crime by 12 percent in one neighborhood. Bratton suggested that predictive policing could have a real impact when used in conjunction with existing policing techniques, such as community policing.³⁰

The RAND Corp., a nonprofit research organization, released a comprehensive study on predictive policing in 2013 and found that technology can be used to predict the place and times of crimes, predict and identify which individuals are likely to commit a crime, predict the profile that accurately matches likely offenders with specific past crimes and predict victims of crimes.³¹

To a large extent, predictive analytics is still under development, according to Bueermann, but it can be helpful for determining the best areas to focus policing efforts. The social aspects of predictive policing can be a challenge; the community needs to understand why officers are in an area if a crime hasn’t occurred. Additionally, determining if police presence deterred criminal activity can be difficult.

However, some agencies have reported successes with predictive analytics. The Santa Cruz Police Department compared crime statistics from the first six months of 2012 to the same timeframe in 2011 when the advanced

“I think there is going to be a mashing of the data and a greater interest in the notion of boundary-less data – the acknowledgment that school, health care, public works, community development and policing data all have value with each other.”

Jim Bueermann, President, Police Foundation

analytics and prediction technology wasn’t being used. Without adding more officers to the streets or changing beats and shift times, the result was a 19 percent reduction in property theft.³²

Whether an agency aims to use predictive analytics to prevent crimes or wants to make better use of the data it collects, key to these efforts will be sharing information across government verticals. “I think there is going to be a mashing of the data and a greater interest in the notion of boundary-less data – the acknowledgment that school, health care, public works, community development and policing data all have value with each other,” Bueermann says.

Breaking down data silos has been key in North Carolina where a statewide system used by more than 29,000 criminal justice professionals is a product of the Government Data Analytics Center. Created in response to two high-profile murders in 2008, the Criminal Justice Law Enforcement Automated Data Services (CJLEADS) integrates information from different offender systems to help provide a complete view of an individual’s history, including arrest warrants. “Using the right tools to protect citizens by keeping bad people off the streets and reducing fraud are both good uses of data and analytics,” says state CIO Chris Estes.³³



SOURCE: CDG DATA AND ANALYTICS SURVEY, 2015

Transportation and Public Works Generate Very Big Data

Public works is one of the most outward-facing aspects of government. From roads and transit to water and trash to winter cleanup and grounds maintenance — these services are considered by some to be the bread and butter of the public sector, especially at the local level. And they are all areas where analytics and big data tools are being implemented to help increase efficiency, resolve bottlenecks and improve the delivery of key services.

Transportation is one of the biggest areas that's being transformed by analytics due to the ever-increasing amount of data available from tools such as sensors, smartphones and new types of technology to track commuter paths, as well as public transportation rider use and trip schedules. While the availability of data is not new for transportation and public transit agencies, new models such as ride sharing are forcing them to pay more attention to the information that's available, use it to improve services and determine the best way to focus limited resources.

Some transportation agencies are using data from their automated vehicle location (AVL) systems to deal with issues such as bus bunching, says Jennifer Carter, senior vice president of technical programs at the Intelligent Transportation Society of America. "Most transit agencies have had access to AVL data for many years, but they're now more proactively making use of that data," she says.³⁴

Historically, transit agencies have made decisions about routes and schedules based on resource-intensive studies, but the popularity of smartphones and apps has helped disrupt this process. Carter says that with so many people using transportation apps that rely on user-generated data, agencies have access to information to examine trip demand and day-to-day traffic scenarios so they can make changes in real time to improve safety and efficiency, as

well as increase the availability of buses. Boston and Los Angeles have both entered into data-sharing partnerships with private vendors to better understand how roadways are used and offer new services to citizens. Los Angeles also plans to use the vendor's data to guide infrastructure upgrades.³⁵

Determining where to focus limited resources is also driving the use of analytics by the Transportation Agency for Monterey County in California. Deputy Executive Director and American Public Works Association member Todd Muck says the agency is looking at performance measures for the projects it wants to fund and using a cost-benefit analysis to compare different options. The county adopted a long-range transportation plan in 2014, and the Transportation Agency is currently prioritizing projects. "Big data is providing access to information that we just didn't have access to before," Muck says. "We want to use it to make more informed choices with our resources."³⁶

Using Big Data and Analytics to Fuel Smart Cities

Big data and analytics are transforming other functions that traditionally fall under the

Transportation agencies are using data from their AVL systems to modify bus routes for more efficient operations.





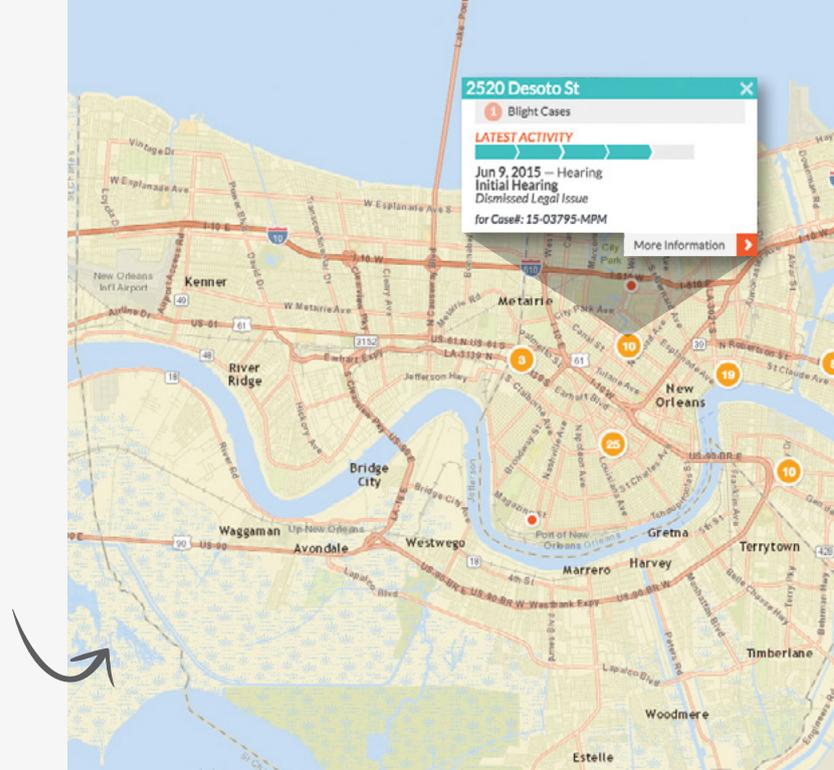
A Citywide Approach to Analytics

New Orleans, a city that has had more than its share of challenges, has emerged in recent years as a leader in the field of big data-driven performance. The city has eight cross-departmental stat programs, according to Oliver Wise, director of the Office of Performance and Accountability.³⁷ Six of them are managed by the Office of Performance and Accountability, a team of data analysts who have backgrounds in fields such as data science, mathematics and public policy. With strong executive support from Mayor Mitch Landrieu, New Orleans now uses data as a tool to track progress toward policy goals. “We’re extending that work into analytics, which we describe as using data and the tools of data science to help departments get an edge in delivering their services more strategically and effectively,” Wise says.

In March 2015, the city began combining available data, free resources and open source technology in an effort to reduce preventable fire deaths. The action was triggered by the fact that in the last four years, every house fire resulting in a fatality in New Orleans was completely preventable — none of the affected residences had a smoke alarm. The Office of Performance and Accountability worked with the New Orleans Fire Department to develop a predictive model to best focus door-to-door outreach and outfit vulnerable properties with smoke alarms. The model was fueled by census bureau data as well as historical city fire data. Their use of open source software for the project means the code is scalable to other cities.

New Orleans has also used data analytics to tackle the city’s significant blight problem, worsened by Hurricane Katrina in 2005. Mayor Landrieu set a goal of reducing the city’s vacant and dilapidated property inventory by 10,000. Wise’s response was BlightSTAT, a tracking system aimed to quantify the city’s performance in dealing with blighted properties. Since its inception, the project has gone through several technology upgrades. Automatic feeds of core data sets are now fed directly to the city’s open data portal so citizens have access to the same data analyzed by decision-makers.

New Orleans is also testing an analytical tool that takes the data code enforcement workers use to decide whether to sell or demolish a property and develops a score on a scale of 0 to 100, which can be used by administrators to help make informed decisions. “It’s not a computer making this decision,” Wise says. “But the computer is giving you a very informed recommendation based on past behavior. We’re using techniques similar to Netflix or Amazon to help make policy decisions more rigorous, more scalable and quicker.”

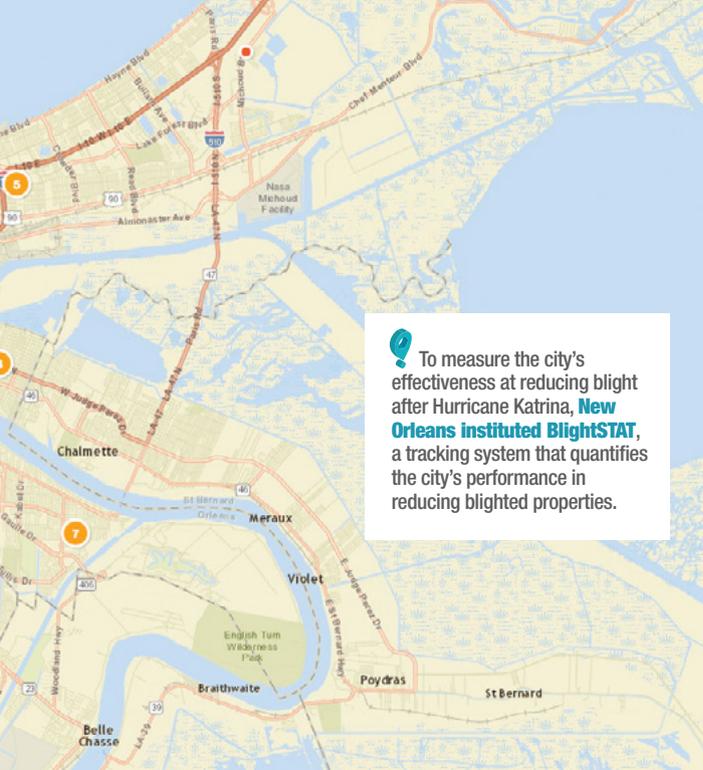


public works heading. The ability to turn nearly everything into a sensor has agencies beginning to harness the Internet of Things (IoT) to track different metrics in real time and use that information to increase the efficiency of their operations. The Boston Department of Public Works, for instance, deployed smart trash cans that track how full they are, allowing officials to change pickup schedules based on need and helping to save money and time. Feeding such information into a citywide dashboard helps agencies take a task that once was done on a set schedule and instead create a demand-based process.³⁸

Smart parking solutions enable cities to track available spaces and allow them to move to a demand-based pricing model. San Francisco outfitted all of its 29,000 parking meters with sensors, and city officials say the meters have reduced the number of parking citations issued.³⁹

Many analytics implementations have two-pronged benefits: Government officials can make smarter use of public assets based on information, and residents can harness data-based tools to have a more accurate picture of what their city is doing and improve personal decision-making.

The tracking of fleet and maintenance vehicles such as snowplows is a prime example of this, as



To measure the city's effectiveness at reducing blight after Hurricane Katrina, **New Orleans instituted BlightSTAT**, a tracking system that quantifies the city's performance in reducing blighted properties.

it's a data-rich area for governments. GPS trackers on Pittsburgh's snowplows not only allow residents to see where the vehicles are working after a storm but also help the public works director identify which areas of the city need to be prioritized for snow removal and assign staff accordingly. "The citizens only see the snowplow tracker and the movement of the trucks, but it's actually reflected in better services because public works is better able to respond to the changing conditions in real time," says Pittsburgh Chief Innovation and Performance Officer Debra Lam.⁴⁰

These are just a handful of examples highlighting how analytics and big data are changing public works and transportation and improving service delivery both internally and for citizens. As more connections are made among government agencies, they will continue to find new ways of harnessing data to be receptive to resident needs and even proactively prevent problems.

Creating Safer Roadways with Data and Analytics

Idaho receives well over 100 inches of snow annually. With so much snowfall each year, the Idaho Transportation Department (ITD) has become an expert at keeping more than 5,000 miles of highway under its jurisdiction clear during the winter months. Experience has a lot to do with it, but so does big data analytics.

Throughout the state, ITD installed 126 road weather information systems — sensors and cameras that constantly monitor road and weather conditions. When a snowstorm is about to hit, the digital outposts feed real-time data into a computer system at ITD's headquarters. This information is integrated with data from controllers mounted on snowplows that measure how much sand and salt is spread on the roads, when the plows are up or down, and the location of the vehicle.

The name of the project is Swarm the Storm, but the combination of big data, analytics and a fleet of trucks operated by skilled drivers has led to significant improvements in safety and operations, according to Shannon Barnes, ITD's enterprise technology service administrator. "We've seen significant efficiencies in the winter maintenance program since using big data analytics," she says. "And we have also significantly increased mobility and reduced crashes."⁴¹

Big data analytics has also helped ITD improve the safety and mobility of nearly 1.5 million trucks that pass through 2 of the state's ports of entry. High-tech sensors at these locations read data from truck-mounted transponders that provide information about the truck's weight, driver's safety credentials, axle configuration and registration. In the past, trucks had to pull off the highway into the port to provide the information; now they stay on the highway and bypass the port, reducing wait times and fuel costs. "Big data has brought a fundamental shift in our strategic thinking," says Barnes. "Our technology is helping industry be more efficient and effective; government is no longer the barrier."

To handle this massive load of data, ITD utilizes a variety of storage systems, including flash, which ranges from on site to cloud based, depending on the mix of elements involved in the data sets. For example, highway video images are stored in the cloud. ☁

TECHNOLOGY

SOLUTIONS FOR A COMPLEX WORLD

The impact of big data and analytics is beginning to ripple across key government businesses. But there should be no doubt that it will have a big impact on IT. Just review its general premise: sifting through large amounts of structured and unstructured data, analyzing it for real-time results, and then deriving intelligence and decisions from that analysis.

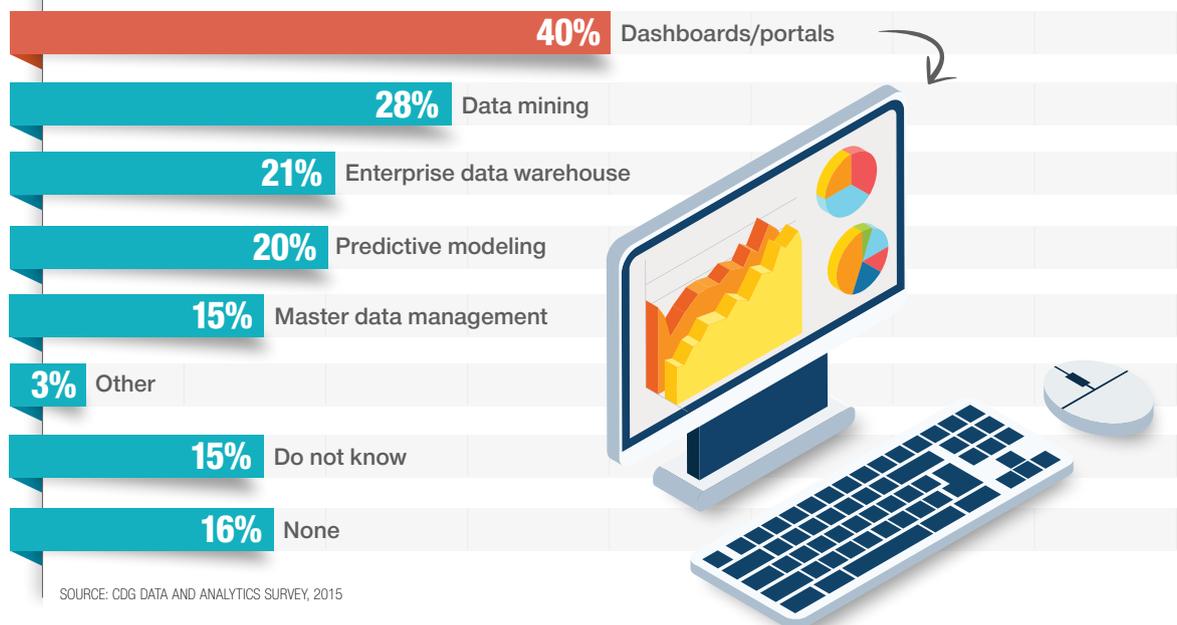
Such an operation calls on the capabilities of a host of IT-related systems, tools and practices: computing platforms, storage, networking, and security and privacy. The technology solutions

available today are endless, however, a few are necessary for any data initiative.

Computing Platform

Both private sector companies and government agencies have adopted open source software for developing applications that can extract value from structured and unstructured data across clusters of servers. Open source platforms tend to be preferred as they also provide scalable solutions. Agencies and IT staff should evaluate which platform works

Data and analytics technologies and techniques used by agencies include:



best for their particular data analytics need, but the ultimate objective is to find the platform that will work best for their data needs, such as aggregating information from multiple data sources into a single database for fast response time from analytical queries.

Memory

Large memory configurations and servers are also necessary for sifting through multiple data sets and pursuing analytical questions. Beyond having the capacity to handle big data, capabilities such as in-memory technology — which allows processing to be brought to the data rather than the other way around — are important to consider. For example, utilities have used in-memory technology coupled with server clusters to show customers their usage patterns and prescribe ways to reduce bills by changing behavior.

Storage

Never a trivial matter, storage can present significant challenges, especially when unstructured data is involved. Agencies should consider moving to the cloud to store data as it can be more scalable, flexible and cost efficient than traditional storage solutions. As data grows at a rapid rate, deploying a storage solution that can scale with the data will be paramount to success.

Some government agencies default to an on-premises storage solution as a way to control data, which is appropriate if the data contains sensitive information and privacy controls are important. However, deployment models, including hybrid clouds, are emerging as options for developing and testing new analytics applications, as well as for storing and processing big data outside the government enterprise. Cloud is also beneficial for rapid or temporary data needs, avoiding investment in permanent infrastructure when it's not necessary.



Open Data and Transparency

CDG's 2014 surveys revealed open government, transparency and open data are top of mind for CIOs: It's the

48 
STATES OFFER SEARCHABLE ONLINE CHECKBOOK-LEVEL DATA.

No.1 priority for cities and ranks in the top 10 for technology leaders at the state and county levels.

The most sought-after information in many jurisdictions is financial. A 2015 study from the U.S. Public Interest Research Group (U.S. PIRG) lists 48 states that offer searchable online checkbook-level data by agency, keyword and vendor. According to the report, state transparency websites continue to make progress toward comprehensive, one-stop, one-click transparency and accountability for state government spending.⁴² For example, Pittsburgh offers detailed budget data that site visitors can use to create customized reports.

TRANSPARENCY IS THE NO.1 PRIORITY FOR CITIES.

Customer Relationship Management (CRM)

CRM software has transformed how state and local governments use data to engage citizens. Not long ago, CRM was primarily used for 311 call centers. However, it has kept pace with the evolution of data and now includes a variety of data sources, including social media, which enable public employees to better respond to and predict citizen needs.

Today, more than 300 local governments use CRM technology to answer queries, complaints and route service requests. In 2014, New York City received 28 million customer contacts, each of which captured valuable data the city analyzes to improve customer services and government operations.⁴³

Data coming from direct citizen interactions provides a telling look into the most pressing issues on the minds of citizens. And using this first-hand information can help local government measure performance and make decisions about where to focus resources to improve overall operations.

Security and Privacy

Security concerns have grown dramatically in recent years as the number and scope of data breaches continue to increase. Since the best big data analytics projects often entail data sharing, state and local government CIOs need to guard against unauthorized users as well as unauthenticated access.


37%
**OF JURISDICTIONS
STORE LESS THAN
10% OF DATA
IN THE CLOUD,
WHILE 27% DON'T
STORE ANY DATA
IN THE CLOUD.**

SOURCE: CDG DATA AND
ANALYTICS SURVEY, 2015



Using CRM, New York City received 28 million customer contacts, which captured valuable data used to improve citizen services and government operations.

“Even in principle, however, one can never know what information may later be extracted from any particular collection of big data, both because that information may result only from the combination of seemingly unrelated data sets, and because the algorithm for revealing the new information may not even have been invented at the time of collection.”

White House, Big Data and Privacy Report to the President, 2014

The National Institute of Standards and Technology (NIST) is currently addressing security concerns around a big data interoperability framework, which will propose security taxonomies, as well as begin mapping security needs to the overall architecture under discussion.⁴⁴

Privacy also continues to be a concern with big data and analytics, especially when collected data is used for activities beyond its original purpose. As a 2014 White House report explained, “Even in principle, however, one can never know what information may later be extracted from any particular collection of big data, both because that information may result only from the combination of seemingly unrelated data sets, and because the algorithm for revealing the new information may not even have been invented at the time of collection.”⁴⁵

Advances in technology have begun to address this issue with new software that can reduce the exposure of certain data sets, making them anonymous but accessible in an aggregated format for analysis. Before implementing any data initiatives, state and local government decision-makers must make sure their data is secured at every corner. From firewalls to authentication, security should be a No.1 concern.

Beyond technological protection, public agencies also need a well-thought-out set of

Hadoop Hoopla

If you spend enough time researching big data and analytics, eventually you will run into the word “Hadoop” — an open source software platform that helps store and manage large amounts of data cheaply and efficiently. Government decision-makers should take note: Hadoop is special because it is not only inexpensive and efficient, but it also operates in a unique way. Hadoop stores enormous data sets across distributed clusters of servers and then runs a “distributed” analysis in each cluster.

As a software framework designed to scale up from single servers to thousands of machines, each offering local computation and storage, Hadoop adds redundancy to the system in case one machine in the cluster fails. It can also lift the traditional constraints that occur with the storage and processing of vast amounts of data. Rather than move data across a network to a software engine for processing, Hadoop moves the processing software to the data, making it easier to process and perform analysis.

As more agencies adopt data initiatives, Hadoop usage will likely grow among IT departments.

HADOOP is an open source software platform that helps store and manage large amounts of data cheaply and efficiently.

policies that focus on the particular uses of big data analytics, which will help to provide a degree of protection from inadvertent (as well as potentially malicious) privacy intrusions. This should also include data plans that build upon conventional data management to address the uses of big data. 🌐

HURDLES

OVERCOMING DATA CHALLENGES

Leveraged correctly, big data and analytics provide the opportunity for state and local governments to revolutionize day-to-day operations, citizen interactions, and community health and safety. However, with every advancement comes challenges — with the right technologies and teams in place, these challenges can be overcome.

Data Quality, Governance & Management

Thirty-nine percent of CDG survey respondents reported data quality as a challenge in big data and analytics initiatives. The growth of big data and analytics will depend to a large degree on the quality, governance and management of data.

Not all data has to be top quality to be part of a big data project — the purpose, magnitude and desired outcome should be taken into consideration. High-quality data can be expensive to produce and maintain, so imposing exacting standards on data quality for a project that does not require high levels of security, authentication and authorization may make it unaffordable. But there needs to be some baseline standards. Also, once the data is created, it's important that the quality is not diluted as it is aggregated, shared and analyzed.⁴⁶

Data quality control requires governance and good management of data. This ranges from the ability to inventory and identify critical data for analytics projects to data ownership — specifying rights and accountability — to ensure data is properly stored, archived and, when necessary, deleted.

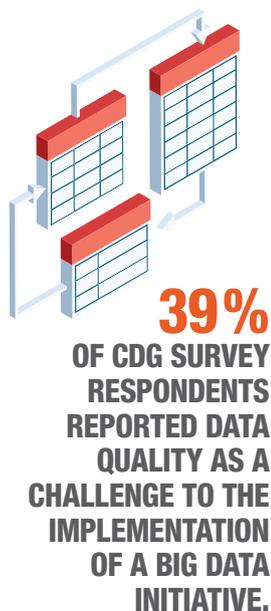
Governance can be challenging in the field of big data because it's broad and must take employee accessibility, eDiscovery and metadata management, and data compliance issues into consideration. To help alleviate the problem at the federal level, the Office of Management and Budget (OMB) published a series of guidelines and recommendations on how agencies can improve their digital governance. These recommendations call for:

- ✓ Gathering a core team with an established leader
- ✓ Assessing existing governance structures
- ✓ Determining the ideal governance structure
- ✓ Building and validating the new governance structure
- ✓ Sharing, reviewing and upgrading the proposed governance structure
- ✓ Establishing the new structure

The guidelines include best practices to help agencies develop or strengthen their governance structures across all three layers of digital services: information, platform and presentation.⁴⁷

Cost and Funding

One driver behind the big data and analytics trend is technology. More specifically, the lower cost of technology. Open source platforms for big data storage and processing are oftentimes a less expensive alternative to enterprise data warehouses, commonly quoted at less than



SOURCE: CDG DATA AND
ANALYTICS SURVEY, 2015

\$1,000 per terabyte.⁴⁸ This low-price entry point could change the minds of the 42 percent of CDG survey respondents who said cost issues were the biggest challenge to a big data project.

But technology is a fraction of the total cost of any IT project. For years, experts have pegged hardware and software at just 15 percent of a project’s overall expense. The other 85 percent is eaten up by a range of administrative, personnel and support costs. Costs can also rise according to the quality of data needed for a particular big data project.

Skillset Requirements

When it comes to big data and analytics, state and local governments need more analysts, data scientists and chief data officers. Various reports estimate that by 2018, as many as 190,000 big data experts will be needed across the public and private sectors.⁴⁹

Industry experts who work with states and localities on big data projects call the skillset gap a major issue. While localities have made progress in finding and hiring data experts, some jurisdictions struggle to acquire the right talent, given the limited

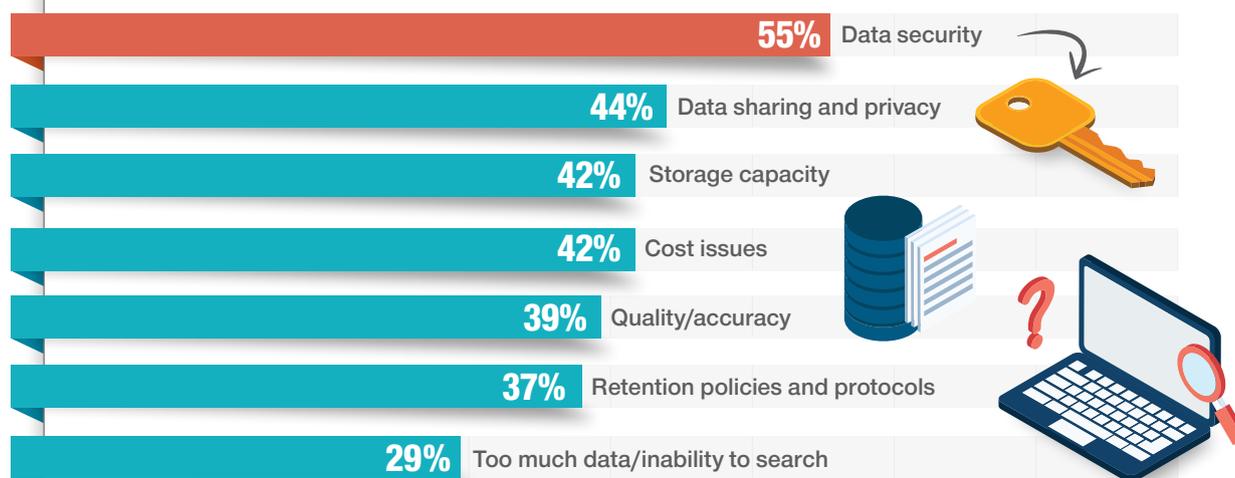
supply. To fill the gap, technology companies and public policy firms are offering consulting services.

Some localities have also solved this challenge by consolidating talent. For example, the city of Jacksonville, Fla., created a business intelligence (BI) group within the IT department that develops BI applications for the city’s agencies.⁵⁰ By leveraging existing talent and resources, state and local governments can meet unique business requirements using a common framework.

Johns Hopkins University launched a graduate program in government analytics to meet the high demand in government for people with quantitative skills. “The public sector needs people who have the skills and knowledge to make sense of all this new information,” says Dr. Bachner of Johns Hopkins.

While Johns Hopkins’ program is unique, other universities are also establishing coursework that will equip students with data analysis skills. New Orleans’ Wise noticed the trend at nearby Louisiana State University. “I’m bullish about the talent that’s available to city and state government when it comes to getting top notch analytical talent in the door,” he says. 

The most pressing big data challenges are:



SOURCE: CDG DATA AND ANALYTICS SURVEY, 2015

TIPS

10 STEPS TO SUCCESS

1 Get buy-in from key stakeholders. Work with key decision-makers such as city council members, mayors and other elected officials to ensure support through every step of a new data initiative.

2 Create a business case to justify new investments. You will need to prove why a data initiative is necessary before securing stakeholder buy-in. Outline your initiative's cost, projected return on investment and potential efficiencies when developing a business plan.

3 Create a data management plan. Prior to launching a data initiative, determine what data you plan to collect and exactly how you plan to use it.

4 Bridge technology and mission activities. Collaborate with program managers to understand how big data can enhance mission goals. Learn the most important questions to ask for fulfilling missions and use these results to guide analytics implementations.

5 Create an IT infrastructure that fully supports big data analytics. Consider features such as in-memory computing for a solid analytics foundation. The technology you implement will need to efficiently consolidate large volumes of data from multiple sources and aggregate information into a single database for significantly faster response times to queries. Your

infrastructure should be scalable as your data grows.

6 Focus on data quality. Regardless of quantity, inaccurate data is not reliable and can lead to poor decision-making — this makes data governance a crucial aspect of any data initiative. Examine internal governance policies and make governance tools a key criteria for evaluating analytics solutions.

7 Re-evaluate internal business processes. Examine existing business processes to identify and address bottlenecks so stakeholders can act quickly on new insights as they arise.

8 Tap into specialized expertise. Data scientists play increasingly important roles as experts who can bridge technical and business departments. Look to universities for potential new employees and professional development organizations for continuing education opportunities for existing staff.

9 Start small. Launch a pilot to determine which data and analytics processes work and don't work. Build on successes by rolling out analytics to additional stakeholders.

10 Stay nimble. Robust and nimble architectures, processes and philosophies are vital to avoiding building tomorrow's stovepipes today. Stay flexible and expect the unexpected. 🌐

Big data analytics has the potential to increase the operating margins of retailers by more than 60 percent. When applied effectively, states and localities can look forward to a similar impact in the future.

CONCLUSION

ACHIEVING RESULTS

Everybody has heard of Amazon and Google, two Internet companies that have achieved enormous success through the use of data analytics. The potential impact of big data and analytics on other sectors of the economy is no less dramatic. By one estimate, big data analytics has the potential to increase the operating margins of retailers by more than 60 percent and could reduce the nation's health care costs by 8 percent.⁵¹

States and localities are already seeing some significant benefits from analytics. For instance, California brought in an additional \$1 billion in tax revenue that had gone unreported. Georgia stopped more than \$30 million in tax fraud, while Miami-Dade County discovered more than \$5 million in unpaid property taxes. And the Los Angeles Police Department used predictive analytics to cut property crime by 12 percent.

By applying quantitative skills and understanding the right questions to ask, data analysts can find that proverbial needle in the haystack to solve problems and tackle some of the most intractable public policy challenges with which governments struggle. However, one of the primary challenges state and local government leaders face is getting their stakeholders to

understand the potential of big data and tying together siloed information to create valuable insights.

For state and local IT leaders, creating the right data fabric to bring together disparate databases inside and outside the enterprise will be the key. Some will do it internally. Others will bring in experts from the private sector to help. But all will need to find the talent and manage the projects properly to achieve success. A successful big data and analytics strategy is more than the sum of its parts. Done correctly, it can achieve transformative results.

Big data analytics is the new face of government modernization. The case studies presented here — even the nascent efforts — demonstrate that the savings are real and the opportunities are enormous.

It isn't about merely copying Chicago, Miami-Dade or California's Franchise Tax Board. Nor is it about waiting on Amazon or Google for the next innovation. It is about imagining the future of your organization and reimagining its capabilities through the use of data. Even a small project can help show the potential for governments to reinvent their processes around the smarter use of data. 🌐

BIG DATA AND ANALYTICS THOUGHT LEADERS

“You can begin to understand your client base by looking at the data sets and different transactions that occur as a citizen consumes public services.”

— John Punzak, Sr. National Sales Director,
State & Local Government/Education, Red Hat

“You need a champion to bring together multiple parties, because the greatest opportunities for data analytics lie in organizational collaboration.”

— Alan Ford, Director of Presales Consulting, Teradata
Government Systems, Teradata Corporation

“You have to start with a clear business case: What do you specifically want to solve?”

— Tony Encinias, Vice President – Public Sector Strategy, ViON

“What can we get software to do in the future that helps analyze the social interactions between police officers and citizens, not only in an after-the-fact perspective but in real time?”

— Jim Bueerman, President, Police Foundation

“Big data doesn’t have to be gigantic volumes of data. It can be important data that has been difficult to organize, manage, search and scan for trends and information that you can use to your advantage to help the community.”

— Richard Travis, SAP Solutions Architect, Lenovo

“You have a much better chance of driving change with good data and analytics. If you can see at a glance how much faster you are working or how much more is being accomplished, it’s hard to deny the power of technology.”

— Patricia Burke, Global Public Sector Strategist, OpenText

“We’re extending that work into analytics, which we describe as using data and the tools of data science to help departments get an edge in delivering their services more strategically and effectively.”

— Oliver Wise, Director, New Orleans Office of Performance and Accountability

“Big data is providing access to information that we just didn’t have access to before. We want to use it to make more informed choices with our resources.”

— Todd Muck, Deputy Executive Director, Transportation
Agency for Monterey County

“As more members of the public move their interaction with governments to an online format, the need to establish a strategy for managing big data has become critical. Access, performance, timeliness, increased mandates around retention and security together create a significant challenge that government technologists must immediately address.”

— Melanie Stevens, Director, State and Local Government and Education, Pure Storage

“We now have the tools to connect massive amounts of data in new ways to solve different problems.”

— Sherry Amos, Managing Director, Industry Strategy –
Education & Government, Workday

Uncovering Hidden Insights in the Public Sector Workforce



In government, a lot of time is spent analyzing data to improve citizen services. But agencies can reap similar efficiencies and operational gains when they harness data for better insight into their workforce. However, significant resources are needed to gather, organize and analyze data to achieve any actionable insights, making it easy to miss opportunities to implement effective change.

Workday Insight Applications harness the power of data analytics to provide agencies with the necessary tools to make quick, informed workforce and financial decisions. Using advanced data science and machine-learning algorithms, these applications provide insights, predictions and recommended actions in real time.

Because Workday Insight Applications are constantly learning, their intelligence grows over time. As the algorithms become smarter, the predictive outcomes and recommendations improve.

Data analytics help agencies uncover patterns in employee behavior, intervene before talent leaves, coordinate promotions and address unforeseen employee needs. The result is improved operational efficiency and a more productive workplace culture. And bridging the gap between human resources activities and finance department efforts by sharing data sets can lead to even greater results, including:

- ✓ **Accurate headcount for budgeting and planning**
- ✓ **Reduced costs and resources**
- ✓ **Competitive pay rates for attracting and retaining talent**
- ✓ **Optimized productivity**

Workforce data and analytics isn't just about numbers and charts — it's about people. Workday Insight Applications help governments uncover hidden insights, enabling real-time change.



To learn more, visit: www.workday.com/applications/insight_applications.php

SAFER, SMARTER, MORE ENGAGED GOVERNMENT

TERADATA HELPS state, local and federal government agencies get more value from data than any other company. Together, our big data analytic solutions, integrated marketing applications and team of experts help organizations leverage their data to gain greater, more meaningful insights into agency outcomes while optimizing service delivery and citizen engagement.

It's a new operating environment for government agencies. The rise of big data, a shift to smart mobile devices and a dramatic increase in cyberattacks is forcing organizations to rethink how they conduct business. From concerns around cybersecurity, fraud detection and emergency response to transportation analytics, census taking and health care initiatives, the demand for getting the right information to the right people at the right time is on the rise.

Now more than ever, that means choosing strategies and technologies to drive deeper insights and empower agencies to answer new questions so they can make smarter decisions to serve citizens more efficiently.

THE TERADATA UNIFIED DATA ARCHITECTURE™

Teradata solutions are based on the Teradata Unified Data Architecture™ — a suite of services, platforms, applications and tools that, together, are uniquely designed to unleash the

potential of data and help decision-makers achieve actionable insights. By applying the right technology to the right analytical opportunities, government agencies can effectively do more by knowing more. Our capabilities include:

- Integrated data warehouse
- Data discovery platform
- Data staging and archiving platform
- Integrated outreach and communications management platform

With more than three decades of successful implementations, we've incorporated our best practices into a patented, proven methodology. Our approach relies on integrated processes, customized tools and quantifiable metrics that demonstrate quality and value during each phase of the solution life cycle. Each project is planned and executed to maximize financial return by accelerating appropriate development cycles to decrease time to market.

With the right tools, government workers can properly collect, process and analyze information, so they can ask the right questions to better serve their constituents.

WHAT WOULD YOU DO IF YOU KNEW?™

TERADATA®

Find out how we can help your organization become safer, smarter and more engaged at www.teradata.com/government.

Turning Information into Answers



Regardless of size or populations served, governments amass large quantities of data every day. Leveraged successfully, this data has the potential to become a valuable asset for public agencies. In fact, 80 percent of government CIOs are actively advocating for data as a strategic asset.¹

To achieve better data-driven decision-making, government must pull data from disparate sources and turn it into actionable information. As a technology partner, Lenovo can help agencies manage the volume, variety and velocity of data they collect while breaking down data silos and transforming information into answers.

Lenovo's solutions, such as System x and Flex System for SAP® HANA®, enable state and local government decision-makers to instantly access, model and analyze data from virtually any data source in real time. Lenovo also provides a reliable, scalable, flexible foundation to manage increasing amounts of data.

With help from Lenovo, agencies can connect the dots among disparate data sources and unlock the value of their information to deliver insights faster.

Garner Valuable Insights Faster

Lenovo big data solutions provide:

- ✓ A scalable foundation that grows with your data needs
- ✓ Industry-leading transaction processing for better, faster business decisions
- ✓ High-throughput capacity for faster decision-making
- ✓ Optimized systems and validated reference architectures

1. *Lenovo Infographic, Anatomy of a Connected Government*

LAYING THE FOUNDATION FOR BIG DATA



Although it is large, unstructured and complex, big data plays a big role in state and local government decision-making. When agencies can effectively tap into big data, it helps them mitigate issues such as fraud and waste, increase operational efficiency and improve service delivery. However, big data is constantly evolving and growing, which requires a flexible, open infrastructure that allows governments to quickly deploy new solutions and unlock needed insights. Red Hat can help agencies access valuable data for quick decision-making by building a faster, stronger, more secure infrastructure.

Red Hat's solutions provide a foundation that integrates multiple data sources and can transition workloads across on-premises and cloud platforms. According to recent research, deploying technology for big data integration enables organizations to make information more available, meet analytical needs and increase the speed of integration.¹

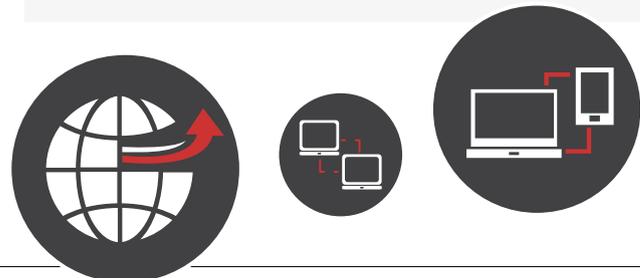
Unlike some proprietary vendors, Red Hat's solutions are cost effective and can be customized to meet the needs of individual agencies. Its open source model allows IT decision-makers to purchase the best infrastructure components for their needs, without purchasing unwanted technology that locks them into a single vendor solution.

1. www.redhat.com/en/files/resources/en-rhjb-ventana-research-infographic.pdf

Red Hat Helps Meet the Demands of Big Data

Red Hat's infrastructure solutions provide a wealth of benefits, which enable state and local government agencies to:

- Tap into unstructured data and discover new revenue-enhancing insights
- Rapidly deliver new big data capabilities and applications
- Choose what works best for their specific environment
- Scale cost effectively to meet changing demands
- Increase flexibility and speed with an open hybrid cloud environment
- Utilize existing infrastructure investments while supporting new workloads



Capture, Manage, Analyze: Making the Most of Video Data to Enhance Public Safety

Video surveillance and other cameras — and their digital video streams — are becoming an increasingly important tool for improving public safety and police and citizen accountability. They provide an incredibly rich source of data that public safety personnel can use to respond to incidents in real time and predict when and where crimes will occur. Digging deeper, this data can also be mined for officials to discover historical patterns and trends. However, it's increasingly difficult for public safety agencies to capture, manage and analyze this unprecedented amount of data — especially when it is streaming in from disparate sources.

Enter Hitachi Visualization (HV). An end-to-end solution built specifically for public safety, HV enables law enforcement and emergency responders to collaboratively address public safety issues by deriving actionable information from large video, audio and data files. By correlating siloed data and video systems geospatially, the solution enables decision-makers to assess situations in real time and improve response times.

With extensive experience in providing data center solutions — such as HV — to public safety customers, ViON understands the requirements needed to deploy an integrated solution for video and data analytics. As an industry expert, ViON can help public safety agencies make the most of their video data, helping to protect those who protect the public and improving the safety of communities.

The Highlights of Hitachi Visualization

HV offers multiple benefits to public safety agencies by:

- ▶ Integrating disparate systems, which enhances communication and improves response times
- ▶ Providing real-time information to law enforcement personnel by linking access control, video systems, call boxes and emergency notification systems
- ▶ Correlating meta-data from various files to make connections and predictively analyze video files



To learn more, visit: www.vion.com/publicsafety

HITACHI
Hitachi Data Systems

Flash Forward: A New Approach to Meeting Government Storage Needs

Despite improved efficiencies in other areas of the data center, storage has failed to keep up even though it's a key component to many data initiatives. To meet growing storage needs, governments often add more spinning disk, but this approach can increase costs, complexity and the data center footprint — with no guarantee of a similar increase in performance. The result is an outdated storage infrastructure that can hinder governments' ability to use data as a strategic asset to enhance application performance for constituents.

Introducing the Effectiveness of Flash

Flash can be a game-changer for governments. In fact, industry experts have described flash memory as the future of storage. In the past, an all-flash storage solution would have been too expensive to deploy across the data center, despite the network performance gains. However, when compared to disk, over a five-year period, the costs are comparable. Flash not only delivers better application performance, but it gets data into the hands of decision-makers faster.

The Pure Storage all-flash array takes these benefits one step further by offering simplicity. Pure Storage eliminates the need

Pure Storage provides the underlying technology that enables agencies to use data to drive decision-making and impact citizen services.

for costly and labor-intensive forklift replacements, allowing IT departments to focus on more strategic data initiatives that benefit the public. In addition, the Pure Storage flat maintenance plan — which allows governments to upgrade hardware and software every three years — keeps storage infrastructure modern and ready for the next data-driven project.

Pure Storage provides state and local governments with a simple and affordable storage solution that improves application performance and brings actionable insight to government leaders.



Recently named a leader in **Gartner's 2015 Solid State Array Magic Quadrant**¹ for the second consecutive year, you can learn more about Pure Storage at www.purestorage.com.

1. <http://info.purestorage.com/2015-Gartner-MQ-Request.html>

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ACKNOWLEDGMENTS



Tod Newcombe

With more than 20 years of experience covering state and local government, Tod previously was the editor of *Public CIO*, e.Republic's award-winning publication for information technology executives in the public sector. He is now a senior editor for *Government Technology* and writes the "Tech Talk" column for *Governing*. Tod is also the author of several books on information management.

With contributions by:

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