IoE-Fueled Capabilities Enable City of Chicago to Improve Operations and Public Transit Service

EXECUTIVE SUMMARY

Objectives

- Department of Innovation and Technology: Leverage technology to improve Chicago's constituent services, efficiency, and government transparency
- Chicago Transit Authority: Provide real-time data on bus/train locations and arrival times

Strategy

- Employ five broad strategies to realize vision of using technology to fuel opportunity, inclusion, engagement, and innovation

Solutions

- Chicago SmartData Platform will utilize open-source, predictive analytics to aid in developing models for service improvement
- WindyGrid spatial analytics platform empowers data visualization and service delivery
- Open-data portal (data.cityofchicago.org) contains datasets on wide range of city services, maps, and statistics
- CTA's Bus Tracker System provides bus location information for automated stop announcements and bus location tracking services. Train Tracker provides similar capabilities

Impact

- Ability to analyze various datasets provides insights for improving operations
- Solutions improve transit management and customer service
- Open-source applications increase knowledge and usage of city services, while providing solutions that can be used by other cities around the world

Background

In January 2014, Cisco released the results of an in-depth analysis of the economic benefits of the Internet of Everything (IoE) for the public sector. Cisco's model revealed that some $4.6 trillion in "Value at Stake" would result from the adoption of IoE capabilities across 40 key public sector use cases over the next 10 years, including smart water, smart buildings, smart energy, smart parking, and more (http://bit.ly/1aSGlzn).

As a next phase of its analysis, Cisco engaged Cicero Group, a leading data-driven strategy consulting and research firm, to undertake a global study of IoE capabilities across these 40 use cases – how the best public sector organizations are "connecting the unconnected," as Cisco terms it. To that end, Cicero Group conducted interviews with dozens of leading public sector jurisdictions – federal, state, and local governments; healthcare organizations; educational institutions; and non-governmental organizations (NGOs) – to explore how these global leaders are leveraging IoE today.

The research examined real-world projects that are operational today, are being delivered at scale (or through pilots with obvious potential to scale), and that represent the cutting edge of public sector IoE readiness and maturity. The aim of the research was to understand what has changed in terms of the jurisdictions' people, processes, data, and things, and how other public sector organizations can learn from (and replicate) the trail blazed by these global IoE leaders. In many cases, these jurisdictions are Cisco customers; in others, they are not. The focus of these jurisdictional profiles, therefore, is not to tout Cisco's role in these organizations' success, but rather to document IoE excellence, how public sector entities are putting IoE into practice today, and to inform a roadmap for change that will enable the public sector to address pressing challenges on multiple fronts by drawing on best practices from around the globe.

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About the Department of Innovation and Technology

The Chicago Department of Innovation and Technology (DoIT) oversees technology application and implementation throughout the City of Chicago government. In 2013, DoIT released the City of Chicago Technology Plan, which provides overarching strategy and an organizational framework for how the city utilizes technology to enhance the well-being of city residents.

The plan, which combines both existing and new programs, highlights 28 initiatives within five broad strategies that together will enable Chicago to realize its vision of becoming a city where technology fuels opportunity, inclusion, engagement, and innovation. Two of the strategies are foundational, providing opportunities for Chicago residents and businesses to become increasingly digitally connected and engaged. Three additional strategies are growth strategies, building on the connected foundation to provide improved services, economic growth, and opportunity throughout the city. Together, these five technology-focused strategies provide the path to solidifying Chicago's place as one of the world's leading cities.

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The Plan's five strategies are:

- **Next-Generation Infrastructure (foundational):** Enable residents and businesses to become more digitally-engaged
- **Every Community a Smart Community (foundational):** Ensure full participation of all Chicago residents and businesses in the digital economy through training and engagement programs that make technology relevant, useful, and productive
- **Efficient, Effective, and Open Government (growth):** Leverage data and new technology to make government more efficient, effective, and open
- **Civic Innovation (growth):** Work with civic technology innovators to develop creative solutions to city challenges
- **Technology Sector Growth (growth):** Encourage the vibrancy of Chicago's technology sector by attracting and retaining STEM (science, technology, engineering, and math) professionals and supporting the creation and expansion of technology companies

Brenna Berman is commissioner and chief information officer for the City of Chicago Department of Innovation and Technology. Ms. Berman previously worked as DoIT's 1st deputy commissioner and as deputy budget director for the City of Chicago, with a focus on enterprise initiatives and enterprise IT consolidation. She also has prior experience with IBM, where she promoted innovation in public initiatives.

About the Chicago Transit Authority

The Chicago Transit Authority (CTA) provides a powerful example of the type of technological innovation that entities in the Chicago area are utilizing to enhance service delivery. The CTA has invested in technology to track public transportation throughout the city and provide real-time information to bus and train commuters. The system combines onboard computers, GPS systems, smartphone applications, SMS, and web-accessible updates that assist in navigating throughout the city.

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John Flynn is chief information officer for the Chicago Transit Authority. He previously served as vice president of technology management with the same organization, and as deputy budget director for the City of Chicago. He also has work experience as a program manager for Cubic Transportation Systems, and as CIO for the Attorneys' Liability Assurance Society.

Objectives

Department of Innovation of Technology

The Department of Innovation and Technology, through the Tech Plan, has adopted a focused strategy of utilizing data and analytics to improve city services. Chicago's SmartData Platform utilizes open-source, predictive analytics to empower city leaders to make more intelligent decisions. The platform aggregates and analyzes city data to discover trends and provide insights.

DoIT Commissioner and City CIO Brenna Berman said, "We're very focused in Chicago about becoming as data-driven as we can be in the provision of services to our residents. As CIO, part of my responsibility is to be executive over our advanced analytics and data management program and making sure that we're using data and technology to make our services work. We are the platform to enable innovation."

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Brenna Berman,
Commissioner & Chief Information Officer,
City of Chicago Department of Innovation and Technology

Chicago Transit Authority

CTA embarked on its user-friendly modernizations initially due to a need to provide clear stop and route information to all its passengers, particularly those with disabilities. The system has grown to enable a powerful, real-time transit tracking system that informs both passengers and CTA officials about transit operations.

Strategy

Department of Innovation and Technology

Chicago city officials believe that connecting people and data is key to improving the well-being of city residents. The department collects, compares, analyzes, and distributes data to facilitate and foster those connections.

Chicago's award-winning SmartData Platform, currently in development, will apply predictive analytics to more than 7 million rows of city-related data per day to determine trends and patterns. The city's datasets are extensive, including building and infrastructure data, roadway use and transit information, public safety information, economic development data, school achievement data, as well as city administration and budget information. The SmartData Platform will analyze this data as a means to find ways to improve service delivery.

A key component of the SmartData Platform is the city's "WindyGrid" tool, which makes key operational data accessible to city officials by providing a unified geospatial dashboard. WindyGrid allows emergency responders and other city officials to visually see what is happening throughout the city to expedite response. The platform also aggregates significant data from outside sources, such as NOAA weather information and even social media feeds such as Twitter. Much of this data is updated in real time.

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In addition to analyzing data via the SmartData Platform, the City of Chicago also makes much of its raw data available publicly via an online data portal. According to Ms. Berman, this data-sharing initiative improves transparency and accountability within city operations, and provides highly relevant and useful information to the public.

While the portal, developed in 2011, predates the overall Technology Plan, it now forms a key component of the plan. The data portal's content includes city service schedules, public utilities and maintenance data, maps, and police information, all provided free of charge. There are currently more than 500 publicly available datasets, and, at the mayor's direction, the city does not charge for any of the data it releases to the public.

A number of smart transport initiatives undertaken by CTA, including Bus Tracker and Train Tracker, provide real-time data on bus and train locations and arrival times, both for the benefit of traffic management and for end-user notifications.

The City of Chicago technological initiatives are publicly funded through a variety of taxes (federal, state, and local), fees, bonds, and grants.

Chicago Transit Authority

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The Chicago Transit Authority is a public institution created in 1947 by an act of the Illinois State Legislature. The CTA was formed as a separate entity from existing city agencies, and is controlled by a seven-member board of directors. Four board members are appointed by the mayor, with three appointed by state government representatives.

Mr. Flynn indicated that half of the CTA's $1.3 billion operating budget is derived from public fares, and the remaining 50 percent is received through a sales tax subsidy. Budgets for capital improvements, including the technological initiatives described herein, are funded through grants and bonds, including significant contributions from the Federal Transit Administration. Bond revenue is provided at the state or city level, or from bonds issued directly by the CTA.

Solution

Department of Innovation and Technology

By bringing city data together for analysis, DoIT is empowering new and innovative solutions to city problems. According to Ms. Berman, correlations in the various data gathered can yield new insights. The city's SmartData Platform forms the backbone of the data analysis efforts. By aggregating data from many sources throughout the city, the platform provides a coordinated view of city operations that breaks information silos and improves perspective, understanding, and coordination of decision makers.

One unique example of a solution developed via the SmartData Platform is a data model that predicts the likelihood of future rat infestations in specific areas. The model combines data from 31 different call types reported to the city's 311 center, ranging from sick pets to abandoned buildings. "We started looking at our 311

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dataset as an incredibly wealthy source of data," said Ms. Berman. "We have a single system and a single database that tracks all of our 311 calls. So far, there doesn't seem to be an end to the relationships that we can test against that."

DoIT, in conjunction with other Chicago government entities, is using similar predictive models in other facets of city operations. Using WindyGrid, the city's spatial analytics platform, city officials are able to integrate various GIS data sources such as weather, public transit, and roadway information. Real-time data feeds – such as location information sent by GPS units placed on all city government vehicles, including snowplows and buses – allow analysis of travel times, weather-related road disruptions, and other incidents. The data also provides insight into how well various city agencies are performing on things like clearing city streets after a storm.

According to Ms. Berman, the goal of providing city data openly is to increase transparency and empower city residents to "hold accountable" their public officials.

DoIT has been at the forefront of another key initiative, making city data publicly accessible. The city's open-data portal (data.cityofchicago.org) contains many of the city's datasets covering a range of city services. The portal also includes maps and statistical information that allows the public to see how efficiently the city is providing service.

According to Ms. Berman, the goal of providing city data openly is to increase transparency and empower city residents to "hold accountable" their public officials. Additionally, the open-data initiative has generated an active civic app development community that helps make the data easier to read and understand via specifically designed apps that pull from the city data.

Some of the apps that have been developed based on Chicago city data include a snowplow tracker app that allows users to see which streets have been cleared following a storm; an app that helps locate available parking spots; a "where's my car" app that provides data on towed vehicles; and an app that provides status updates on responses to city 311 service calls.

Chicago Transit Authority

Chicago Transit Authority's Bus Tracker System is one specific IoE example that has proven extremely useful in Chicago. Bus Tracker provides bus location information for automated stop announcements as well as bus location tracking services.

Bus Tracker was originally designed as a computerized stop announcement system that called out each upcoming stop automatically as the bus approached it. The purpose of the service was to ensure that all passengers were informed about the stops – specifically, those passengers who had difficulty reading route maps and signs – since drivers were not consistent in how they called out stops. According to Mr. Flynn, this enabled bus drivers to focus on driving without worrying about announcing each stop as the bus approached. However, the success of the Tracker today is due to wide usability beyond its original intent.

The key is in Bus Tracker's technology, which can be applied for many purposes. Each of the city's 2,000 buses has an onboard computer and GPS, which connect via modem to a central data server at 15- to 30-second intervals. The central

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receiving system, Bus Time, processes incoming data for traffic management, while logarithms also produce arrival predictions for consumers. Information is published from the Bus Time system to an API for access by smartphone applications and other commuter notification systems. The system compensates for time-of-day traffic flow.

CTA also sends on-demand text messages with real-time information for those without smartphones, using the same database. "If you're standing at the bus stop, you can send a text message with the number of the bus stop, and it returns the next three buses that are coming," Mr. Flynn explained. "We get over 2 million hits a month on just that text-messaging function alone. Since they're all using the same data source, they all have the same degree of accuracy. The difference is just in the look and feel with the buttons and functionality that these apps may provide." Arrival information is also available on the CTA's website, www.bustracker.com, and on Bus Tracker signs at 250 of the busiest stops throughout the city.

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Chief Information Officer,
Chicago Transit Authority

Once the system was developed, Mr. Flynn says that bus scheduling and real-time location information was made available for private application development. "When the smartphones came along ... and people started developing apps, we realized that we just didn't have the internal capability to keep up with this. We decided to just publish the data and let the public develop apps and let the best one win. Now there's probably half a dozen apps that you can buy on the iPhone and Android stores that are CTA Bus Tracker apps. They all use the same data feed, which is published through an API, and anybody can plug into it. We also felt that this would be the quickest, cheapest way to get this information into the public's hands." Mr. Flynn names CTA Tracker, Buster, and Busboy as popular options.

Mr. Flynn states that data collected for Train Tracker is similar to the Bus Tracker data, but that it is technology that uses the internal circuitry of the third-rail power line rather than GPS. Real-time schedule information is made available to the public on a website and through signs at each station.

The Bus Tracker/Train Tracker applications and the SMS messaging system have proven very popular, with robust downloads of several privately developed applications. Cold winter weather can bring as many as 100,000 hits on the Bus Time server every five minutes, and online reviews of the CTA's overall services are generally positive.

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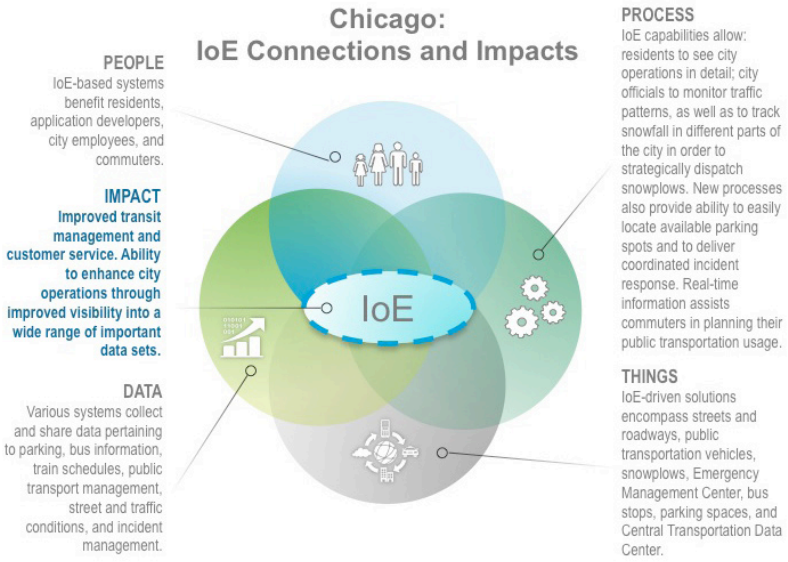
Figure 1. Chicago: New and Better Connections.



Source: Cisco Consulting Services, 2014

"We are the platform to enable innovation. We provide the data always enabled by an API."

Brenna Berman,
Chief Information Officer,
City of Chicago Department of Innovation and Technology

Impact

Department of Innovation and Technology

According to Ms. Berman, data collected by the city cover virtually every major area of operation. Mashing up and analyzing this data via the SmartData Platform provides a fruitful area for drawing conclusions and improving operations via predictive modeling, such as in the case of the rat infestation model and the WindyGrid dashboard.

Ms. Berman also indicates that the open-data initiative and the apps developed from it have had a positive effect, particularly in increasing resident engagement with the city. For instance, one application that utilizes city data was developed for free by civic-minded community members. The application takes GIS files of recent school closures and pairs them with crime data and business licensing data to map the safest routes for children to walk to school.

"I am never going to have the bandwidth, ingenuity, creativity, or insight into building all of the micro applications that every neighborhood in the city is going to want," said Ms. Berman. "I just couldn't do it, but the civic development community with grassroots commitment can."

This collaborative mind-set and approach has motivated another key facet of the SmartData Platform and the WindyGrid tool. Both have been created utilizing an open-source data infrastructure, meaning other metropolitan areas can utilize the technology to improve their operations as well. They can import the predictive models and adapt them to meet their own data analysis needs. By using an open-source approach, the City of Chicago is not only saving development costs and making future updates easier, but is also providing tools to improve the well-being of people in other cities.

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According to Ms. Berman, "We are the platform to enable innovation. We provide the data always enabled by an API." While the city has vowed not to use the data to raise revenues, companies can monetize the applications and services they develop based on the city's data. City officials see this as a new economic development opportunity, cultivating a city-focused app development ecosystem.

Chicago Transit Authority

Making Bus Tracker system data available for access by both public and private application developers has several benefits. Providing a common data feed of real-time information for smartphone apps, an SMS notification system, a dedicated website, and electronic signs at stops means that commuters receive consistent information and updates across all platforms. In addition, keeping the data available for open-market applications has saved the CTA the time and costs typically involved in developing and supporting an internally created application.

Mr. Flynn believes that improved customer service is the most important benefit of the Bus Tracker and Train Tracker systems, adding that "empowering your customers with information" is a "game-changer" in the industry.

According to Mr. Flynn, the location data provided by the Bus Tracker and Train Tracker systems provides advantages in transit management as well. Mr. Flynn gave an example of "bus bunching," the tendency for buses to congregate in bumper-to-bumper fashion, describing it as one of his industry's largest concerns, and saying the phenomenon is reduced by the new system. "Our long-term goal is to try to eliminate that to the extent possible," he said.

Bus location data allows CTA to address the issue via intervention with the bus drivers. "We've used this technology to build some webpages internally that we deliver," Mr. Flynn explained. "We have laptops and supervisor vehicles that are connected through a data modem, and the supervisors can see the street. We are trying to use this technology to bring visibility in real time to what's happening out on the street so that people can react to it and improve the service."

Mr. Flynn believes that improved customer service is the most important benefit of the Bus Tracker and Train Tracker systems, adding that "empowering your customers with information" is a "game-changer" in the industry. "It has made our customers more loyal to the product. It makes us more of a quality experience to the customer and, therefore, our customers ... have a higher opinion of our service quality."

Lessons Learned / Next Steps

Department of Innovation and Technology

The Department of Innovation and Technology is currently studying ways to use existing cameras for other types of measurements. While cameras were originally intended for monitoring traffic and safety issues, Ms. Berman says there is a wealth of other captured data that large cities like Chicago can use. "When it snows here, it does not snow evenly," said Ms. Berman. "It can be snowing in the north and not in the south .... One discussion we started to have is the roles cameras can play in determining the patterns and depth of snowfall in the city. The cameras essentially become a set of eyes wherever they exist. What can they tell us about the snowfall across the city, and how can we use that data to influence the deployment of snow

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removals across the city? It's using that sensor in a different way from what it might have originally been deployed for."

While city officials see benefits in using video in new ways, one technical challenge is figuring out how exactly to process the video data. "The challenge right now, before we even get to the policy questions of using it, is technically processing video data," Ms. Berman stated. "There are technical challenges there that we are trying to address. How you structure that database is our challenge right now."

Another challenge for the city is how to use the data without infringing on people's privacy. Protecting privacy is of high importance in every area of data usage. "How do we anonymize that in such a way that we are protecting the privacy of our residents but still leveraging the usefulness of that data to improve city operations?" Ms. Berman asked. "I'm the steward of that data, but I don't own it. It belongs to the people of Chicago. They entrusted the city with the proper care and use of that data, but I need to protect it and ensure its proper usage within the proper privacy provisions of that data."

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Chicago Transit Authority

Mr. Flynn describes the challenge inherent in any technological initiative as selling executive management on the costs of investment in the infrastructure. "[There is] the notion that, 'Why can't we be as nimble as the consumer market? Why does it cost $10,000 for a computer on a bus when I can go to the store and buy an iPhone for $400?' That's because Apple sold a billion of them. We're only buying 2,000. It's education and constantly communicating with people," he said.

Mr. Flynn describes another daunting aspect of the initiative as the pace at which public sector improvements tend to proceed versus the pace of technology. "The way that government procurements and funding operate, there are very long lead times," he said. "You have to issue RFPs, and those take time. By the time you come up with the idea, write it down, issue an RFP, get the responses from the vendors, and award a contract, the technology itself could already have evolved. The danger you have is that you've procured something based upon yesterday's technology. You're already obsolete before you've even started."

Mr. Flynn says that his planning strategy to address this includes "trying to future-proof these ideas so that you can take advantage of new technology capabilities when they come along, and you don't have to rip it all out and start over again; making sure that [components] can be broken apart and reassembled, so that the server operating system isn't dependent upon the database version, which is dependent upon the operating system version, which is dependent upon the network protocol." He said that he tries "to make sure that we've set things up so that if we get a cheaper cell-phone bill from another carrier, we can just swap out the modem and not completely reengineer all the software."

CTA attempts to present Bus Tracker and Train Tracker data in similar formats across websites and applications, although Mr. Flynn notes that bus data is GPS-driven and published to an API, while train location data presents a challenge in being gathered from third-rail circuitry, a technology that is decades old and not currently publishable to an API. He indicates that while CTA is in discussions with Google

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Maps, and will soon provide Bus Tracker information in the required General Transit Feed Specification (GTFS) standard used by Google, negotiations for providing real-time train data are still in the future because of the way the data is structured.

Mr. Flynn also says the CTA Board of Directors recently approved a contract to procure a Computer-Aided Dispatch Automatic Vehicle Location system (CAD AVL), the industry standard for real-time vehicle management, and that CTA will be deploying this system in the near future. Mr. Flynn describes this system as installing a small-flat screen monitor on the dashboard of all buses to provide a live map of bus locations for each driver.

By summer 2014, commuters will be able to purchase fares using credit or debit cards at each station, or to use the NFC capabilities of smartphones directly at the gate.

"Now the bus operator will be able to see his or her leader and follower," he said. "They will be able to see where they are in relation to their schedule, where they are in relation to the rest of their fellow operators that are on the street. The control center will then be given a tool so that they can manage the street. The system will have some automated capabilities to send messages – stop, slow down, speed up, what have you – to the operator when the bus starts to bunch [with other buses] or there are big gaps."

Mr. Flynn describes other improvements currently taking place, including the installation of the Ventra open payment system. By summer 2014, commuters will be able to purchase fares using credit and debit cards at each station, or to use the NFC capabilities of smartphones directly at the gate. An additional mobile application will be created for Metra, a commuter rail agency in Chicago that is affiliated with – but not controlled by – CTA.

Mr. Flynn says that the Bus Tracker and Train Tracker program are continually in the process of being upgraded, and additional 4G capabilities are being worked into the systems. "We tweak them and enhance them based upon experience and feedback," he said. "They're constantly undergoing improvement and enhancement."

Both the Chicago Department of Innovation and Technology and the Chicago Transit Authority are working to improve residents' lives in Chicago by utilizing IoE technology and solutions. Per the city's Technology Plan, city officials, along with the private sector, are working to better connect Chicago residents and communities with the city's services, resources, and opportunities.

More Information

For more information, visit http://www.cityofchicago.org

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