Dallas, USA
Smarter Cities Challenge report

Contents

1. Executive summary

Introduction

The City of Dallas, Texas, was selected through a competitive process as one of 16 cities to be awarded a Smarter Cities Challenge® grant in 2014. During a three-week period in February 2015, a team of seven IBM experts worked in Dallas to deliver recommendations around key issues for Mayor Mike Rawlings, City Manager A.C. Gonzalez and their team: David Brown, Chief of Police, Dallas Police Department; Bill Finch, Chief Information Officer; and Cornell Perry, Senior IT Portfolio Manager Public Safety for the City of Dallas.

As the ninth-largest city in the US, Dallas is rightly proud of its recent achievements in crime reduction and economic growth. But chronic issues of poverty and urban blight remain, and in affected neighborhoods, the City is determined to address related public safety issues. The Mayor, City Manager, Chief of Police and head of Communication and Information Services (CIS) all believe that data and technology can play a key role in resolving these chronic issues and so asked IBM to investigate.

The challenge

The City of Dallas faces the challenge of creating a comprehensive public safety management database that is flexible, scalable and intraoperationally usable across departments. The City maintains an overload of data, compiled in separate databases, which tracks crime statistics and code enforcement issues, fire-related incidences and emergency management operations. Though the data is useful within individual departments, the data sets don't "talk" to one another or connect departments. The City would like help in creating better links.

The City asked the IBM Smarter Cities Challenge team to address the following challenge statement:

How can the City of Dallas and its citizens best exploit the multiple data stores they own and to which they have access? How can they use the latest-available technologies to derive insights from this data — and to share and publish information — in order to make the city a safer, more pleasant environment for all its inhabitants?

Findings and recommendations

The team met with more than 80 City staffers, community leaders and other public officials. It identified the following:

1. **Data and insights are trapped inside of isolated and disparate databases.** For a given task requiring data, users retrieve information serially from the limited databases to which they have access. Calling on other users is key to getting additional information needed. The overall effectiveness and inefficiency of this ad hoc process correlates directly to the current state database structure.

2. **Users have a poor experience getting data needed for specific tasks.** City employees and citizens expressed frustration, lost time and lack of awareness of where data exists and how they interact with and use technology. This is a critical area for improvement.

3. **A "protective" culture exists when it comes to sharing data with others.** Domain owners within each department typically build datasets and information for their respective area. Legitimate fear of litigation and concern over privacy are major barriers to free and open sharing of information. Sharing does occur when requests are made, but this remains a challenge and an area for improvement.

4. **Trust and perception can continue to be improved between the City, neighborhood associations and citizens.** One measure of this need is how DPD engages with communities outside of crime incidents. While DPD has a very strong emphasis and programs in this area, there is still a perception that more can be done in revealing more data about Dallas services and crime through the open data portal.

5. **Initiation of and support for citywide IT projects is challenging.** That said, the City has made great strides with a disciplined IT governance process that does support the business technology requirements set forth by departments. This governance has eliminated redundancy and helped to see common requirements across departments.

The Smarter Cities Challenge team recommends a new approach to data management with three main components as listed below:

1. Organize, consolidate and govern data
CIS is already conducting a big data study, which should lay the foundation for a "data lake" that consolidates the City's reporting data. Comprehensive access controls will be needed to achieve the right balance between making data available and ensuring that individuals' right to privacy is protected.

2. Create query and analytics capability
This integrated capability should span both City-owned data sources and data sets owned by Dallas County, the State of Texas and other related agencies. The objective is to deliver relevant data to users, irrespective of source or ownership.

3. Improve user experience
The City should introduce a new focus on user experience, concentrating on key roles and their use of data. It should master the discipline of user-centered design and appoint user champions as part of CIS. It is particularly important that a user champion for external users (communities and citizens) is appointed.

Conclusion
Better and easier access to data could open up huge new opportunities for analysis by users, as well as insights that are derived by, and shared with, citizens. Besides the obvious direct benefits from data analysis, the underlying objective is to grow the engagement of the community and rebuild trust in the City — both key enablers for improving public safety. This vision for data management is ambitious but can be tackled in steps.

Highlights
- The City of Dallas has a wealth of data, which it must consolidate and organize more effectively
- Consolidating data into a central "data lake" will enable the City to build advanced search and analytic tools that allow users faster access to the data they seek
- The City needs a major new focus on user experience to improve the effectiveness of City departments and to build the trust of citizens

2. Introduction

A. The Smarter Cities Challenge

By 2050, cities will be home to more than two-thirds of the world's population. They already wield more economic power and have access to more advanced technological capabilities than ever before. Simultaneously, cities are struggling with a wide range of challenges and threats to sustainability in their core support and governance systems, including transport, water, energy, communications, healthcare and social services.

Meanwhile, trillions of digital devices, connected through the Internet, are producing a vast ocean of data. All of this information — from the flow of markets to the pulse of societies — can be turned into knowledge because we now have the computational power and advanced analytics to make sense of it. With this knowledge, cities could reduce costs, cut waste and improve efficiency, productivity and quality of life for their citizens. In the face of the mammoth challenges of economic crisis and increased demand for services, ample opportunities still exist for the development of innovative solutions.
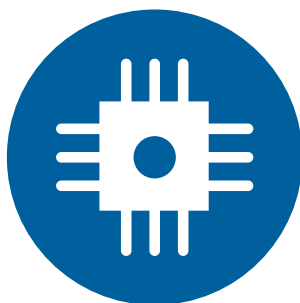
In November 2008, IBM initiated a discussion on how the planet is becoming "smarter." By this it meant that intelligence is becoming infused into the systems and processes that make the world work – into things no one would recognize as computers: cars, appliances, roadways, power grids, clothes and even natural systems, such as agriculture and waterways. By creating more instrumented, interconnected and intelligent systems, citizens and policymakers can harvest new trends and insights from data, providing the basis for more-informed decisions.

A Smarter City uses technology to transform its core systems and optimize finite resources. Because cities grapple on a daily basis with the interaction of water, transportation, energy, public safety and many other systems, IBM is committed to a vision of Smarter Cities® as a vital component of building a Smarter Planet®. At the highest levels of maturity, a Smarter City is a knowledge-based system that provides real-time insights to stakeholders and enables decision makers to manage the city's subsystems proactively. Effective information management is at the heart of this capability, and integration and analytics are the key enablers.

Intelligence is being infused into the way the world works.

The IBM Smarter Cities Challenge contributes the skills and expertise of top IBM talent to address the critical challenges facing cities around the world. It does this by putting teams on the ground for three weeks to work closely with City leaders and deliver recommendations on how to make the city smarter and more effective. Over the past five years, more than 100 cities have been selected to receive grants. The Smarter Cities Challenge is IBM's largest philanthropic initiative, with contributions valued at more than $50 million to date.

The City of Dallas, Texas, was selected through a competitive process as one of 16 cities to be awarded a Smarter Cities Challenge grant in 2014. During a three-week period in February 2015, a team of seven IBM experts worked in Dallas to deliver recommendations around key issues for Mayor Mike Rawlings, City Manager A.C. Gonzalez and their team: David Brown, Chief of Police, Dallas Police Department; Bill Finch, Chief Information Officer; and Cornell Perry, Senior IT Portfolio Manager Public Safety for the City of Dallas.

Instrumented
We can measure, sense and see the condition of practically everything.

Interconnected
People, systems and objects can communicate and interact with one another in entirely new ways.

Intelligent
We can analyze and derive insight from large and diverse sources of information to predict and respond better to change.

Figure 1: Instrumented, interconnected, intelligent

B. The challenge

Dallas has significant opportunity for economic development and growth, but it must first address a number of challenges.

City leadership has a key agenda to improve public safety to make all parts of the city more attractive and prosperous. Its top priority is to establish effective communities that can lead the transformation of their own neighborhoods. The City believes strongly that this depends not only on effective policing but also on strong, empowered communities that have excellent relations with the police and other City authorities.

Data and technology are key to this initiative. Previous attempts to create a safer environment have been hampered by the City's inability to coordinate and share data in support of the services it provides. Over many years, individual applications and technology have evolved independently. At the City, county and state levels, application and data silos have matured and become increasingly isolated and protected by department owners. In parallel, there is constant pressure to increase efficiency and reduce costs.

The City recognizes economic and quality-of-life disparities across Dallas. It has partnered proactively with community groups, including Safer Dallas and Economic Partners Investing in the Community (EPIC), to fund upgrades, such as camera installations in Targeted Action Area Grids (TAAGs), and special taskforces that helped to abate some crime trends.

But the City remains unable to pull data into one synthesized view for predictive planning or prevention in high-crime areas, and efforts are duplicated across departments that should be working together.

A comprehensive public safety management "data lake" could provide more political capital across City and community stakeholders. It could help the City to reach budget and organizational consensus on better-connected methods to fight crime and improve quality of life in challenged areas.

External stakeholders include more than 1,100 neighborhood Crime Watches that function as "eyes on the street." Additionally, the City partners with Dallas County, the Dallas Independent School District, Safer Dallas, Texas State Senator Royce West and US Representative Eddie Bernice Johnson. Crime reduction, nuisance abatement and educational partnerships abound across all 27 TAAG areas and serve to bridge the gap in services provided by the City and other governmental entities.

The City engages citizen participation in its day-to-day operations, from service on its City Council and Commissions to the encouragement of citizen activism in public safety, recreation and other livability measures.

The City believes that this type of interaction would feed well into the DPD's current 10-70-20 approach to community engagement. Under this approach, the DPD and its partner entities understand that 10% of the population in high-crime areas accounts for 70% of the crime, while 20% of the community actively engages in crime-reduction efforts.

The City asked the Smarter Cities Challenge team to address the following challenge statement:

How can the City of Dallas and its citizens best exploit the multiple data stores they own and to which they have access? How can they use the latest-available technologies to derive insights from this data — and to share and publish information — in order to make the city a safer, more pleasant environment for all its inhabitants?

The City identified the following focus areas for the challenge:
• Bridge the "trust gap" between citizens and authorities
• Make policing, fire and rescue services more effective
• Target investments for the benefit of neighborhoods
• Give citizens the information they need to improve their neighborhoods

The Smarter Cities Challenge team interviewed more than 80 stakeholders from diverse backgrounds, including City employees, citizens and representatives of other public bodies. See Appendix A for a full list.

3. Context, findings and roadmap

A. Context

Theme 1: Current state of data and information

While the City has made progress, significant challenges remain in achieving its vision for unified and integrated data. The overarching problem is the proliferation of isolated data whose owners are protective of how it is to be used and by whom.

The team discovered the following:

- There is no comprehensive understanding of where data exists across the City. Some departments are carrying out analysis on data to enrich it and gain new insights, but the results are rarely shared.
- The new records management system (RMS) is viewed as a better solution for the long term — but its first deployment and implementation is perceived as cumbersome, slow performing and having less information than the previous system.
- DPD's Fusion Center uses an estimated 25 - 30 databases. Performance is highly variable across all these systems. Access to each is managed individually.
- The Fusion Center is the "Swiss army knife" of crime investigations. Key to analysis is associating how people are connected to key individuals. This is a critical service in support of department users.
- Departmental data is not shared and is territorial, largely because of concern for legal action around misuse or unintended release of information.
- There is a need for better interfaces to enable detectives (and the public) to get information and not burden analysts/the Fusion Center.
- Citizen organizations want a better understanding of how and where crime is happening in their neighborhoods; they are frustrated with data access.

Theme 2: Optimizing workflow and interactions with applications for various City roles

The City is home to a broad range of departments and roles. Each has unique tasks and responsibilities. Examples include DPD Patrol Officer, Fire Officer, Office of Emergency Management (OEM), Detective, Code Officer and City Planner. Each position finds and uses data. Some require maximum speed as they do this, such as a patrol officer responding to a 911 call. Others are less time-sensitive, such as a code officer looking at property compliance or a detective looking at relationships connected to a cyber crime. Whatever the scenario, data is a critical enabler to getting work done efficiently.

While the City employs very high-performing and well-trained individuals who bring experience and capability to their roles, there is significant opportunity to improve how work is done through the engagement and use of technology.

The team discovered the following:

- Deriving data relationships in real time is problematic for patrol officers, who need to access different databases and "cut and paste" while driving to incident locations.
- Police patrol officers' ability to get information is highly dependent on the skill and experience of the officer and the use of in-car technology.
- Criminal assault investigations require the collection of video from businesses or citizens (via smartphones). Collection and analysis of video on different media and system types is time-consuming and not streamlined.
- In a fire, the provision of key information could make the fire patrol's task much safer and more effective. This includes the structure's known electrical systems, water control and more, as well as any historical data on code violations or previous crimes.

Theme 3: Community engagement and empowering the citizens of Dallas

Making a difference in neighborhoods is a key objective and vision for City leaders and is clearly on the agenda of work being done today. Examples include such innovative programs as Chief on the Beat[1] and the deployment of Neighborhood Police Officers (NPOs). Engaging the public and having people see officers in non-crime situations helps build trust in the community and forms a "community policing" approach, ultimately improving public safety.

Key to these efforts is empowered and passionate citizens who champion change. If the City can increase community engagement through efficient access to data, citizens will bring innovation and ingenuity to the benefit of all.

The team discovered the following:
- Communication plays a vital role in ensuring community engagement. However, there remain significant gaps in methods that need to be addressed.
- Community crime-watch organizations want crime data in a more granular format. Missing information, which now is restricted and not released, is causing frustration and mistrust.
- Chronic quality-of-life issues must be addressed. Once crime is established in a neighborhood, a cycle develops that impacts the entire community for generations.
- Code enforcement issues centered on tracking home ownership would address dilapidated property, crime houses and more.
- Deploying more police officers in crime-ridden areas is an effective strategy for diminishing and preventing future crime.
- Libraries are important information centers for low-income communities, offering access to a broader range of data, education and job training, which in turn adds value to the community.

Theme 4: Information technology and solutions

Communication and Information Services (CIS) and City leaders recognize that applying technology to business problems is a key enabler for improving public safety. CIS has made significant strides to get more work done, be more efficient and bring new innovation to the departments it serves.

Central to CIS's governance is an established process for Business Technology Requests (BTRs). BTRs are vetted and brought forward for consideration annually. New project proposals are created in direct response to the requirements of each department. This is a very strong approach that ensures technology investments are linked to the high-priority needs of City departments. Cross-department or enterprise-wide solutions have had increasing importance in past years but are challenging to champion and fund, given that the majority of CIS funding is required for current operations.

The City must look at the ways scarce new investment dollars are utilized and ensure the ongoing currency and support of technology solutions are maintained. With the current "buy" approach, IT service providers take on the burden of maintenance and staying current.

The team discovered that CIS has built a "my inspector" application in-house to meet specific requirements. The department is now exploring the possibility of selling this application so that it does not have to maintain it.

Theme 5: Organization and culture

The City is collecting data effectively but is not using it to maximum advantage. This is especially significant given the low ratio of officers to citizens. For example, while technology can never replace police officers on patrol, it can make those officers and other City staff more effective, efficient and productive. Organizational silos currently prevent data from being shared effectively.

The team discovered the following:
- Data sharing is limited to a "need-to-know" process between departments.
- There are limited insights from siloed data.
- Insights gleaned from department data are not shared with others in an organized way.
- Sharing of data with communities and external sources is driven by legal enforcement and not an organized, proactive process.
- There is a lack of clear ownership around enhancing user experience with systems and data.
- A decentralized thought process around application acquisition limits the use of analytics applications for valuable insights.

B. Findings

After careful consideration of stakeholder interviews and other information gathered, the Smarter Cities Challenge team identified five key findings. The team looked at the total information from two perspectives: data (how data is used to do the work of each department) and safety (how could better use of this data improve public safety).

The findings are as follows:

1. **Data and insights are trapped inside of isolated and disparate databases.** For a given task requiring data, users retrieve information serially from the limited databases to which they have access. Calling on other users is key to getting additional information needed. The overall effectiveness and inefficiency of this ad hoc process correlates directly to the current database structure.

2. **Users have a poor experience getting data needed for specific tasks.** City employees and citizens expressed frustration, lost time and lack of awareness of where data exists and how they interact with and use technology. This is a critical area for improvement.

3. **A "protective" culture exists when it comes to sharing data with others.** Domain owners within each department typically build datasets and information for their respective area. Legitimate fear of litigation and concern over privacy are major barriers to free and open sharing of information. Sharing does occur when requests are made, but this remains a challenge and an area for improvement.

4. **Trust and perception can continue to be improved between the City, neighborhood associations and citizens.** One measure of this need is how DPD engages with communities outside of crime incidents. While DPD has a very strong emphasis and programs in this area, there is still a perception that more can be done in revealing more data about Dallas services and crime through the open data portal.

5. **Initiation of and support for citywide IT projects is challenging.** That said, the City has made great strides with a disciplined IT governance process that does support the business technology requirements set forth by departments. This governance has eliminated redundancy and helped to see common requirements across departments.

C. Roadmap

The recommendations are described in detail in the next section.
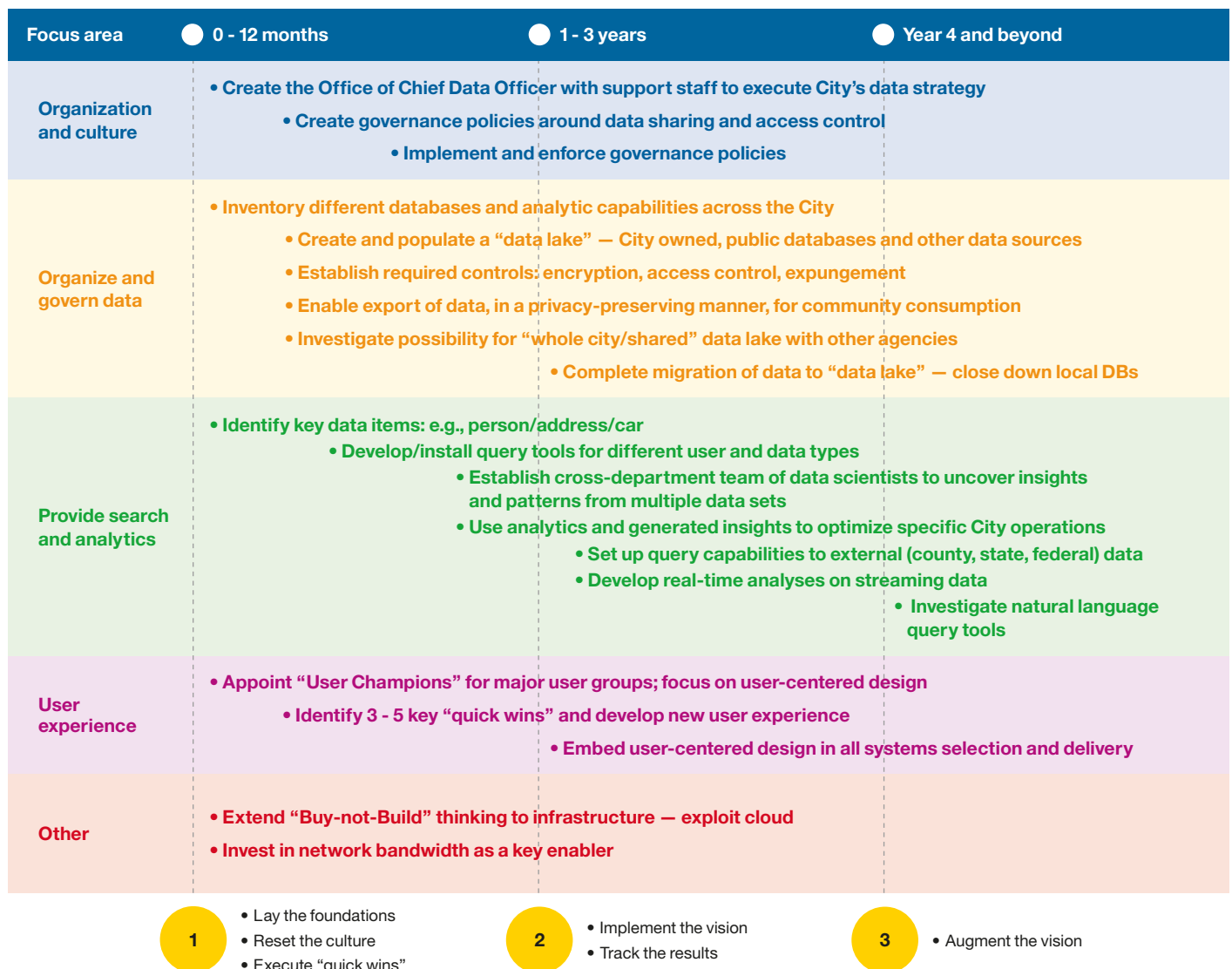However, the summary below sets out a possible phasing for implementation.

Focus area	⬤ 0 - 12 months	⬤ 1 - 3 years	⬤ Year 4 and beyond
Organization and culture	• Create the Office of Chief Data Officer with support staff to execute City's data strategy • Create governance policies around data sharing and access control • Implement and enforce governance policies		
Organize and govern data	• Inventory different databases and analytic capabilities across the City • Create and populate a "data lake" — City owned, public databases and other data sources • Establish required controls: encryption, access control, expungement • Enable export of data, in a privacy-preserving manner, for community consumption • Investigate possibility for "whole city/shared" data lake with other agencies • Complete migration of data to "data lake" — close down local DBs		
Provide search and analytics	• Identify key data items: e.g., person/address/car • Develop/install query tools for different user and data types • Establish cross-department team of data scientists to uncover insights and patterns from multiple data sets • Use analytics and generated insights to optimize specific City operations • Set up query capabilities to external (county, state, federal) data • Develop real-time analyses on streaming data • Investigate natural language query tools		
User experience	• Appoint "User Champions" for major user groups; focus on user-centered design • Identify 3 - 5 key "quick wins" and develop new user experience • Embed user-centered design in all systems selection and delivery		
Other	• Extend "Buy-not-Build" thinking to infrastructure — exploit cloud • Invest in network bandwidth as a key enabler		

1 • Lay the foundations
• Reset the culture
• Execute "quick wins"

2 • Implement the vision
• Track the results

3 • Augment the vision

Figure 2: Summary of recommendations

4. Recommendations

Recommendation 1: Organize, consolidate and govern data

A major challenge faced by the City is the diverse variety of databases, holding different kinds of data, that are spread across different departments. A significant headache is that each database and data source has its own set of nuances around who owns it, who can access it, what the format of the data is and how it can be accessed. The figure below illustrates some of the various data sources within and outside the City.
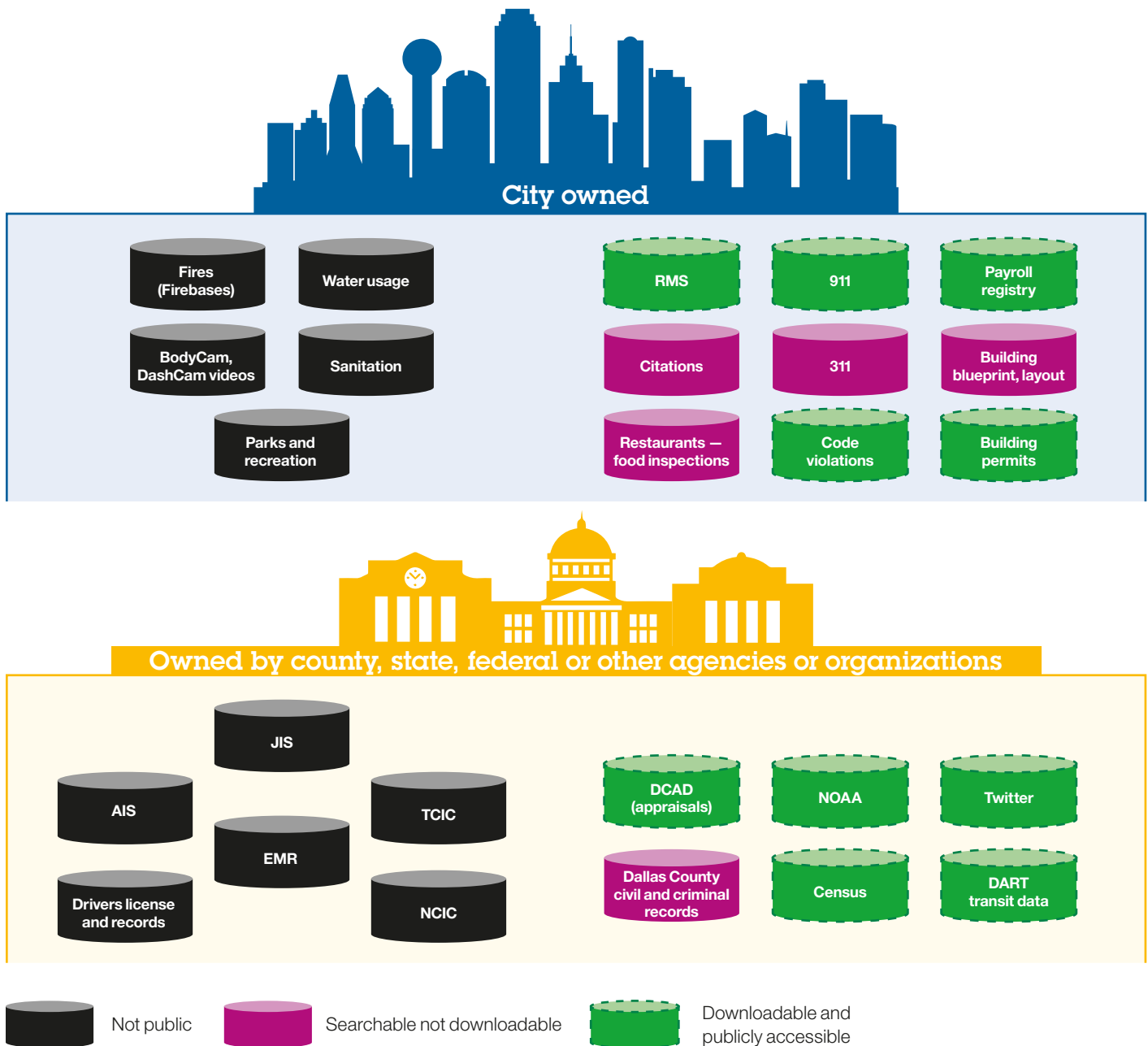

City owned

Fires (Firebases)	Water usage	RMS	911	Payroll registry
BodyCam, DashCam videos	Sanitation	Citations	311	Building blueprint, layout
Parks and recreation		Restaurants — food inspections	Code violations	Building permits

Owned by county, state, federal or other agencies or organizations

JIS

AIS · EMR · TCIC

Drivers license and records · NCIC

DCAD (appraisals) · NOAA · Twitter

Dallas County civil and criminal records · Census · DART transit data

Not public   Searchable not downloadable   Downloadable and publicly accessible

Figure 3: Data sources within and outside the City

The City should implement a "data lake," a storage repository into which data from disparate sources can be consolidated in a scalable and continuous fashion. The principle behind a data lake is that multiple datasets can be gathered quickly, with relatively few constraints in terms of consistency or format. This reduces the cost of data ingestion compared to more-structured databases, in which often big-data modeling and transformation need to happen before the data is ingested.
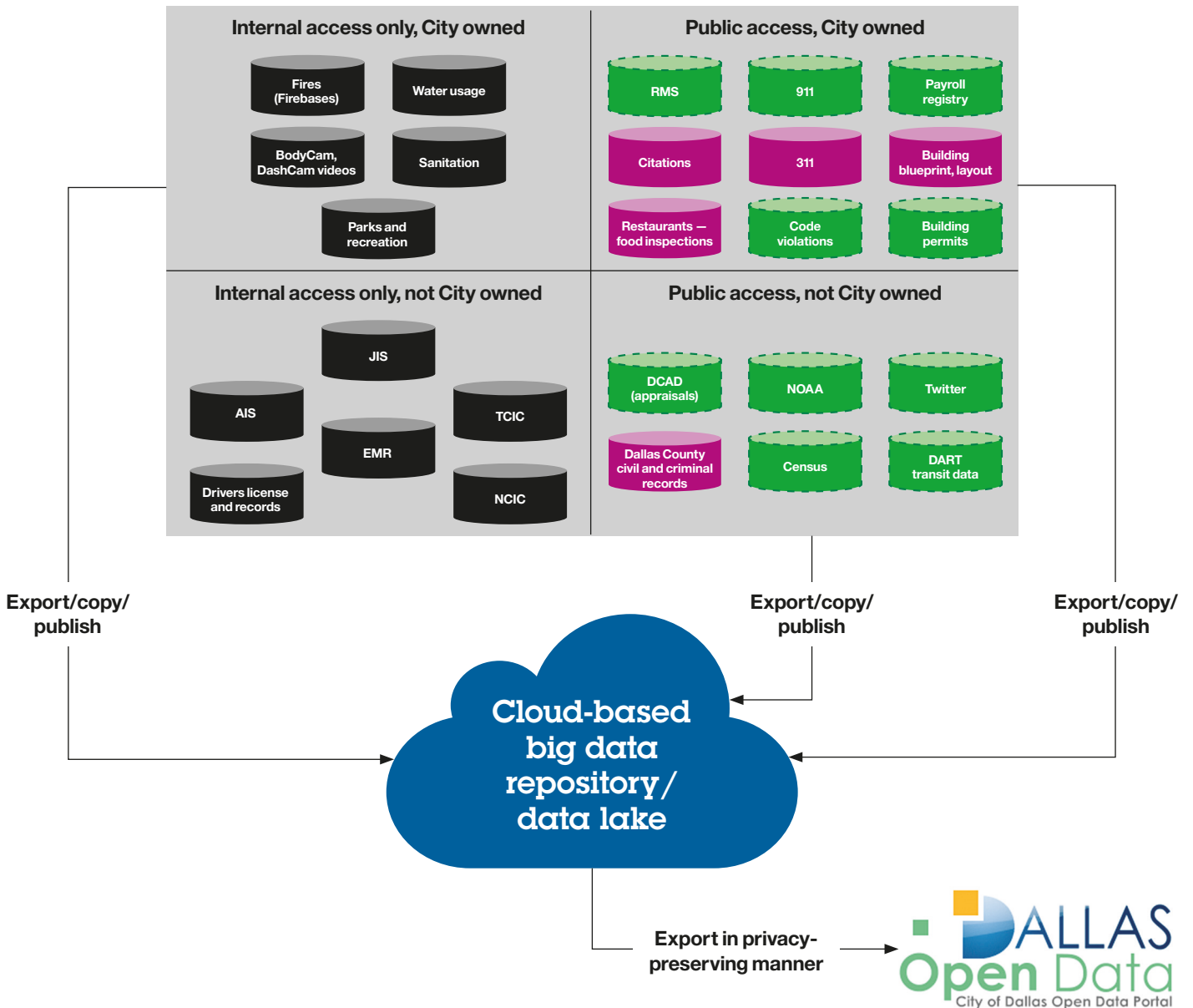

Figure 4: A data lake

Once data is ingested into the lake, it can be organized in different ways by different users. The data lake gives different users the flexibility to manipulate and analyze data according to their needs. It allows agile and rapid access to all kinds of data.

A common platform for implementing a data lake is Apache Hadoop, which is a popular big data platform. Its storage costs are often one-tenth the costs of a data warehouse.

The IBM team recommends that the City implement the lake on a cloud to give the additional advantages of elasticity, availability and cost.

The data lake can be the source of information available to a public data portal, through which citizens can access data and then conduct their own analyses. Data can be exported in a privacy-preserving manner using various masking and anonymization technologies.

It is key that the data lake be governed and secured. More specifically, the lake should have the following features:
- Security, in terms of user authentication and data encryption.
- Access control, meaning users can only read and write the data for which they have permission to use.
- Privacy, meaning all relevant regulations, like Health Insurance Portability and Accountability Act (HIPAA) and Payment Card Industry (PCI), are followed, and any data exposed to users is masked appropriately.

While this recommendation is focused very much on technology, the organizational and cultural implications are equally important and are described in more detail in Appendix E.

Recommendation 1: Organize, consolidate and govern data

The City should create a big data repository, or "data lake," where all relevant and useful data is consolidated and organized. The City can then institute methods for sharing, managing and governing this data.

Scope and expected outcomes

A data lake will make City data available quickly, reliably and accurately. It will help all involved in public safety work more effectively, and it will grow the trust and confidence of citizens.

Scope
The City should take the following steps to create the data lake:

Technological:
1. Identify and catalog data sources
2. Categorize these sources along the following dimensions: publicly accessible versus restricted access; free versus charged; searchable versus non-searchable; available for bulk download versus searchable for individual entries only (City, county, state, federal, private)
3. Identify data sources that can be pulled into the data lake and establish processes for exporting and updating it, including all data sources owned by the City as well as any public data, such as National Oceanic and Atmospheric Administration (NOAA) and Dallas Area Rapid Transit (DART) data
4. Establish minimum common standards for formatting the data, such as date-time format and number format
5. Install and set up the data lake
6. Decide on common authentication, access control and masking technologies
7. Start populating the lake

Cultural:
1. Change the culture of various departments from "need to know" to "duty to share"
2. Promote a collaborative environment in which multiple users, inside and outside the City, can interact with the data in terms of providing it, giving feedback on it and correcting it

Organizational:
1. Establish the position of a Chief Data Officer (reporting to the Chief Information Officer), in charge of initiating and managing the data lake and of infusing rigor into all aspects of the City's data management operations
2. Establish a governance council with representation from various departments, including the City Attorney's Office, to decide on processes and regulations around sharing data

Expected outcomes
The City will get a single place where a wide variety of data is available. This will greatly simplify access to critical information, both for City employees and the public.

Cost of inaction
The continued existence of silos will lead to continued deterioration of citizens' trust and continued frustration on the part of City employees as they stumble through fractured City data.

Recommendation 1: Organize, consolidate and govern data (continued)

Proposed owner and stakeholders	Suggested resources needed
Owner: Chief Data Officer **Stakeholders:** CIS, all City departments, City Manager, Mayor and the community	People, technology or funding needed: • Chief Data Officer and two data engineers to kick off data lake • Big data platform and associated tools for security, development and visualization • $500,000 funding **Cost estimate:** Medium initial cost, with low continuous costs (once data becomes a utility)
Dependencies	**Key milestones, activities and timeframe**
• Identification of use-cases on big data • Selection of vendor for the big data solution request for proposal	**Short term:** • Culture change and organizational change • Cataloging data and initial population of data lake with five most important data sources **Medium term:** • Establish standards and set up security **Long term:** • Open to wide array of users and departments

Priority

High

Recommendation 2: Create query and analytics capability

Once an initial set of data is in the lake, the next step is to provide mechanisms to query and analyze the data. Queries allow users to obtain the most relevant data quickly.

The City should establish a single interface or portal for querying all available data sets, both those in the data lake and data owned by county, state, federal and other agencies. The query interface should present a unified and integrated view that hides the details of individual datasets. The query capability would be as listed below:

- **Federated:** It goes against multiple data repositories, both those managed by the City in the data lake and those owned by other parties.
- **Work on both structured and unstructured data:** It can return results from structured sources, like databases, as well as unstructured sources containing text, documents, images and videos.
- **Works on both real-time and historical data.**
- **Enforces access-control and privacy regulations:** Only exposes results based on the credentials of the user and masks appropriately the results, based on the user making the results.

All users should be able to perform various kinds of analytics on the data to uncover insights, such as the following:

- **Descriptive:** Provide consolidated and summarized information on the current or historical state of a part of the city, such as what crimes have occurred or are occurring
- **Predictive:** Suggest what will happen in the near or distant future or detect patterns, trends or anomalies in the data — for example, when and where are crimes most likely to occur in this neighborhood in the next seven days?
- **Prescriptive:** Offer recommendations on actions to optimize certain outcomes, such as how police patrol officers can be positioned optimally to reduce the occurrence of crime

Another way of grouping analytics is by the timeliness of the insights and the freshness of the data used, as in one of the following ways:

- Real-time analytics, using the most current, often streaming, data to produce insights as soon as possible
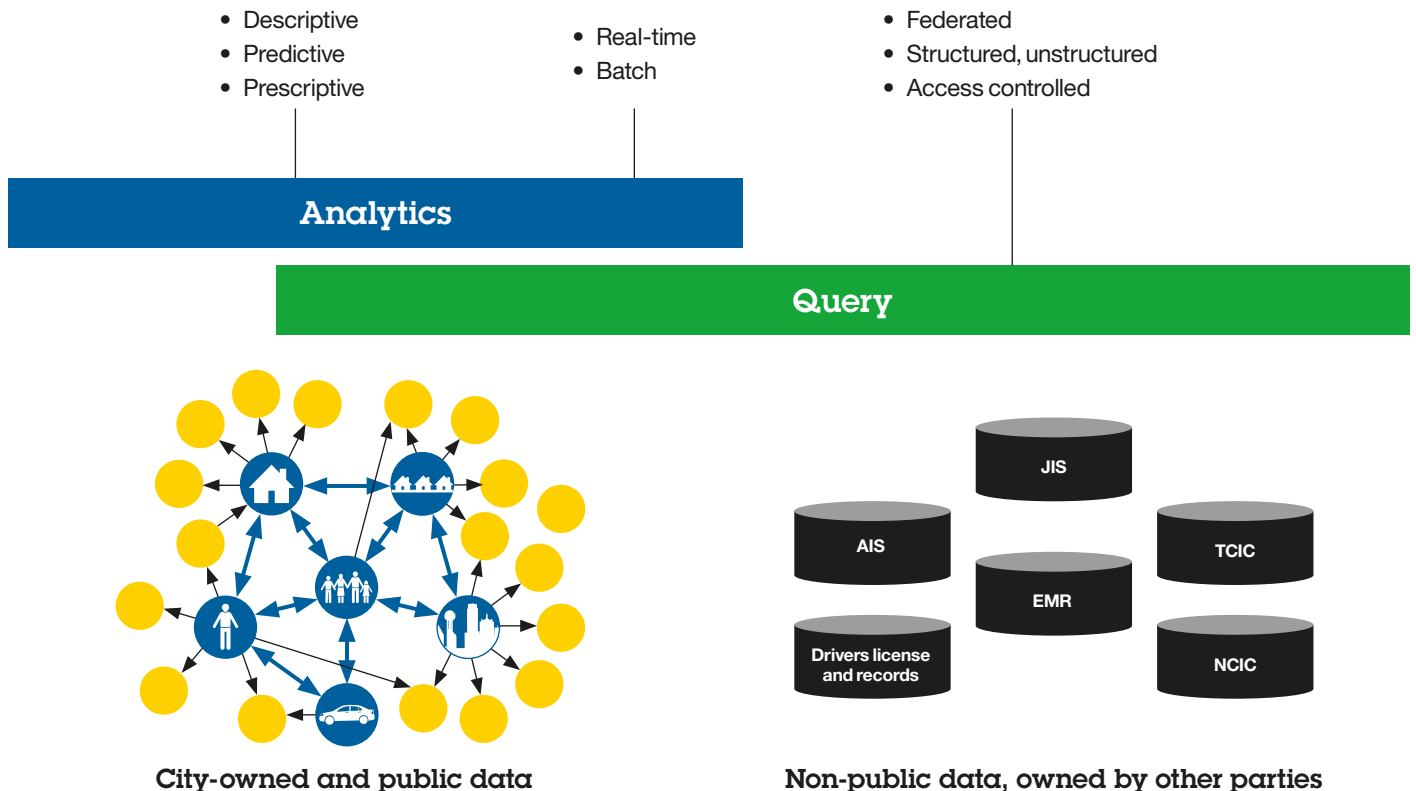- Batch analytics, using large volumes of historical data to come up with long-term insights.

- Descriptive
- Predictive
- Prescriptive

- Real-time
- Batch

- Federated
- Structured, unstructured
- Access controlled

Analytics

Query

City-owned and public data

Non-public data, owned by other parties

Figure 5: Data lake query and analytics capabilities

Data integration

The first step to providing an integrated query and analytics capability is to organize and integrate the data in the lake around key entities. These entities may be people, families, addresses, neighborhoods, buildings, vehicles and more. The goal is to allow users to perform queries and get information about these entities in a simple and consistent fashion, rather than worry about which data sources specifically contain the needed information. For example, a user should be able to query for all information about a person or address rather than individually access multiple datasets, like RMS, census, Texas Department of Motor Vehicles (TxDMV), National Crime Information Center, Texas Crime Information Center, Adult Information System (AIS), Juvenile Information System (JIS), citations or Twitter.

The City could do this in one of multiple ways. One popular mechanism is to create views of multiple data sets integrated by a common key (or by several keys). For example, the citation and the RMS databases may be integrated by person's name and date of birth. These consolidated views of people and other entities can form the basis of all queries and analyses around these entities.

Often, a necessary precursor to building the consolidated views is identity (or entity) resolution. That is, there is a need to determine that two "entities" are actually the same based on various factors. For example, the system would need to determine that "John Smith" in the citation records and "J. Smith" in the RMS database are actually the same person based on name, address or other factors.

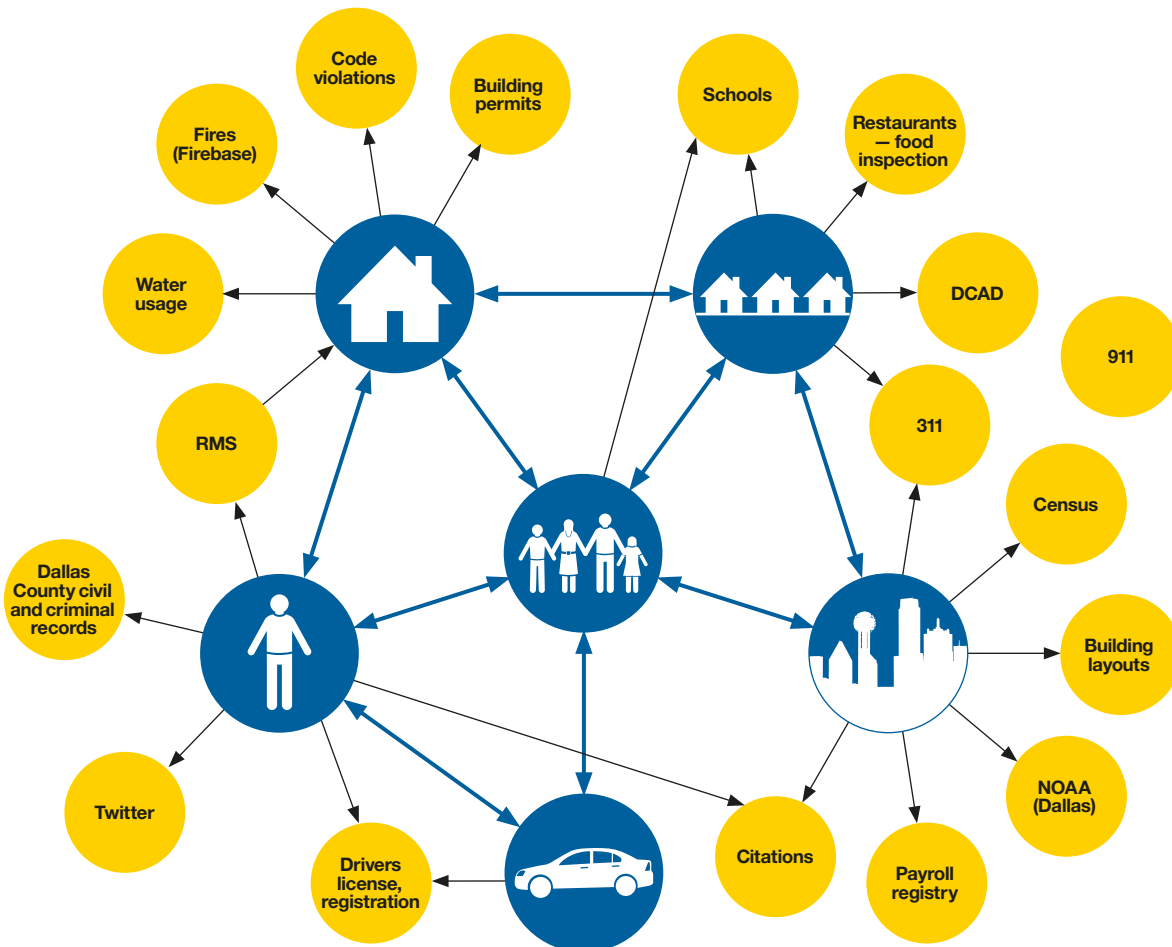Figure 6 shows a schematic for how data in the lake can be organized and integrated around key entity types.

Figure 6: Schematic for organizing data around key entities

Technical architecture

A comprehensive query and analytics capability can be achieved through a complete big data architecture, including the following components:

- Real-time processing and analytics
- Data lake
- Reporting and dashboarding system
- Query and search system
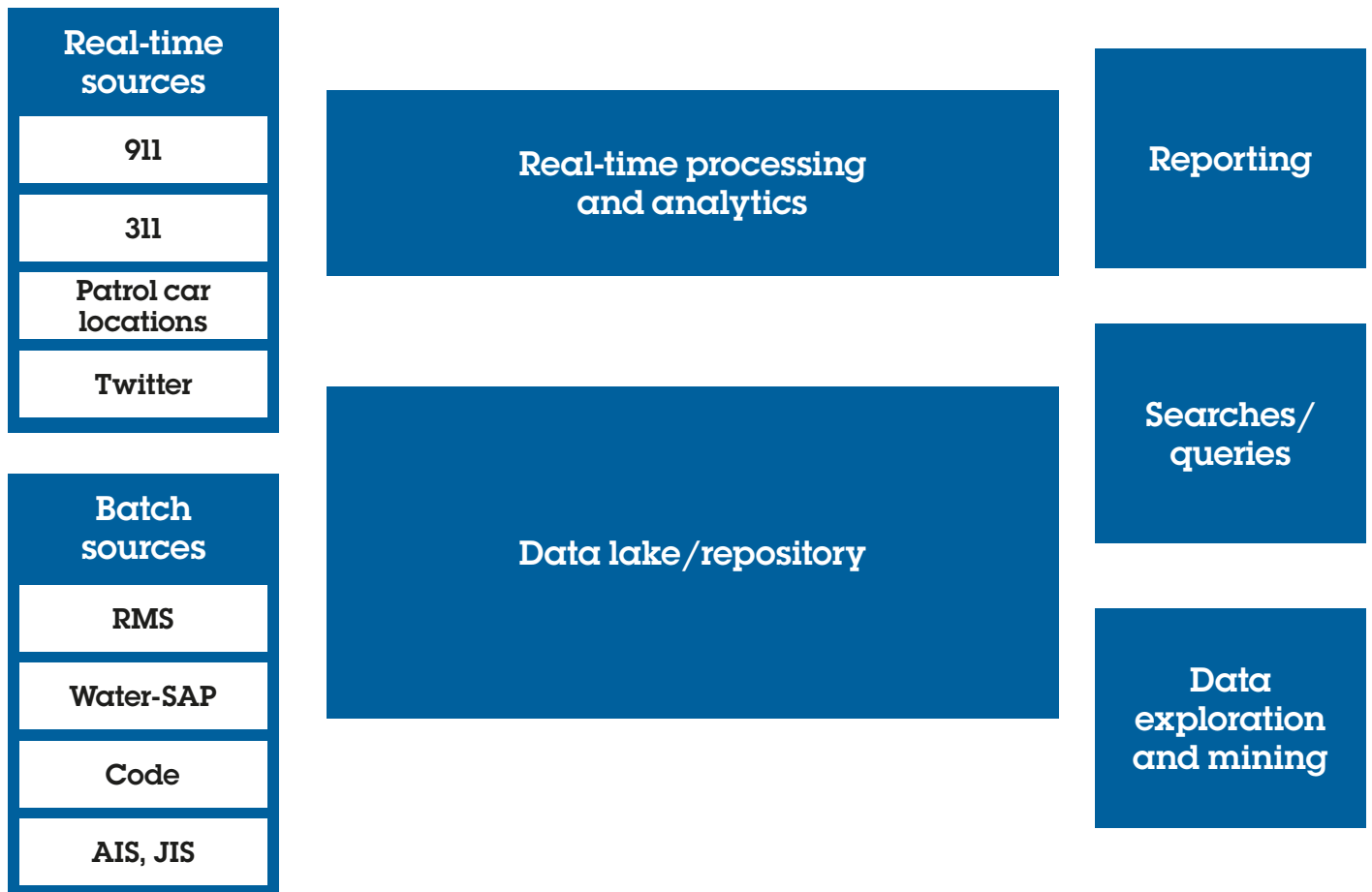- Data exploration and data mining systems

Real-time sources

911

311

Patrol car locations

Twitter

Batch sources

RMS

Water-SAP

Code

AIS, JIS

Real-time processing and analytics

Data lake/repository

Reporting

Searches/queries

Data exploration and mining

Figure 7: Illustration of efficiency within a data lake

Real-time processing

Real-time processing is possible with a stream processing system that can rapidly ingest streaming data, such as 911 calls, 311 requests, patrol car locations and Twitter data, as soon as it is available and generate real-time insights. This capability is especially useful for emergency scenarios in which time is of the essence. For example, this component would ingest 911 call data and perform different kinds of real-time processing and analytics in the following way:

- **Descriptive analytics:** Look up historical 911 and 311 archives to see previous requests coming from that location or that person; look up TxDMV, census, AIS and JIS systems to collect more information about the person making the call or the person mentioned; look up locations of nearest hospitals and fire stations
- **Predictive analytics:** Classify the kind of call based on the words used in the call description, the location of the call and a background description of the people mentioned in the calls as a situation that may or may not turn violent
- **Prescriptive analytics:** Based on the insights extracted from the above analyses, decide the best course of action to take — for example, whether to call in backup

Data lake

The data lake will hold large historical datasets of different kinds. The team recommends that the City use Hadoop for purposes of cost, extensibility and scalability. A common approach is to store these datasets of files as comma-separated values (CSV) or other formats based on the examples listed below:

- **Descriptive analytics:** Analyze historical data about fires to find out where and when fires occur most often
- **Predictive analytics:** Analyze data about fires, as well as associated data about buildings, code violations and weather, to come up with a model that can predict which buildings are most at risk of fire
- **Prescriptive analytics:** Based on the predictions of where and when fires might occur in the near future, optimize the schedule of fire inspections and the staffing of fire stations, given the resources (people and capital) available.

Reporting and dashboarding

For purposes of disseminating information to various kinds of users, the City should provide reporting and dashboarding facilities. Different dashboards can be created for various police departments, as well as for the general public. There are various dashboarding tools that can interface directly with stream processing systems, as well as with data lake systems. The dashboards can show both real-time data and long-term data. A great example of a dashboard available to the public is the City of Los Angeles dashboard that displays a set of KPIs on different elements of that city's performance.

Searches and queries

For the data in the lake, there are many options for performing queries and searches efficiently. Queries can be both on structured and unstructured data.

Various Hadoop platforms have their own Structured Query Language (SQL) interfaces for querying data on Hadoop FileSystem (HDFS). There also are various tools for indexing and searching all text, image, video and audio data. Other kinds of data, such as location-based data, can have their own specialized mechanisms to speed up queries. All location-based data can be utilized to promote rapid searches on locations at different levels of granularity.

Apart from data in the lake, there is also a need to access and query datasets not owned by the City. Today, patrol officers, the Fusion Center and others are frustrated, especially with the challenge of having to log into and query non-City databases individually, including AIS, JIS, DMV and more. Since these databases are owned by other governmental entities (like county, state or federal governments), the City itself has less control over how to access and query these databases.

Typically, the owning agency provides a query interface, and sometimes this interface needs the user to log in with provided credentials. This process of querying multiple databases can be simplified by providing a metaquery or metasearch system, whereby a given user just needs to enter the query once into the system, and the system will in turn query the individual databases and present an aggregated and collated set of answers to the user.

Data exploration and mining

Various tools exist for exploring data, aggregating it by different dimensions and visualizing it using various widgets. These tools range from spreadsheet-like interfaces, reporting and dashboarding tools, as well as collaboration tools for sharing the results with other people.

In addition, there are tools for mining the data and uncovering insights, patterns and anomalies. These tools, often used by data scientists, allow an understanding of the statistical properties of the data, revealing correlations between various variables and building predictive machine learning models to classify data points or to look for anomalies.

Finally, there are decision-support tools that perform optimizations to formulate the best strategies for responding to certain real-time situations or to handle long-term issues.

Recommendation 2: Create query and analytics capability

The City should provide an integrated query and analytics capability on both data in the data lake and outside data, wherever possible.

Scope and expected outcomes

The ability to integrate, query and analyze multiple sources will unlock the power of the data and produce new insights for City officials and all citizens.

Scope
The City should take the following steps to create the query and analytics capabilities:

Technological:
- Identify the key entities to query and analyze
- Integrate data from multiple sources in the data lake into views corresponding to each entity type
- Perform entity resolution to correlate entities across multiple sources
- Provide query and search facilities around key entities
- Set up metaquery facilities to simplify access to multiple non-City-owned databases
- Provide tools for exploring, visualizing and mining the data
- Provide tools for doing different kinds of analytics on the data
- Use analytics and generated insights to optimize specific City operations

Cultural: Promote a culture of sharing data and insights across all City departments and with the community and encourage the community to perform its own analyses on the data.

Organizational: Establish a team of data engineers and data scientists (or outsource it) for uncovering insights and patterns from multiple data sets from a cross-organizational perspective.

Expected outcomes
The City gets mechanisms to uncover insights from the data at its disposal by using techniques ranging from simple queries to complex analytics.

Cost of inaction
Inefficient use of data by the City and citizens; lack of insights and understanding of the problems faced by the City and optimal solutions for the same.

Recommendation 2: Create query and analytics capability (continued)

Proposed owner and stakeholders	Suggested resources needed
Owner: Chief Data Officer **Stakeholders:** CIS, all City departments, City Manager, Mayor, City Council and the community	People, technology or funding needed: • Data engineers and data scientists • Tools for querying, visualizing and analyzing the data • Funding depends on the complexity of the analytics **Cost estimate:** Medium

Dependencies	Key milestones, activities and timeframe
Creation of a data lake, as per Recommendation 1	**Short term:** • Query and data exploration facilities on data in lake **Medium term:** • Query extended to data outside lake • Simple descriptive analytics on the data • Entity resolution **Long term:** • Predictive and prescriptive analytics on the data • Real-time analytics

Priority
High

Recommendation 3: Improve user experience

The City should ensure that all users have a positive experience when accessing City data or systems. Each interaction should leave the user satisfied that he or she located the information needed, when needed, and that the systems, websites and/or apps involved were efficient and easy to use. This principle applies equally to all users — be they City employees (police, fire or planning departments), community leaders or citizens.

This concept of user experience is pervasive in most large commercial organizations today. In an increasingly competitive world, creating an experience that is both effective and pleasant is seen as critical to growing customer trust and loyalty. With more and more interactions becoming digital, technology is central to positive user experience.

The same principles apply to the City of Dallas. If the user experience is positive, employees will be more productive and effective, and trust between the City and citizens will grow. However, unlike most large corporations, the City currently has no specific focus on user experience, which has negative implications for the City. Below are two examples:

- Police patrols attending 911 calls have access to many systems on a patrol car laptop, but there is no integration. To investigate a complainant, suspect or vehicle, officers need to navigate multiple systems, often cutting and pasting data between them. Typically, they will be driving as they try to do this. This is a poor user experience for them, particularly as they have an urgent, real-time need to get information. The inability to get the right information could impact officers' ability to resolve an incident and even place them in personal danger.

- Despite several good initiatives to make data available publicly, there are still too many different potential data sources available. Citizens have difficulty determining which is the best dataset to use. At times they find inconsistencies in the data. In addition, legitimate caution on the part of City officials (due to data privacy and other legal constraints) gives an impression that the City might be trying to suppress data. Unintentionally, the City has created a poor user experience, which undermines citizens' trust in City authorities.

In these two very different examples, there is no easy fix to transform the user experience; it requires work and investment. However, the underlying issue is that the importance of the user experience is not recognized, understood or addressed. Within the current organization, no one is accountable for owning and resolving this issue.

Attention to user experience as a standard practice has the potential to redirect investments toward projects that could have a significant, positive impact on the effectiveness of employees and the engagement of the public.

User experience must be centered on the individual or role and not on specific systems or technology solutions. The purpose is to understand and enhance the total experience created for the user by the many solutions with which he or she works. This focus will become increasingly important, as more technology is made available to employees and citizens.

Some specific considerations on community engagement based on strong user experience are described in more detail in Appendix D.

User-centered design

Specific methods exist for formalizing user experience and user-centered design. User-centered design specifically drives attention to the needs of end users of a system or process at each stage of the design process. This requires designers not only to analyze and foresee how users are likely to use a product but also to examine the validity of their assumptions with regard to user behavior in real-world tests with actual users. Such testing is necessary as it is often very difficult for the designers of a product to understand intuitively what a first-time user of their design experiences and what each user's learning curve may look like. The chief difference from other product-design philosophies is that user-centered design tries to optimize the product around how users can, want or need to use the product, rather than forcing the users to change their behavior to accommodate the product.[2]

There are a number of methodologies for user-centered design.[3] These include the following:

1. Focus groups
A focus group involves encouraging an invited group of intended/actual users of a website (participants) to share their thoughts, feelings, attitudes and ideas on a certain subject and is most often used as an input to design. Focus groups generally produce nonstatistical data and are a good means of getting information about a domain (for example, what peoples' tasks involve).

2. Usability testing
Usability testing sessions evaluate a website by collecting data from people as they use it. A person is invited to attend a session in which they are asked to perform a series of tasks while a moderator takes note of any difficulties they encounter.

3. Card sorting
Card sorting is a method for suggesting intuitive structures/categories. A participant is presented with an unsorted pack of index cards. Each card has a statement written on it that relates to a page of the site. The participant is asked to sort these cards into groups and then to name these groups. The results of multiple individual sorts are then combined and analyzed statistically.

4. Participatory design
Participatory design does not just ask users' opinions on design issues but involves them actively in the design and decision-making processes. An example would be a participatory design workshop in which developers, designers and users work together to design an initial prototype. This initial prototype would then feed into a more traditional design process.

5. Questionnaires
Questionnaires are a means of asking users for their responses to a predefined set of questions and are a good way of generating statistical data.

6. Interviews
An interview usually involves one interviewer speaking to one participant at a time. The advantage of an interview is that a participant's unique point of view can be explored in detail. It is also the case that any misunderstandings between the interviewer and the participant are likely to be quickly identified and addressed.

All of these approaches follow the ISO standard: Human-centered design for interactive systems (ISO 9241-210: 2010).[4]

The ISO standard describes six key principles that will ensure a design is user centered:
1. The design is based upon an explicit understanding of users, tasks and environments.
2. Users are involved throughout design and development.
3. The design is driven and refined by user-centered evaluation.
4. The process is iterative.
5. The design addresses the whole user experience.
6. The design team includes multidisciplinary skills and perspectives.

Recommendation 3: Improve user experience

The City should adopt a new focus on the experience of all users (internal and external) and appoint specific user champions.

Scope and expected outcomes

The City should appoint user champions who sit between the departments and IT (at CIS). These user champions will be charged with understanding the user experience for specific roles and (over time) ensuring that technology investments enhance it. These user champions should report to CIS portfolio managers and work closely with City departments. In addition to internal-facing user champions, the City should appoint a user champion for communities and citizens.

The user champions should develop a citywide center of competence in these methods and select standard approaches appropriate to the City's need.

It is important that this investment is grounded in reality and focused on positive outcomes. It is unrealistic to cover all City roles or understand every possible user experience. It is equally important that the user champions do not become focused solely on researching methods and processes.

The Smarter Cities Challenge team identified three specific examples in which user experience could be improved significantly, which could be the basis of some short-term quick wins. The scope and recommended activities are therefore intended to achieve a balance between establishing a long-term capability and delivering positive outcomes for key users as quickly as possible.

Recommended activities (year 1)
1. Initiation and setup:
   – Appoint three to five user champions to work for CIS Portfolio Managers
   – Ensure at least one user champion focuses on external (community and citizen) users
   – Review and select user experience methods based on current industry standards
   – Train user champions in the selected methods

2. User champion outputs (for each):
   – Select one to two critical user roles and understand/document their user experience, highlighting specific issues or impacts
   – Identify one to two critical examples in which user experience could be significantly improved, either through a new project or changes to an existing project
   – Execute and implement these changes

The team identified three clear short-term opportunities as listed below:
1. A review of citizens' user experience and consideration of the need for much better integration of all City initiatives for data sharing through a single website and mobile app
2. A specific focus on the ease of use of police patrol laptops and the opportunities for producing a much better experience that will enhance officer effectiveness and safety
3. A similar initiative for the fire department, enabling all relevant information about a specific address, such as details of past inspections, code violations, name and phone number of owner/occupiers, details of electricity/gas/water supply points, to be automatically "pushed" to a fire truck as it travels to an incident

Recommended activities (year 2 and beyond)
1. Ensure that all high-value City roles have a user experience champion and that the overall user experience and use cases for each role are documented

2. Mature and formalize user experience methods as part of the standard technology delivery process as below:
   – Every CIS procurement and delivery project should include a review and sign off by the relevant user champion.
   – Over time, surveys and other formal methods of assessing the effectiveness of user experience and measuring user sentiment should be introduced.

3. Identify specific projects required to enhance user experience: Invite each user champion to submit specific projects through the IT governance process

4. Over time, review the effectiveness of the user champion function and revise staffing levels accordingly

Recommendation 3: Improve user experience (continued)

Scope and expected outcomes (continued)

Expected outcomes

The City will gain valuable insights into how specific user groups perceive it through the total set of systems, apps and websites they use. These insights will help identify and prioritize technology projects that enhance the user experience. The result should be greater productivity and effectiveness for City employees and greater trust, leading to stronger engagement with all members of the community.

Cost of inaction

- Continuing damage to the City's reputation with its own citizens, who will continue to see the City's data as inconsistent, incomplete and fragmented. This is already undermining the trust that the City is keen to build with its citizens and neighborhoods.
- A missed opportunity to improve the effectiveness and safety of emergency services staff (fire and police), who could receive more relevant information more easily while travelling to 911 incidents. The current systems not only make it difficult for officers to obtain the data they need but also can distract officers speeding to 911 calls, as they struggle to obtain data from disparate systems. This is a threat to their personal safety.

Proposed owner and stakeholders	Suggested resources needed
Owner: CIS (CIO) **Stakeholders:** CIS, all City departments, City Manager, Mayor and the community	People, technology or funding needed: • Three to four permanent user experience champions • Investment in training and consultancy to launch the function **Cost estimate:** Medium It is anticipated that the user experience champions will identify specific projects to be prioritized and funded as part of the normal IT governance process.
Dependencies	**Key milestones, activities and timeframe**
None	• See recommended activities in years 1 and 2. • A key objective should be to carry out two or three projects that show real benefits within the first year.
Priority	
High	

5. Conclusion

The Smarter Cities Challenge team would like to thank the City of Dallas and, in particular, the sponsors of this study, Chief Brown of the DPD, and the CIO, Bill Finch. It would also like to thank the more than 80 individuals from the City, the Dallas community and other organizations who gave their time.

Dallas has a significant opportunity to be more effective in its use of data to enhance public safety. The team's three recommendations set out a blueprint for the long term — and a roadmap to implement this long-term vision — while driving short-term benefits. It is very clear that the will and commitment to proceed exists at the highest level in the City.

The roadmap is a multi-year journey. The team is conscious that budgets are finite and that investments need to be reasonable and show some short-term return. But the City Manager and the CIO do understand the trade-off between short-term gains and setting down the right foundations for the long term. The current IT governance process is sound and, with further maturation, will provide a good process for managing the various investment priorities.

It is important that the City recognizes that the benefits will not be realized through technology alone. Real change is needed across the City in attitudes to data ownership. Creative thinking is needed around user experience so that CIS and other departments can identify the new possibilities enabled by technology. The proposed new roles (Chief Data Officer and user champions) are vital to this transformation. Their responsibilities for driving cultural and organizational change are every bit as important as their technical leadership.

Finally, the City must not neglect critical investments in underlying infrastructure. These investments are particularly hard to justify as they are enablers, rather than direct drivers of value. Whatever strategy the City adopts, investment in network bandwidth is critical, so the City should ensure it is a priority.

The team wishes the City of Dallas well in its journey toward leadership in open data, which will support public safety.

6. Appendix

A. Acknowledgments

Name and title	Organization
Mike Rawlings, Mayor	Mayor's Office
A.C. Gonzalez, City Manager	City Manager's Office
Jill Jordan, Assistant City Manager	City Manager's Office
Joey Zapata, Assistant City Manager	City Manager's Office
Eric Campbell, Assistant City Manager	City Manager's Office
Theresa O'Donnell, Director of Planning	City Manager's Office
Chief David Brown	Dallas Police Department
First Assistant Chief Charles Cato	Dallas Police Department
Lt. Kimberly Owens, Police Technology	Dallas Police Department
Sgt. Chuck Schmidt, Police Technology	Dallas Police Department
Sr. Corporal Stephan Gable, Police Technology	Dallas Police Department
Sgt. Eric Garrett, Crime Analysis	Dallas Police Department
Major Melissa McGee	Dallas Police Department
Sgt. Adriene Thompson, Fusion Center	Dallas Police Department
Sgt. Desiree Webb, Fusion Center	Dallas Police Department
Sr. Corporal Johann Ortega, Fusion Center	Dallas Police Department
Lt. Archie King, Assaults, Fusion Center	Dallas Police Department
Police Research Specialist Tim Brown, Assaults, Fusion Center	Dallas Police Department
Police Specialist John Bonham, Robbery, Fusion Center	Dallas Police Department
Sgt. L. Gonzalez, Robbery, Fusion Center	Dallas Police Department
Sgt. Calvin Johnson, Homicide, Fusion Center	Dallas Police Department
Lt. Thomas Castro, Homicide, Fusion Center	Dallas Police Department
Detective Harold Varner, Homicide, Fusion Center	Dallas Police Department
Sgt. Steven Armon, Fusion Center	Dallas Police Department
Sgt. Henry Lozano, Fusion Center	Dallas Police Department
Ryan McCarrick, Detective, Fusion Center	Dallas Police Department
Sr. Corporal Matt Gnagi, Patrol Officer	Dallas Police Department
Police Officer Leah Risse, Patrol Officer	Dallas Police Department
Pavala Armstrong, City Attorney	City Attorney
Sylvia McClellan, City Attorney	City Attorney
Bill Finch, CIO	Communication and Information Services

Name and title	Organization
Tony Aguilar, Assistant Director	Communication and Information Services
Justine Tran, Assistant Director	Communication and Information Services
Sheila Robinson, Assistant Director	Communication and Information Services
Cornell Perry, Sr. IT Manager	Communication and Information Services
Tyrone Williams, IT Manager	Communication and Information Services
Robert Roussell, IT Manager	Communication and Information Services
Thanh Phan, Network Analyst	Communication and Information Services
Austin Kelley, Network Analyst	Communication and Information Services
Dale Denton, Programmer Analyst	Communication and Information Services
Gaye Leggett, Programmer Analyst	Communication and Information Services
Sherri Barkley, Database Analyst	Communication and Information Services
Ronnie Jackson, Programmer Analyst	Communication and Information Services
Girish Ramachandran, IT Architect	Communication and Information Services
Lynn Chaffin, Sr. IT Manager	Communication and Information Services
Pavel Isham, Sr. IT Manager	Communication and Information Services
Roald van Antwerpen, Business Analyst	Communication and Information Services
Tuan Nguyen, Business Analyst	Communication and Information Services
Will Walling, Sr. IT Manager	Communication and Information Services
Maureen Milligan	Community Prosecutor
Yulise Waters	Community Prosecutor
Baron Poitier	City Courts, Marshal
Claudia Chavez	City Courts, Marshal
Ron Everett	City Courts, Marshal
Ryan Rogers	City Courts, Marshal
Kevin Oden, Sr. Emergency Management Specialist	OEM
Greg Guthrie, Emergency Management Specialist	OEM
Daniel Salazar, Assistant Chief	Dallas Fire Rescue
George Gamez, Deputy Chief	Dallas Fire Rescue
Chris Martinez, Deputy Chief	Dallas Fire Rescue
Tameji Berry, Deputy Chief	Dallas Fire Rescue
Dwight Freeman, Fire Marshall	Dallas Fire Rescue
Shawn Williams, Manager	Community Affairs

Name and title	Organization
Sgt. Felicia Thornton	Community Affairs
Joli Robinson, Representative	Community Affairs
Jo Giudice, Director	Dallas Public Library
C.K. Mandava	Dallas Public Library
Gary Griffith, Safer Dallas	Business and Community Leaders
Paul Landfair	Business and Community Leaders
Rene Martinez, LULAC	Business and Community Leaders
Edna Pemberton	Business and Community Leaders
Linda Long, General Manager, Southwest Center Mall	Business and Community Leaders
Vicki Martin, President, Ferguson Rd. Initiative	Business and Community Leaders
Pat Priest, COO	Greater Dallas Chamber of Commerce
Angela Farley, VP of Education	Greater Dallas Chamber of Commerce
Jeremy Vickers, VP of Innovation	Greater Dallas Chamber of Commerce
Jane Massey, Director of Neighborhood Research & Revitalization	Habitat for Humanity
Beverly Stibbens, Director of Corporate Engagement	Habitat for Humanity
Melissa Cameron, Chief Development Officer	Habitat for Humanity
Stanley "Vic" Victrum, CIO	Dallas County
Richard Ballard, Asst. IT Chief	Dallas County
Gary Miller, Software Support Manager	Dallas County
Brett Taylor, Justice Systems Architect	Dallas County
Anna Hill, SE	Crime Watch Executive Committee
Alex Garcia, SW	Crime Watch Executive Committee
Carl Raines	Crime Watch Executive Committee
Judy Brooks, SW	Crime Watch Executive Committee
Manuel Valadez, Jr., SE	Crime Watch Executive Committee
Darren Dattalo, Central	Crime Watch Executive Committee
Phillip Gipson, SC	Crime Watch Executive Committee
Carol Gatzler, NW	Crime Watch Executive Committee
Michael Przekwas, Central	Crime Watch Executive Committee

B. Team biographies

Anand Ranganathan
**Global Technical Ambassador – Big Data,
IBM Thomas J. Watson Research Center
IBM US**

Anand Ranganathan works with big data customers, with a specific focus on stream processing systems and real-time analytics. In this role, he has interacted with more than 75 customers and 15 business partners — in such industries as banking, telecommunications, transportation, manufacturing, law enforcement, cybersecurity, finance and government — in 20 countries.

Ranganathan was previously a Research Staff Member at the IBM Thomas J. Watson Research Center, focused mainly on data stream processing and software composition. He received the IBM Master Inventor Award in 2010 and has more than 15 patents and 75 academic publications in conferences, journals, magazines and workshops.

Ranganathan has a PhD in computer science from the University of Illinois, Urbana-Champaign, and a B-Tech in computer science and engineering from the Indian Institute of Technology, Madras, India.

Joe Doria
**Director, zEnterprise® Marketing
IBM Systems Group
IBM US**

Joe Doria is a director and marketing professional with more than a decade leading and managing teams at IBM. His current responsibility is in the IBM Systems Group unit that supports IBM z Systems™ technology globally. Doria has led marketing for IBM Power Systems™ and Thinkpad brand offerings at IBM. He has a BS in electrical engineering from the University of Illinois and an MS in management of technology from the National Technological University.

Previous to joining IBM, Doria worked in product management for the international division of AT&T Bell Laboratories and at Westell Communications.

John Black
**IBM Distinguished Engineer and Executive IT Architect, Chief Technology Officer, IBM Global Business Services, Europe
IBM UK**

John Black works in the IBM Global Business Services® (GBS) division, which focuses on business consulting and application solutions for clients in all industries. As Chief Technology Officer for GBS Europe, he leads a community of technical architects and specialists who design innovative systems based on cloud computing, new mobile capabilities and analytics.

Over the course of a 29-year career with IBM, Black has worked as a product specialist (on PCs and local area networks), as a system design consultant and solutions architect and as global chief architect for the infrastructure outsourcing division. He has consulted with clients across all industries on enterprise architecture and on the challenges of standardization and integration across disparate organizations.

Between 2009 and 2012, Black worked on a global outsourcing deal in Singapore but returned to the UK to take up his current position three years ago. He is a champion of technical leadership at IBM, having coached many others through to senior technical levels, including Distinguished Engineer.

Black has a doctorate in inorganic chemistry, and his technical work with IBM has enabled him to qualify as a UK Charted Engineer and become a Fellow of The Institution of Engineering and Technology.

Judy Lyne
Human Resources Leader,
IBM Global Business Services
IBM Canada

Judy Lyne provides consultative advice and guidance to more than 250 managers across several business lines — from frontline managers to senior executives — in a highly matrixed, geographically dispersed environment.

Lyne's career has advanced progressively over 18 years exclusively at IBM, during which time she has built skills and comprehensive expertise in a wide range of human resource management disciplines, including learning and knowledge, diversity, mentoring, recruitment programs, executive calibration, talent management, internal career leadership and the resolution of employee relations issues.

Over that time, Lyne has held a number of HR program management roles, including National Campus Recruiting Manager in the Talent organization, Career Coach (where she obtained her Professional Life Coach designation) and Leader of Mentoring and Educational programs.

Lyne has substantial financial responsibility and authority. Her responsibilities have encompassed Human Resources procurement, including the sourcing and contracting of professional and technical subcontractors. In this capacity, she has managed commodity and team strategy spending, savings, bid activity, negotiation, contract and supplier management.

Lyne has her qualification as a Certified Professional Life Coach, from the Coaches Training Institute (International Coach Federation, CA, 2006) and is active in Toastmasters. She has her Bachelor of Arts in English from Carleton University (Ottawa, 1995).

Mandi Hanks
Senior Security Specialist,
IBM Global Security
IBM US

An IBMer for four years, Mandi Hanks is responsible for the overall development, implementation and technical leadership of a comprehensive security and business management process in support of assigned Midwest locations and new IBM acquisitions. She has worked extensively with the Global Security and Real Estate acquisition teams and various IBM business units to facilitate a seamless integration for newly acquired companies.

Prior to joining IBM, Hanks was part of the Sterling Commerce Global Real Estate management team for fifteen years, responsible for all the North America locations. In addition, she was responsible for project management and design development on new construction projects in Europe, Asia Pacific and South America.

Hanks attended Texas Tech University, as well as the SMU Cox School of Business Executive Program.

Rajesh Sukhramani
Director of Big Data and Analytics
IBM Systems Group
IBM US

Rajesh Sukhramani is responsible for strategy and solutions for IBM hardware platforms optimized for big data and analytics workloads. He is also responsible for influencing technology direction, operational execution, strategic partnerships and new business models for hardware that leverages big data and analytics technology.

Prior to this role, Sukhramani was the Business Line Manager responsible for High Performance Computing in the System x part of the IBM Systems and Technology Group (now IBM Systems Group). He was responsible for the HPC portfolio, comprehensive execution, marketing and product management. Previously, Sukhramani was a Marketing Manager in System x, responsible for introducing many industry-first computing and storage products, such as iDataPlex — an innovative high-density compute platform — and DS3000 — an entry level storage product.

Sukhramani began his IBM career in 1997 in Dubai, UAE, as a Systems Sales Manager and moved to Research Triangle Park, North Carolina, in 2000. He has served on the boards of industry trade associations and community organizations, and he is actively involved in local charitable organizations.

Sukhramani holds a bachelor's degree in electrical engineering from University of Mumbai, India.

Sandy Dochen
Manager of Corporate Citizenship
& Corporate Affairs for Texas,
Louisiana and Arkansas

A 16-year IBMer, Sandy has served with three Smarter Cities Challenge teams, enjoying and learning from each one. In the process, he's built a knowledge base of city policy development, governance and political processes.

C. Community focus — accelerating engagement through data

The importance of creating an excellent user experience for citizens has already been highlighted in Recommendation 3. This appendix covers some of the ideas and techniques used elsewhere that could help the City to achieve this.

The City should develop a modern and interactive community-specific open data portal using existing media. The City could integrate social networks and visual maps and combine them with a set of neighborhood activities to encourage and empower the community.

Over the course of the 80 interviews the Smarter Cities Challenge team conducted, it became apparent that the community leaders felt they were not heard or actively involved in the City's solutions. Citizens continually complained about the lack of crime statistics, available code violation data and evolving trends in neighborhoods. By improving the community's access to this data, the City would build trust within neighborhoods and further improve overall public safety.

Despite great intentions, Dallas was discovered to be ranked in the 56th position (out of 76) in the US City Open Data Census during the team's time in Dallas.[5] The City releases crime data, such as 911 and RMS data, and other data, such as the locations of fire and police stations and payroll information, on its open data portal. It also releases data, such as code violations and permit information, on various scattered websites. However, data about fires, parks, water, sanitation, restaurant inspections and more is not easy to find.

For some of these datasets, the City provides a way of searching for specific records. One example is searching inspection records for a particular restaurant. However, there did not seem to be any way of getting a complete dump of all the data – which is essential for purposes of detailed analysis – or building interesting applications or systems on top of this data by the community.

The City should use modern technology as an enabler to push data to citizens, along with activities, marketing campaigns and competitions to involve technical and entrepreneurial communities.

Other cities, such as Los Angeles, New York and San Francisco, publish many more datasets and have very active communities that build analytics and derive insights from these datasets. The Los Angeles open data portal is an example of an interactive way to present crime data. Citizens can see information displayed geographically on a map and filtered by date, crime type, address and other criteria. Citizens can register to receive information by email if an incident occurs in a specific neighborhood or about topics in which they are interested. Los Angeles has an easy-to-access dashboard of various metrics related to city services. Figure 8 shows snapshots of the dashboards offered by Los Angeles.
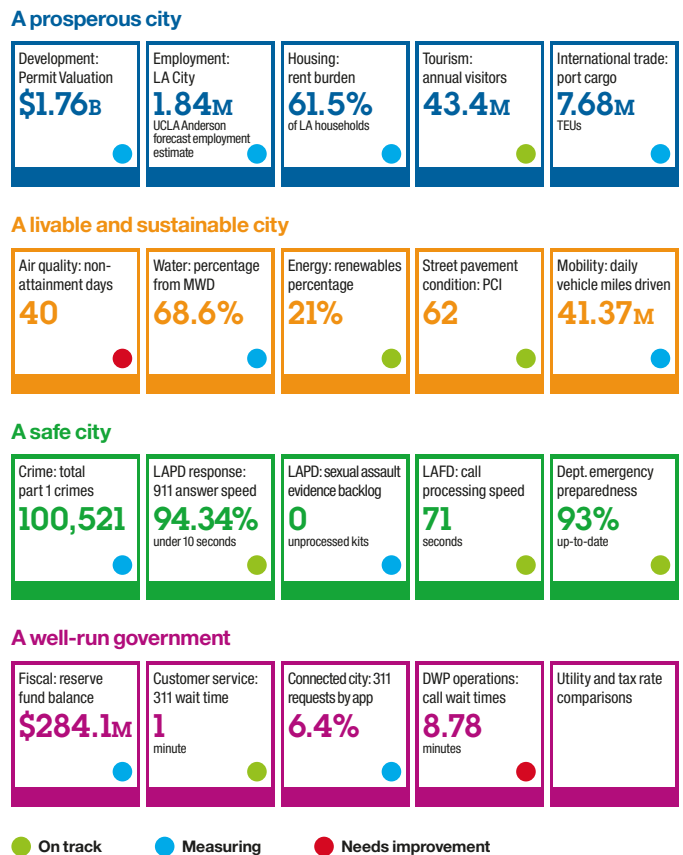

A prosperous city

Development: Permit Valuation	Employment: LA City	Housing: rent burden	Tourism: annual visitors	International trade: port cargo
$1.76B	1.84M UCLA Anderson forecast employment estimate	61.5% of LA households	43.4M	7.68M TEUs

A livable and sustainable city

Air quality: non-attainment days	Water: percentage from MWD	Energy: renewables percentage	Street pavement condition: PCI	Mobility: daily vehicle miles driven
40	68.6%	21%	62	41.37M

A safe city

Crime: total part 1 crimes	LAPD response: 911 answer speed	LAPD: sexual assault evidence backlog	LAFD: call processing speed	Dept. emergency preparedness
100,521	94.34% under 10 seconds	0 unprocessed kits	71 seconds	93% up-to-date

A well-run government

Fiscal: reserve fund balance	Customer service: 311 wait time	Connected city: 311 requests by app	DWP operations: call wait times	Utility and tax rate comparisons
$284.1M	1 minute	6.4%	8.78 minutes	

● On track   ● Measuring   ● Needs improvement

Figure 8: Community Engagement through Data

Cities across the country are encouraging local businesses, entrepreneurs and citizens to develop apps utilizing open data that impacts City services, public safety, residents, tourism and businesses positively. These engagements are generally driven through competitions and "hackathons." This enables citizens to innovate and contribute back to the City open data portal.

Figure 9 shows a visualization map of bicycle accidents in New York City in an app created by a community member. This type of analytics allows City officials and communities to determine where appropriate bike lanes should be implemented and prioritize these decisions.

Figure 9: Visualization map

The overarching theme is a shift from citizens as followers to supporters of the City's data output. Citizens can help analyze and drive positive change within communities. By making data available to communities, any city can emulate what New York, Los Angeles and San Francisco have done. Organizations in Dallas, such as EPIC, for example, could help drive community engagement and participation.

The profile of crime in Dallas, in common with other major cities around the world, is changing. It is clear from the statistics that, while not yet at levels that would cause significant concern, cyber, drug and firearm-related crimes are on the increase. Criminals are becoming more sophisticated. It is therefore essential that detection methods at least keep pace with the changing modus operandi of the modern criminal. In addition, there is a high demand for data to be shared with other City departments and county, state and other agencies in order to improve services.

It is widely recognized that the collection, organization and use of associated data — and the implementation of IT to automate, aggregate and analyze it — are essential to providing effective policing, public safety and related citizen services in the 21st century.

D. Creating a culture of sharing through the Chief Data Officer

In Recommendations 1 and 2, the team recommended both technology and organizational changes that would enable the City to make more effective use of its data. This appendix describes the organizational and cultural changes that need to be made in order for this strategy to be effective.

The City should appoint a Chief Data Officer within CIS with the following resources:
- Information (Data) Architect
- Project Manager
- Business Analyst
- Integration Specialist
- Governance Specialist

The Chief Data Officer is responsible for embedding the analytics-led approach in the organization. He or she must have many of the characteristics and responsibilities of a typical Chief Information Officer but add two critical perspectives. First, the role must ensure that IT is driven by information and data requirements rather than system requirements. Second, the role must enforce an information security model that better protects privacy while also promoting information sharing, moving from a "need-to-know" toward a "duty-to-share" model.

Typical functions of this team will be to own the design, architecture and implementation of a central data repository and design the information model needed to underpin the central data system. The general process would include the following steps:

1. Gather requirements by understanding what information or data is needed to generate the necessary insights. Create standards for the database architecture for the selection, acquisition and implementation of new technology by the City of Dallas.

2. Inventory all the existing data sources to understand what exists, where it resides and how it may be used.

3. Implement advanced analytic technologies that will enable insights from data from various sources, with an emphasis on simplified user experience while interacting with data.

4. Establish the required information access, security and privacy policies and create Documents of Understanding with partners — organizations that will provide information to the City, as well as those who will consume information or insights from the City.

5. Plan development and implementation in stages. For example, start with one department, such as multiple data sources for the DPD, then branch out across the City before including external partners and service providers.

6. Establish a process to provide data for external community use in the open data portal and drive programs with community relations in order to benefit from community skills in leveraging data for public use.

7. Implement a governance model to ensure data privacy is protected for internal as well as external consumption. This is particularly important: The absence of this means that users currently have no confidence that their data will not be misused if shared, which is a major inhibitor. It drives the current mindset of sharing based on a "need to know" only. Strong, clear governance that users can rely on would remove the major barrier to a culture of sharing.

8. Monitor and measure information requirements and usage to optimize and prioritize resources and activities.

9. Adjust plans and activities based on the changing information needs.

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