



City Hall's Technology Journey:

Using Data to Improve the Lives of Citizens

By Steve Poftak (Rappaport Institute for Greater Boston)

Introduction

Given its location in the middle of a hotbed of private sector innovation in the field of information technology, it is not surprising that the City of Boston has adopted technology and the use of data as a tool to improve governance. However, juxtaposition is not enough to create a culture of innovation in municipal government. This brief explores the City's initial efforts, the subsequent evolution of those efforts, and the lessons that can be learned from three specific projects.

The City of Boston's use of technology has been nurtured by the supportive leadership of the late Mayor Thomas Menino and current Mayor Marty Walsh. While neither mayor was a technophile, both saw very clearly how technology could be used as a means to policy-related ends and gave strong support to their staff who were leading these efforts.

Structure of Activities

The modern era of data use in Boston City Hall dates back to the mid-1990s when the City began systematically collecting data on outputs and outcomes as part of the budget process. By 2002, this data collection process had become formalized as "Boston About Results" ("BAR") and was being released publicly in conjunction with departmental

budgets. Examples of measures included the number of summer jobs provided by the Boston Youth Fund and the annual dropout rate for BPS. By 2006, the City had a nascent form of distributed performance measurement with the installation of performance indicators on managers' desktops.

This focus on performance trends led to a desire to have dedicated capacity to address specific problems and to take advantage of opportunities to innovate. The fundamental challenge the City faced was twofold. Senior managers and their top staff had their hands full running their departments making it difficult to sustain attention to performance improvement projects. In addition, most departments lacked in house talent with sufficient technology expertise.

The Mayor's Office of New Urban Mechanics ("MONUM") was formed to take on specific challenges with a focus on policy innovation and civic engagement. This was an internal team of young policy entrepreneurs with a portfolio of skills including, but not limited to technology. Several elements were critical to the success of the MONUM. First, the beginning words of their office, "Mayor's Office", coupled with their physical location in the 5th Floor Mayoral suite at City Hall, gave them the imprimatur

Over the past decade, the City of Boston has been at the forefront of efforts to utilize data and information technology as a tool to improve governance. This paper examines the structure of Boston's data efforts and the substance of several specific efforts, with the goals of understanding how these efforts have affected the lives of citizens and allowing other communities to learn from Boston's experience.

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of the Mayor. In a city operating under a 'strong mayor' form of government, along with the obvious gravitas of then-Mayor Menino, MONUM projected a clear mandate to the remainder of city government.

Also critical was the leadership approach taken by MONUM's founding co-chairs, Nigel Jacob and Chris Osgood. In working with city departments, Jacob and Osgood sought to be "collaborators, not consultants." They avoided a dependence on the top-down appeal to authority to execute on projects. Rather, MONUM built relationships with department heads and developed an understanding of the culture of each department engaged in a project. This sense of institutional respect, fostered in part by a 'low ego' approach by MONUM's leadership, was a key to its success. This approach is quite distinct, and deliberately so, from other approaches to driving technology into public sector operations, such as 'SWAT teams' or the characterization of subject departments as 'laboratories.'

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Another critical element of MONUM's approach was to manage a portfolio of projects that included both internal projects (such as the placement of multifunctional street furniture and the opening of a coffee stand on the mezzanine of City Hall) and external projects with departments as partners, with a clear understanding that many of the projects would be discontinued if they failed to produce results. In some cases, the shared understanding (between MONUM and certain department heads) that certain projects might

not succeed allowed department heads to off-load risks onto MONUM and use that office for higher risk pilot projects (such as variable pricing for parking or on-street carshare parking).

As the City of Boston's efforts with technology have expanded, there has been an expansion of roles in City Hall. MONUM was conceived as a small team of 3 – 5 program managers and 2 co-chairs with a fluid portfolio of projects. These projects might end up being scrapped, moved out to the department, or kept at MONUM. Major projects in the MONUM portfolio include Where's My School Bus (a smartphone-based tracker that allows parents to see where their child's school bus is), mobile parking payment apps, and a series of projects to activate underutilized public spaces (e.g. the modifications to the mezzanine at City Hall intended to create more traffic and usage of the space).

Another signature projects is the Citizens Connect app. This app allowed smartphone users to submit service requests via the "Mayor's Hotline" (since re-branded and renumbered as "BOS311"). The Hotline served as a phone-based means for Boston residents to call in requests for city services, such as broken streetlights, missed trash pickups, and other complaints.

Citizens Connect took the hotline's call-based concept and allowed for submission via smartphone – users could use the Citizens Connect app to send in requests along with photographs of issues. On the back-end, City staff could distribute service requests via the City's work order system and close out cases when they were resolved. By providing an additional channel for citizen requests, Citizens Connect contributed to increased usage of the hotline. Currently, Boston 311 accepts requests via phone call, app submission, Twitter, and a website form.



Source: City of Boston

This team works on projects apart from MONUM but, at times, also in cooperation with them. CAT team members also characterized the relationship as complementary with MONUM leadership relied on for support and guidance at times. CAT is distinct from MONUM in that it has a narrower portfolio – only projects with a strong data analysis component but with the ability to go more deeply in specific areas.

As MONUM and the Citywide Analytics Team were expanding to provide greater capacity for the City to undertake innovation and performance improvement projects, so too was the availability and frequency of critical data that enabled the Mayor, management, and staff to better understand and monitor City operations.

This change enabled the creation of CityScore, housed within CAT. In its current iteration, CityScore tracks 21 indicators on a daily, weekly, monthly, and quarterly basis and displays them on a web site designed to look like the Fenway Park scoreboard. Indicators range from the number of daily library users to the numbers of stabbings, and from on-time permit reviews to fire-department response time. Indicators are reported relative to performance targets, with values above

one indicating that performance is exceeding the target and values below 1 indicating performance below target. The 21 indicators average into a single overall CityScore – again reported on a daily, weekly, monthly, and quarterly basis.

The rollout of CityScore was the culmination of an ongoing process to get the City to a series of data reports that were available on a high-frequency basis and could be used in real time by managers to track performance. It also represents the culmination of a target-setting process that aligned metrics and performance targets for those metrics with the goals of the Mayor's office. While earlier performance management efforts focused largely on long-term performance statistics, CityScore seeks to provide real-time data that can be used daily by managers and that provides insight into the impact on quality of life outcomes, not just operational outputs.

One of the drivers in the creation of CityScore was the Mayor's early and public adoption of multiple data dashboards in his office. His rotating dashboards currently show CityScore, data from Boston 311, and a series of measures on housing violations, public safety, human services, and basic city services.

The Mayor's personal engagement with data and, specifically, the physical location of dashboards in his office, set the tone for the rest of his administration. It also built internal credibility for deeper, more analytical data projects.

The city's portfolio of data activities now spans two inter-related entities -- MONUM and CAT, with CAT further dividing its efforts between department-specific long-term projects and the development of performance management tools like CityScore and a variety of department-specific dashboards. CAT has grown into a team of over 20 employees with deep expertise in data-related projects, and MONUM continues to operate a portfolio of civic engagement and policy development projects, many of which utilize technology and several of which overlap with CAT's portfolio.

Next, three examples of data-driven projects will be examined in greater depth to show how specific improvements in service were achieved and what broader lessons can be derived from each.

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Permitting

The revamp of the City of Boston's permitting process is among its most comprehensive and complex attempts to utilize technology to better serve citizens. The desire to reform the process began against a backdrop of complex cross-agency workflows and a poorly functioning system of permit application and processing that was anecdotally acknowledged to be a

hindrance to development of property and businesses.

The City's permitting process has been criticized for years. A McKinsey analysis performed during the transition between mayoral administrations put a data frame on their criticisms. The average approval time for long form building permits was 42 days, with 10% taking more than 85 days. For short form building permits, average approval time was 8 days, with 10% taking more than 3 weeks. Planning and zoning reviews were taking 18 days for their initial review and another two weeks for follow-up reviews.

The McKinsey analysis made the case for much faster reviews. It set a target of less than 15 days to approve long-form building permits and 1 day for short-form permits. For planning and zoning reviews, it targeted a total of 11 days for the initial and subsequent reviews.

In addition to criticism on the customer service front, the client agency, the Inspectional Services Division ("ISD") had attempted a major technology upgrade with the installation of a back-end workflow system in 2009. The system was purchased with the goals of automating many ISD processes, decreasing paper-based activities, and allowing customers greater visibility during the application process. While the system did streamline some portions of the process, it not deliver the anticipated technology gains and the implementation process had a number of challenges, leaving ISD employees to feel as if they had been left with a system that was not able to fulfill key business needs.

The Department of Innovation and Technology team entered this environment, with a client apprehensive about technology and under public (as well as internal) pressure to improve service, and began with an immersive, fact-finding approach. DoIT analysts and project managers described spending extensive

amounts of time embedded with ISD staff, even trouble-shooting basic desktop computer issues, as a means of building trust and learning more about business needs.

In addition, a significant effort was made to make sure that “1010” (the City’s universal shorthand for its municipal permitting entities, most of whom are housed at 1010 Massachusetts Avenue in the Newmarket neighborhood, a somewhat isolated location geographically separate from downtown and City Hall) was seen as the owner of the reform effort. One significant signal to staff was the Mayor’s choice of 1010 as the venue to announce the permitting initiative, a move that both signaled the high level attention being paid to the effort as well as providing a direct acknowledgment of ISD staff’s efforts.

The City took a multi-step approach to improving the permit process. Some reforms occurred at the process level -- a Zoning Board of Appeals subcommittee was created to address the needs of small businesses and residents.

The City took an iterative approach that built internal confidence in implementation while also being flexible enough to surface and address business requirements.

Next, the City needed to address the underlying issue of the IT infrastructure underpinning the permitting process. Typical public sector practice would be a major IT scoping, procurement, and implementation process. However, the McKinsey analysis had noted that the current software, was being used in a number of other major cities and there was no clear superior alternative. Additionally, there was the nagging issue of implementation --



Source: City of Boston

ISD was still grappling with internal distrust around the 2009 implementation of its back-end system. Lastly, given the ongoing criticism of the permitting process, there was some skepticism that a comprehensive understanding of business requirements (that reflected both internal and external needs) could be developed.

Into this uncertain situation, the City took a new approach to IT development and procurement. It settled on an iterative approach that built internal confidence in implementation while also being flexible enough to surface and address business requirements.

It began a major procurement for the “Boston Permitting & Licenses” project, which would serve as the front-end for the permitting process but would continue to the same system as the backend. This project was designed to be executed in stages to incorporate new business requirements but also to allow for longer term integration of other permitting entities in the City.

The City also held a “Hackathon” with the objective of creating a tracking system for permits and dealing with the city’s idiosyncratic use of different street address structures. A hackathon is time-limited event (typically a day or two over a weekend) that brings together computer programmers with an interest in civic tech along with public officials (and, perhaps more importantly, their data) to develop solutions around specific problems.

The Hackathon resulted in Permit Finder -- which allowed user to determine where their permit was in the ISD approval process. It also resulted in a second application that translated between the city's primary and secondary address systems. In addition, the City purchased an off-the-shelf piece of software that allowed them to create Zoning Check, which provided users with the ability to enter addresses and determine the address' zoning status.

These three products have served to address key business requirements within ISD and created confidence (both internal and external) that technology can be a useful solution moving forward. The important "Boston Permits and Licensing" project was recently launched with a stronger sense of business requirements and a more receptive client.

To address performance, as these technology solutions were being developed and rolled out, the Citywide Analytics Team worked to implement a data-intensive management strategy for employees responsible for delivering services. CAT built workload reports to help employees with prioritization of work. This same information was rolled up to a managerial level so managers were able to track both individual and overall performance. A high-level variation of the same information was then provided to the Commissioner and the Mayor. The Citywide Analytics Team hosted monthly meetings with divisions within ISD to surface any remaining roadblocks to performance improvement.

As a result, the issuance of long-form permits is now down to a median of 22 days, which appears to be an improvement on the baseline average of 42 days at the end of 2013 (but not quite at the 15 day average targeted initially). Plan reviews were down from an average of 32 days to a median of 12 days, just above the target of 11 days.

Transportation

Even with a vast array of signals under its control and scores of sensors feeding information to its command center, the City's ability to manage traffic has its limitations. The Boston Transportation Department ("BTD") controls more than 500 traffic signals from its operations center in City Hall, with the ability to adjust them in real-time. It has more than 200 cameras in the field to monitor traffic conditions as well as detectors embedded in roadways throughout the city. While

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these assets allow some control over traffic conditions, the City is limited in its ability to control traffic volumes and is dependent on a third party, the MBTA, for transit operations.

In 2014, the City initiated a partnership with the Waze app (which had been acquired by Google in 2013). Waze is a crowdsourced traffic app, which collects data from users to determine traffic conditions then provides optimal routes from users to take. With a large volume of users in the Boston area providing data both on a passive basis (i.e. transmitted regularly via a data connection based on the movement of the phone) and an active basis (i.e. users can proactively report conditions, including traffic congestion, accidents, and road closures), Waze offers a means to measure how traffic conditions are changing in real time.

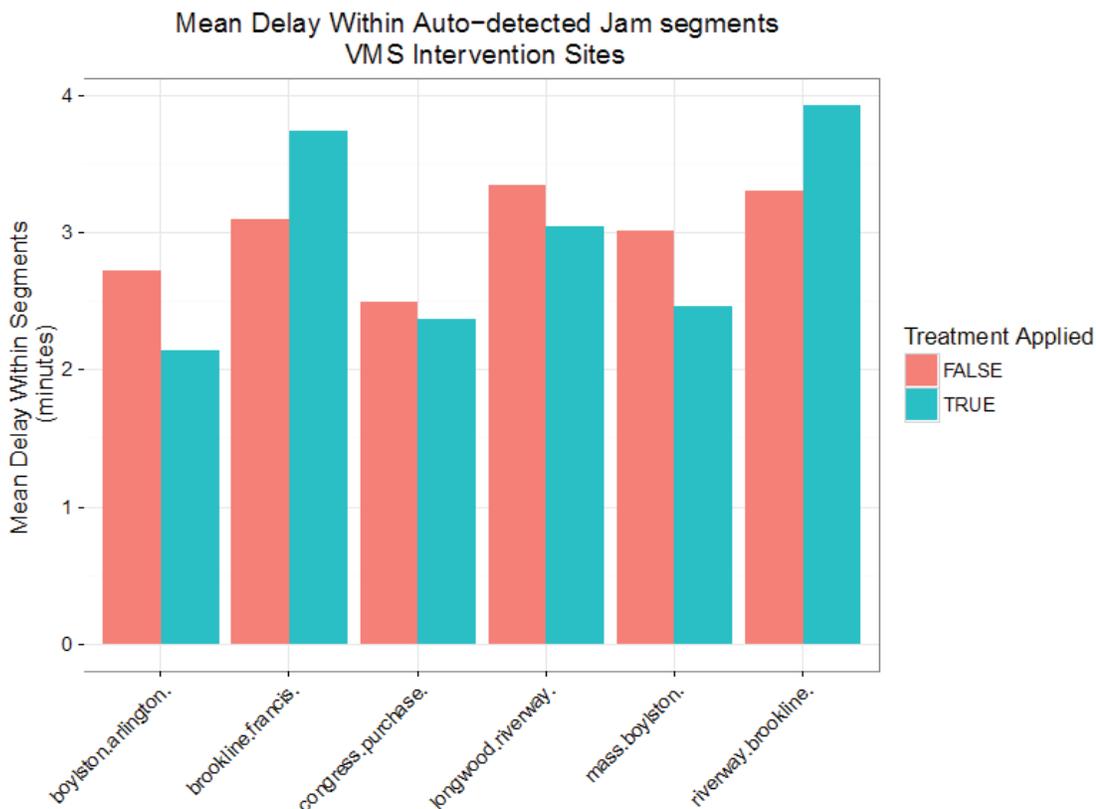
Waze's potential for measurement offered an opportunity for the City to do a better job of evaluating which efforts to reduce congestion

and improve safety were effective and which were not. Previous interventions were measured using either fairly inelegant outputs, such as the number of tickets issued during an anti-grid lock operation, or labor-intensive car counts, thus limiting the number and size of these experiments. Waze gave CAT the ability to move beyond administrative inputs and outputs to measures to provide a customer-focused measure with which to judge the success of new congestion reduction and safety improvement efforts.

The initial relationship with Waze was a simple exchange of data -- the City provided regular information about construction and road closures to Waze, and Waze provided data files on congestion. Next, came a series of interventions.

One key source of congestion in Boston, particularly during the morning and evening

commute, is 'blocking the box' -- the act of crossing an intersection which does not clear during the green light cycle and preventing perpendicular traffic flows from getting through. To mitigate this, the Citywide Analytics Team partnered with the Mayor's Office, MONUM, BTD and BPD's Traffic Enforcement Department, around two interventions -- stationing a police officer at key intersections where 'blocking the box' occurs and putting electronic signage at other key intersections. The CAT team also experimented with persistent versus staggered placement of officers (over time) to see if there was a residual effect of past placement (i.e. if an officer was at an intersection on a given day, did it also affect driver behavior the following day even though the officer was no longer there.).



Source: City of Boston Internal Analysis based on Waze data

By reviewing Waze data before, after, and during these interventions, it was concluded that they did not have a sustained, statistically significant impact. There were certain intersections where there appeared to be an impact but it was limited in both time and location.

Most broadly, this evaluation helped demonstrate that several of the common approaches to deterring 'block the box' behavior did not have a meaningful impact on congestion. More narrowly, CAT's experience with this approach pointed out several of the challenges of staging experimental interventions. First, applying a consistent 'treatment' was a challenge -- the act of deploying police officers did not capture the variability in their activity, with a possible range from a passive visual presence to proactive ticketing. Second, while Waze congestion data is far superior to previous measures, the data alone are not sufficient to answer the key evaluation questions. It requires sophisticated analytic work to control for temporal variation in underlying congestion patterns and to model other contextual factors like induced demand.

A second intervention involved the retiming of traffic signals in the Seaport District to decrease congestion levels for cars exiting the Seaport to the Financial District. With this intervention, CAT was able to use Waze data to measure congestion before and after the implementation of the signal re-sequencing and determined that an 11% month over month reduction in congestion had occurred.

Another intervention was targeted at double-parking. Waze data feeds were used to identify spots where double-parking was occurring. As with the 'block the box' intervention, this intervention also surfaced some practical complexity around the treatment. Double-parking actually consists of two types -- the

running vehicle with a driver and the parked, driverless vehicle. For the former, enforcement may consist of a 'move along' -- a verbal order by the enforcement agent to move the vehicle without a formal ticket. The team attempted to collect this information via survey data but this was more of a challenge to capture than ticketing which created a record.

The Citywide Analytics Team's approach, emphasizing an understanding of the client's business needs and a respectful collaboration with the department, gave them the internal credibility to build that relationship.

A fourth evaluation examined the impact of adding protected bike lanes and reducing automobile travel lanes. BTD added a protected bike lane at the corner of Massachusetts Avenue and Beacon Street and moved a bus stop. Based on Waze data, CAT found no increase in traffic congestion and, in fact, found improvement across several traffic metrics.

CAT's experience with Waze highlights several important lessons. The ability to partner with a private sector actor was an important step in generating data that the city did not have and would have been hard-pressed to replicate on its own. Further, this data has provided a tremendous tool to conduct a number of experiments across the city with a variety of transportation interventions.

Most importantly, CAT and its client, BTD, are conducting these experiments on material issues and interventions. They have also been forthright in conceding failure with those interventions where the data show no result or a negative result, a practice not always encouraged in public sector policymaking.

CAT is looking to continue its use of Waze data to study other potential innovations. As part of this, they are working with MONUM and looking to BTD staff for ideas about future interventions. For example, one potential area for future research is the use of Waze to test the impact of the City's new parking meter system that allows for performance-based pricing.

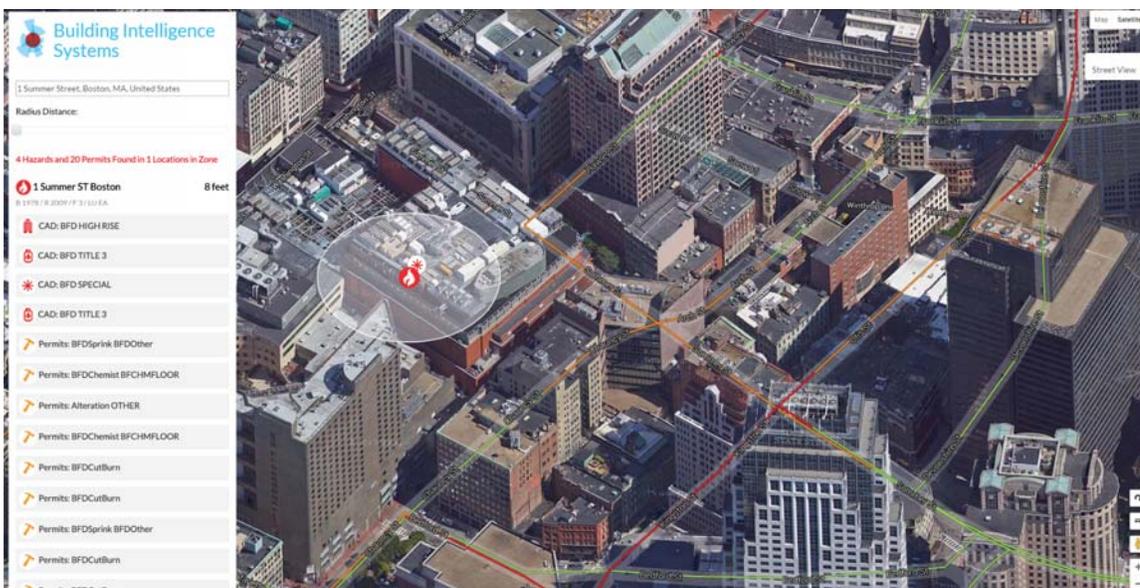
Boston Fire Department

The Boston Fire Department represents one of the City's success stories in using data to improve operations working in close partnership with Department front-line staff. Many of the Department's operations are still manual and paper-based, and its ability to use data and improve services may not be immediately apparent. However, these existing processes presented significant opportunities to use data to improve decision-making.

As a complement to this internal desire for more data resources, the Citywide Analytics Team's approach, emphasizing an understanding of the client's business needs and a respectful collaboration with the department, gave them the internal credibility

to build that relationship. To begin that process, the Citywide Analytics Team worked with the Boston Fire Department ("BFD") and held a number of meetings with senior leaders (both uniformed and civilian) to determine their needs. From these meetings, support for the human resources department was identified as a key need. BFD had a complicated system of tracking daily attendance that included the data entry of attendance at individual firehouses, the creation of PDFs that were sent to Headquarters, then the manual entry of data from hard copies of the PDFs. Additionally, the contours of the collective bargaining agreement for firefighters are quite different from a standard 35 – 40 hour/5 day week contract. The standard contract envisions a firefighter working a day shift, a night shift and a full 24 hour day within a work week, with some flexibility to alter shifts.

In response to concerns about overactive shift-swapping and a prohibition against working more than 38 consecutive, regularly-scheduled hours, there was the desire for better tracking of shifts from the management of the fire department. In response, the Citywide



Source: City of Boston

Analytics Team developed the initial iteration of FireStat, a series of dashboards allowing executives and staff to better understand three main topics – shift swapping (by flagging any employee with a swap balance of greater than 5 shifts on a calendar year to date basis), sick time usage (by flagging any employee with more than 10 unexcused absences), and a monitor on “38s” (the prohibited practice of working more than 38 regularly scheduled hours). FireStat was built entirely with internal resources using BFD’s existing database and development provided by CAT.

As further iterations of FireStat and in response to BFD’s requests, the tracking of hydrant inspections is being added. In addition, a generic search function was also added to the database, which allows the database to be searched across various dimensions, including individual employee, leave type, and date range. This provides managers, particularly in the personnel office, an efficient means of examining data.

FireStat resulted in better control of the department and greater transparency around staffing issues, but the benefits of the system were not purely administrative. Department staff noted that units were able to train together and work together (as there were fewer substitutions due to leave or shift swaps) which resulted in greater unit cohesion.

Another project in the implementation stages with BFD is the Building Intelligence System, which grew from an internal request by the BFD’s own dispatch unit to better understand building hazards. The intent with this program is to take the existing property-specific sources of data in the city and put it into the hands of Dispatch and firefighters -- so that they can know what known hazards exist in and around a building before entering. The Building Intelligence System will allow BFD to access important information like building permits,

hazardous material permits, and building ownership data in real time as they respond to fire calls.

BIS currently draws on data from seven separate data sources – ISD, Assessing, Code Enforcement, and multiple internal BFD databases. It overlays the data on the Google Maps platform, providing a familiar environment for its users. BIS was developed internally by CAT staff and did not require any external development or purchase of external software.

This project is currently available at BFD Dispatch, allowing them to send specialized equipment and companies as needed, with a longer term plan to implement the system on screens in vehicles and on mobile devices for personnel.

Conclusions

Boston’s use of data has demonstrably improved the quality of life for Boston’s citizens. How the City got there contains instructive elements for other municipalities:

-Low ego leadership: Boston’s approach to data has been characterized by internal leadership that was quick to share credit internally, particularly with affected departments and open to exploring varying distribution channels, including the formation of a department dedicated to data, in the form of the Citywide Analytics Team.

-Tolerance for Failure: Both the MONUM and CAT have a portfolio of projects underway at any given time with a clear expectation, from the Mayor on down, that many of the projects will not work. This allows departments that in practical and political terms have a greater downside risk to failures, to put pilot projects in the MOMUM and CAT portfolios and avoid reputational and political risk to the individual departments.

-Executive Leadership: The placement of MONUM in the Mayor's office, along with explicit Mayoral support has been important in getting institutional buy in for the City's data efforts. Further, Mayor Walsh's public adoption of a data dashboard in the early days of his mayoralty sent a similar signal to City executives. It drove an awareness that data dashboards would be a commonly-used management tool. Also, the knowledge that the Mayor might be viewing data about one's department likely drove an interest in a similar displays of data for departmental leaders.

-Collaborative, Client-Focused Approach:

Both MONUM and CAT practiced an approach that sought to engage with clients and understand their business problems before developing solutions that involved data. This required a three part approach. First, spending time with department leaders to learn about business problems (frequently probing to understand the roots of performance management issues), followed up with time spent with mid- and lower-level staff to learn more about specific problems as well as build rapport and determine what functionality would be actually used by end users. Second, surfacing internal champions within the departments who understood the problems that needed to be solved, could provide potential solutions to test, and finally serve as local ambassadors to encourage broad adoption of the new solutions. Third, where relevant, a review of the external customer experience to get a better sense of problems that may not be as apparent to an internal audience.

-Flexibility with IT Solutions: The standard public sector IT procurement process consists of an inventory of relevant business requirements, the development of an RFP, a lengthy procurement process that (in practice) limits the number of participants, and a lengthy product development and implementation

period. Both MONUM and CAT have used a variety of different approaches – including in-house development (in the case of FireStat, BIS, and CityScore), external rapid development (from permitting Hackathons), and smaller, iterative development of products that attached to a legacy backend system (permitting system). This approach has allowed the City to rapidly solve immediate problems, building internal and external credibility for their broader projects. It has also avoided lengthy, high cost IT procurements. Lastly, this flexible approach acknowledges a key problem in public sector IT procurement – it is difficult for departments, particularly in projects that span multiple departments (as the permitting project does), to accurately articulate their business requirements in a comprehensive way. An iterative approach allows new requirements to surface and be incorporated as the project progresses.

-Focus on Problems; Not Data Sophistication:

While the world of technology and data frequently emphasizes cutting edge, highly sophisticated solutions, the City's approach has been grounded in the business problems of their departmental customers. In most cases, customers needed real-time data on their departments, not higher level analysis.

Data alone does not create better policy or improve citizens' lives. However, when used in thoughtful combination with the attributes above, data and analysis can drive process re-engineering that significantly improves city services.