

# The MTA in the Age of Big Data:

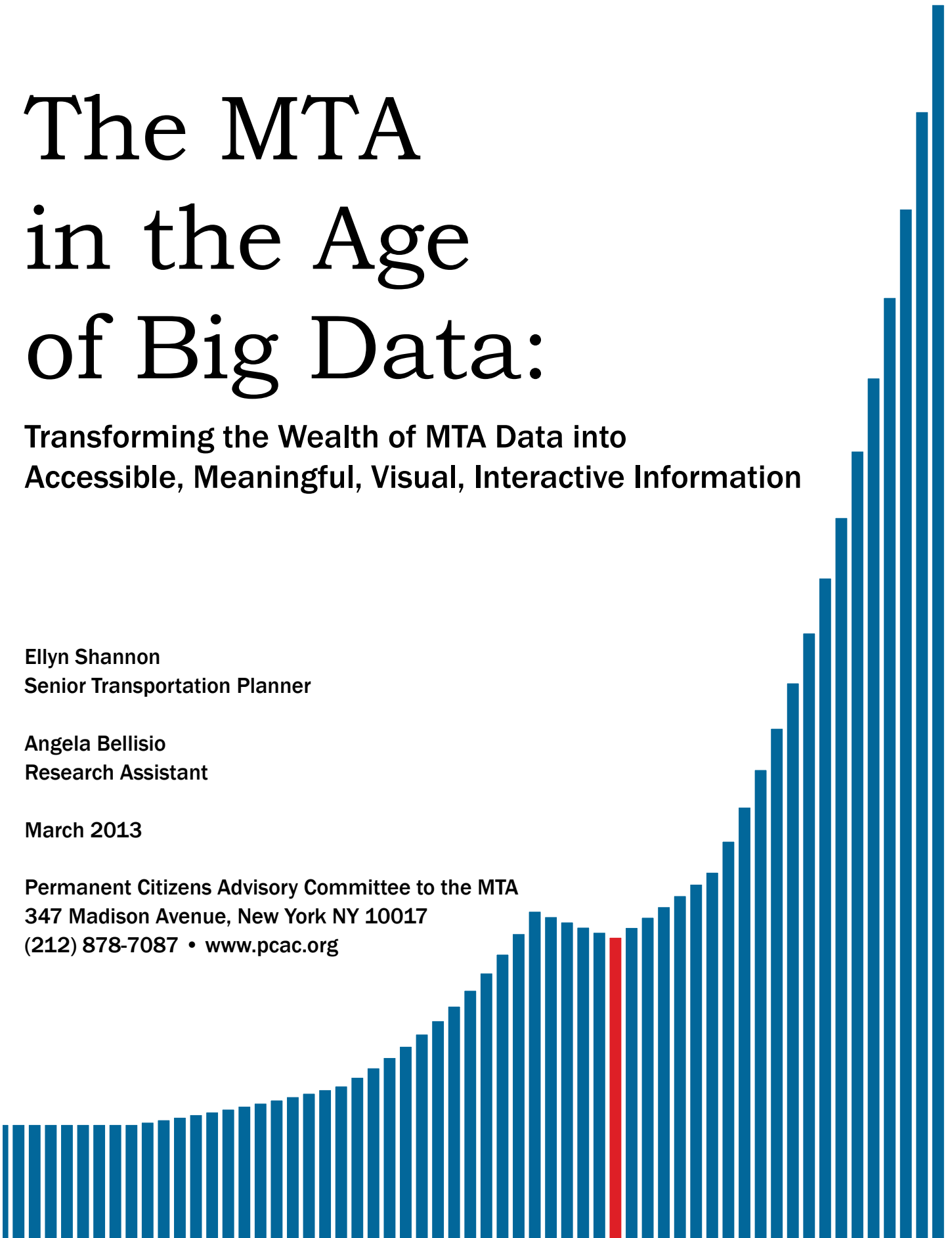
Transforming the Wealth of MTA Data into  
Accessible, Meaningful, Visual, Interactive Information

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## Forward

Upon completion of the PCAC's 2010 report Minutes Matter, a study of performance measures at the Metropolitan Transportation Authority (MTA), the Permanent Citizens Advisory Committee to the MTA (PCAC) participated in the Transportation Research Board's (TRB's) 4th International Transportation Systems Performance Measurement Conference. The event was held over three days in 2011 at the Beckman Center of the National Academies in Irvine, California with 140 transportation professionals from across the country in attendance. One of the presentations that created substantial interest was titled "Transforming Experiences—From Data to Measures, Measures to Information, and Information to Decisions Using Data Fusion and Visualization."<sup>1</sup> This eye opening presentation demonstrated possibilities for efficiently communicating the wealth of information public transportation data contains. This talk also made clear that highway performance metrics were on the cutting edge of new approaches in displaying and making sense of their data, while other transportation agencies still had a long way to go.<sup>2</sup> The PCAC staff returned to New York thinking about whether implementation of this approach at the MTA made sense and what the challenges and benefits resulting from such an implementation might be.

## Acknowledgements

The PCAC would like to acknowledge with appreciation the access we have been given by the presidents of Long Island Rail Road, Metro-North Railroad, and New York City Transit.

We would also like to thank Jan Wells PhD, AICP, for her unwavering support of this project and for setting our eyes on sights beyond the MTA to see the importance of outside resources like those found at the Transportation Research Board.

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1. Yoshihide Sekimoto, "Transforming Experiences: From Data to Measures, Measures to Information, and Information to Decisions Using Data Fusion and Visualization" (paper presented at the annual meeting for Transportation Research Board, Irvine, California, May 18-20, 2011).

2. The New York State DOT has created a traffic data viewer that displays public traffic data graphically as an interactive map. "Traffic Data Viewer," accessed February 7, 2013, <http://gis.dot.ny.gov/tdv/>.

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## PART I: Introduction

The way we think, learn, and communicate is changing with the growth of more collaborative and visually engaging technologies... A “visual shift” is taking place in society, making it necessary to understand its impact on transportation, and explore the role visualization will have on educating our future workforce, and established professionals in a world influenced by social networking, video games, and virtual world technologies.<sup>3</sup>

--Michael Manore, Chair<sup>(’96 - ’12)</sup>

Visualization Committee of the Transportation Research Board

The Permanent Citizens Advisory Committee to the MTA (PCAC) originally set out to write a report proposing that the Metropolitan Transportation Authority (MTA) apply visualization techniques to their performance data in the belief that those techniques would improve stakeholder understanding of the MTA’s performance and allow the MTA to link the value of its capital investments to performance. While there is still a need to make the case for data visualization, we found it necessary to expand the scope of the report to also address the MTA’s data capabilities, which are directly tied to the Authority’s ability to achieve accurate data visualizations. The foundation of the report therefore became the need for improvements in the MTA’s data infrastructure and analytic capabilities, with the idea that these improvements would create opportunities for the data visualizations necessary to properly communicate MTA performance.

The goal of our initial research was also to visualize how 30 years of capital investment in the MTA system has impacted the operational performance of the system. We planned to look beyond the impressive, and frequently touted, on-time-performance and ridership metrics. We wanted to dig deeper by capturing three key measures that significantly impact a rider’s daily commute and localize the information by looking at line and branch performance, believing visualizations of these metrics would make capital investments more meaningful for stakeholders. These indicators, while not the ones riders might immediately request, would help stakeholders understand why and how money is being spent at

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3. Michael Manore, “Creating an Innovative Workforce: Augmenting Words, Equations, and Data with Visualization,” (Transportation Research Board Webinar Presentation, October 1, 2009).

the MTA. In order to see this larger picture, the 30 years of performance measures we were most interested in included:

- a. **Commute Speeds** (track investments and expansion): How improved track conditions and an increase in express train service have changed commute speeds.
- b. **Service Frequency** (rolling stock expansion): How an increase in service frequency allows less waiting time between trains.
- c. **Major Delay Frequency and Recovery Time** (signal and communication modernization): How the recovery speed from a major delay has changed in thirty years.

However, we found that little of the data required to perform the analysis and create the visualizations were readily available. We then worked to identify MTA operating and capital data sets, understand how the data are managed, and learn what data are contained in isolated data silos and what data are maintained in broader relational databases. We learned that the creation of data visualizations was hindered by a lack of good data architecture in the steps leading up to the creation of those visualizations.

With ridership demand increasing and MTA resources decreasing, an accurate accounting of performance metrics through an increased emphasis on data analysis and visualization becomes significantly more important. Transportation researcher Thomas J. Kimpel makes the argument, stating:

While the amount of work undertaken in the area of performance measurement has been considerable, much of the information is not being presently utilized due to the sheer quantity of information available. Efforts to incorporate new data visualization techniques will do much to assist with the identification of operational problems as well as provide insight into potential solutions.<sup>4</sup>

In this report we identify issues with the MTA's data infrastructure and make a case for changing both the infrastructure itself and the MTA culture and attitudes surrounding its data. Changes such as these will improve data accessibility and increase the appreciation of the value of MTA data and the stories it can tell. The use of new data visualization tools and analysis techniques offer the MTA the opportunity to provide its internal and external stakeholders with comprehensible information. By moving in this

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4. Thomas Kimpel, *Data Visualization as a Tool for Improved Decision Making with Transit Agencies*, (Washington DC : Transportation Northwest, 2007), 3.

direction, the MTA will finally be able to demonstrate the value of its investments through the visualization of multi-year trend lines as well as greatly improve transparency and decision-making. The MTA needs to tie the massive amounts of data it possesses to the new and improved analytical and presentational tools that are available today. When it does so, internal decision-making will be improved and the ability of all stakeholders to understand complex issues will be enhanced, making it easier to reach a consensus on current and future actions.

## PART II: Background

### MTA Data History

When Portland, Oregon became the first city visualized on Google Transit in November of 2006, the MTA was struggling with the concept of open information.<sup>5</sup> Throughout the early 2000s, the MTA, still in a proprietary mindset, was involved in lawsuits with bloggers, app developers, artists and entrepreneurs accusing them of infringing on MTA's intellectual property rights.<sup>6</sup> In 2008, the MTA took the first steps in making its transit information more accessible to the public.

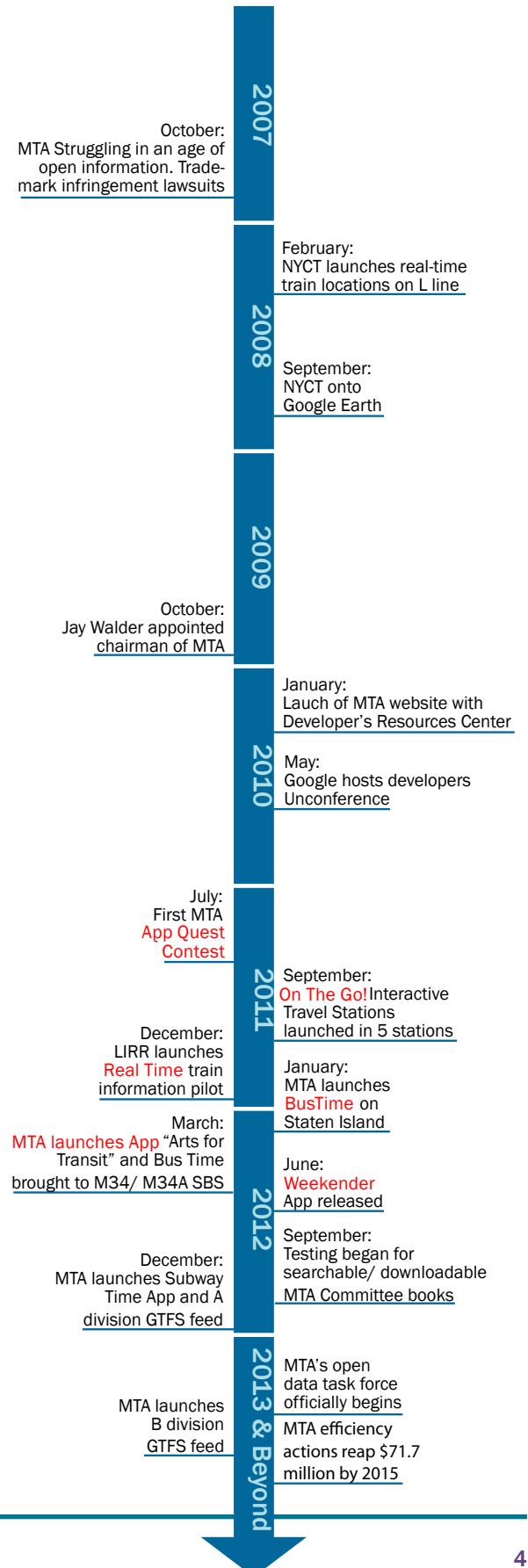
The MTA has now created an Open Data Task Force, and continues to participate in Hackathons<sup>7</sup> and promote app contests. Thus the MTA has been steadily moving in the direction of open data for visualizing its real-time transit information.

However, the MTA could better support its capital proposals by highlighting the successes of its past achievements. While the MTA has spent \$116.7 billion over 30 years investing in capital improvements in the system, there has been no comprehensive retrospective look at what those dollars have done for the performance of the systems or the regions they serve since 2004 when New York University's Rudin Center produced its report "From

5. Benjamin Kabak, "MTA Struggling in an Age of Open Information," *2nd Ave. Sagas*, September 14, 2009, accessed June 12, 2012, <http://secondavenuesagas.com/2009/09/14/mta-struggling-in-an-age-of-open-information/>.

6. Ron Coleman, "MTA's Way or the Highway," *Likelihood of Confusion Blog*, September 2, 2009, <http://www.likelihoodofconfusion.com/mtas-way-the-highway/>.

7. A hackathon is an event where computer programmers and others in the software development fieldwork together on a software development project, frequently a mobile app.



Rescue to Renaissance.”<sup>8</sup> There has also not been any serious analysis to demonstrate how much more needs to be done in order to bring the MTA system into a position that is competitive with its peer systems around the world. Such an analysis could be visualized as an interactive report with trend lines similar to those found in a set of stock performance comparison charts.<sup>9</sup>

## MTA Performance Data

Before addressing the MTA’s performance data visualization possibilities, we must first address the MTA’s data analytic capabilities, which requires an appreciation of the two types of data the MTA struggles with: historic data and real time information data (or Mega Data). Historic Data is comprised of all MTA data that have been retained over the last 100 years. These aggregated data show trends over time and include MTA financial information, performance indicators, ridership counts, capital investments, and scheduling data. Mega Data, on the other hand, consist of current data acquired through technology such as Automatic Train Supervision (ATS) and Bus Time, and fare collection systems. These huge data streams are the drivers for on-the-go apps that require real time data and are the most valuable data sets for developers, but are also the largest and most cumbersome. Mega Data provide intricate levels of location and time-based information, which can connect to stakeholders in a more personal way. For example, Mega Data can be used to highlight specific information about a particular region or district or be used to analyze a specific route at rush hour. Over time, Mega Data will be distilled into Historic Data for use in analyzing MTA performance. Both types of data sets contain important MTA performance information and are valuable to both external and internal MTA stakeholders.

As shown in the timeline at the beginning of Part II, the MTA recently increased its efforts to become a more transparent, visually-oriented system. Rider tools like “Train Time” and the “NYCT Weekender App” are being developed more quickly and frequently. Yet, none of these apps address the MTA’s history of improved performance throughout the network; they simply report conditions. While this scenario is ideal for riders, it is important for the MTA not to neglect the use of data internally. Prior to 2011, the MTA did not invest in a cogent data management and analysis structure to improve the efficiency of the Authority. Because the MTA has primarily focused its energy on addressing the needs of the riders, further progress must now be made by looking inward. An asset management plan that uses performance

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8. Mark Seaman, Allison L.C. de Cerreno, Seth English-Young, *From Rescue to Renaissance: The Achievements of the MTA Capital Program 1982-2004*, New York: NYU Wagner Rudin Center for Transportation Policy and Management, 2004.

9. An example of a stock performance comparison chart can be seen in the beginning of the Findings section on page 15 or on websites like Yahoo! Finance: [finance.yahoo.com](http://finance.yahoo.com).



data would allow the MTA to better account for current actions and plan for future investments. If the Authority tracked before and after performances as they relate to investment, these metrics could easily be displayed through data visualization and would support the case for future investments.

## **Tools that Help Demonstrate the Value of MTA Performance Data**

### **Asset Management**

The Institute of Asset Management defines asset management as the “systematic and coordinated activities and practices through which an organization optimally and sustainably manages its assets and asset systems, their associated performance, risks and expenditures over their life cycles for the purpose of achieving its organizational strategic plan.”<sup>10</sup> Assets can be physical, financial, human, or intangible, like knowledge or data. Good asset management maximizes cost effectiveness and stakeholder satisfaction, increases reliability, and allows users to see trends in data to anticipate future obstacles.<sup>11</sup> It also goes beyond data systems to encompass the business community as a whole. An asset management scheme enables management to better align processes and resources by improving inter-departmental and inter-agency communication, aids in change management as a business philosophy, facilitates a whole-life cost analysis of assets, and also increases transparency.

The Publicly Available Specification 55 (PAS 55) for Asset Management, published by BSI British Standards and International Standard Organization 55000 (ISO 55000) for Asset Management are two international standards in asset management, which outline best practices for optimizing business strategies and managing business assets.<sup>12</sup> In order to facilitate the establishment of an asset management system at the MTA, an MTA-wide Asset Management Coordinating Committee was formed in 2012 to provide guidance and help prepare goals.

### **Business Intelligence and Analytics**

Business intelligence (BI) is the term applied to the ability of an organization to collect, maintain, and organize data. BI technologies are able to provide historical, current, and predictive information on business operations by transforming raw data into meaningful and useful information, which can be

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10. “Definitions,” The Institute of Asset Management, accessed January 5, 2013, <http://theiam.org/knowledge/definitions>.

11. “What is Asset Management,” ISO 55000 International Standard for Asset Management, accessed January 5, 2013, <http://www.assetmanagementstandards.com/>.

12. “What is Asset Management.”

used to inform more effective strategic, tactical, and operational insights and decision-making. While large-scale BI programs, such as those offered by IBM and SAP, are available in a few places within the MTA, many parts of the MTA lack these tools. Data analytics is concerned with how to get information and value out of data and how to use that information when making the best possible decisions.

## Data Visualization

2	1	4	3	9	5	6	7	8	2	3	6	5	9	4	0	1
6	7	9	3	4	9	0	5	6	2	5	8	4	0	5	2	6
9	8	2	6	3	5	9	3	2	9	3	7	2	6	3	4	8
8	1	6	2	3	8	7	9	5	0	2	3	9	2	8	4	3
0	9	1	8	5	4	2	9	4	7	4	6	8	4	0	2	9
3	9	2	7	3	6	6	5	2	9	4	0	4	9	4	8	6
5	2	4	3	6	4	8	1	0	3	9	4	8	4	7	3	2
8	6	2	3	0	8	7	3	6	2	5	4	4	8	3	5	0

How many sevens are in this box?

2	1	4	3	9	5	6	7	8	2	3	6	5	9	4	0	1
6	7	9	3	4	9	0	5	6	2	5	8	4	0	5	2	6
9	8	2	6	3	5	9	3	2	9	3	7	2	6	3	4	8
8	1	6	2	3	8	7	9	5	0	2	3	9	2	8	4	3
0	9	1	8	5	4	2	9	4	7	4	6	8	4	0	2	9
3	9	2	7	3	6	6	5	2	9	4	0	4	9	4	8	6
5	2	4	3	6	4	8	1	0	3	9	4	8	4	7	3	2
8	6	2	3	0	8	7	3	6	2	5	4	4	8	3	5	0

How many sevens are in this box?

These two images are stills from a Column Five video (at [columnfivemedia.com](http://columnfivemedia.com)), which explains why visualizations are helpful. It is easier to identify a pattern in data (in this case the number of sevens) when some visual technique is used. That technique can be as simple as a change in color or size.

One way to analyze data is through data visualization. Visualization is the use of pictures or images or animations to better communicate a set of data. Under the umbrella of visualization, there are a number of subcategories. Visualizations can be static, dynamic (animated), or interactive, depending on what mode is the best fit for the information you are trying to convey, the medium you are using, and the intended audience. The value of data visualizations for MTA's internal and external stakeholders is that they enable those stakeholders to better comprehend concepts and statistics. A more thorough discussion of the types of data visualization can be found in Appendix 2.

## Transparency

Acting in a transparent way is operating with a level of openness and accountability. In order to be transparent, an agency must allow the the public to have access to information that allows them to understand how and why decisions are made. Implementing an asset management program can help bring a greater level of transparency to an organization by presenting information in an accessible way. Included as one tool in an asset management program, data visualization can highlight useful information aiding decision-making.

Transparency is a responsibility to share information that is readily and easily understandable or to give a tool or mechanism that can inspire people to learn what's true. Transparency is not simply opening all data, but rather it is the delivery of information along with the tools required to process that information. Today it is no longer acceptable to simply produce and distribute reams of data without accompanying that data with a means to access it.

### Implementing Asset Management at the MTA

The MTA has begun to address their existing practices, systems, and culture in order to implement a successful new asset management system. Their plan identifies fundamental changes required in business processes, organizational capabilities, and information technology, requiring great energy, as well as time and financial resources. Strategic investments in information systems and improvement in information governance will provide the MTA the ability to show operational improvements resulting from capital investments using data analytics and visualization.

There are also structural obstacles that must be addressed. Many datasets, for example, are kept separately by department. An extra burden is added by the use of these data-storage silos, making cross-referencing financial, operating, capital, and real estate information more complicated. Because BI technology is only as good as the underlying data, the incomplete input caused by data silos renders this powerful analytic tool less effective. Therefore, while it is critical that the MTA be proactive in its approach to data analytics, it is as important for the Authority to integrate its data storage practices. The MTA should prioritize systems integration and data standardization across all agencies.

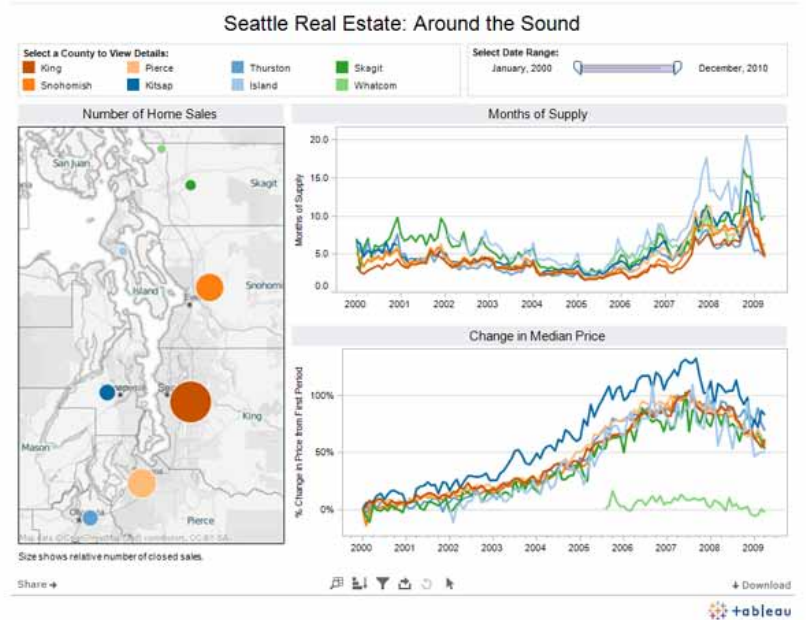
### Practical Applications in Data Analysis and Visualization

A focus on data management strategies will ultimately result in an improvement in the MTA's transparency, which can be illustrated through meaningful data visualizations. These visualizations can be created for internal use through desktop intranet software or for internal and external use through mobile mediums.

## Desktop Software

Many software programs currently allow a desktop user to transform an Excel spreadsheet into an interactive dashboard to aid the analysis of data, which can then be shared electronically. Including interactive visualizations in monthly performance reports can improve interdepartmental communications and make hundreds of pages of information more manageable. There are multiple ways to implement business intelligence practices and we feel it is important that the process is undertaken, regardless of the tool used. Tableau, one example of an interactive desktop visualization programs, allows a user to drag and drop data from a spreadsheet onto visualization templates, to quickly create meaningful business analytics and to easily see dashboards identifying data in different ways.<sup>13</sup>

### Real Estate Prices



**Tableau Desktop** is an interactive visualization program through which a user can create meaningful business analytics from spreadsheet data.  
Image from [visualisingdata.com](http://visualisingdata.com)

## Mobile Applications

When it was introduced in April 2010, the Apple iPad was heralded as the ideal BI consumption device. The first large BI vendor to announce an iPad version of its BI platform was MicroStrategy, which demonstrated its mobile BI application capabilities in June 2010.<sup>14</sup> Other vendors quickly followed suit. End-users saw the gesture-driven tablet as an ideal device to bring highly interactive BI applications into the mainstream. Although the original focus of vendors was firmly on Apple products, many products are now available for Android tablets and scheduled to be released for Windows tablets.<sup>15</sup>

Because BI programs are still in the early stages of development, these programs have not reached their

13. Tableau Desktop software can be found at [tableausoftware.com](http://tableausoftware.com)

14. Andreas Bitterer and Bhavish Sood, "Mobile Business Intelligence Puts Data on the Road," *Forbes*, April 24, 2012, accessed January 3, 2013, <http://www.forbes.com/sites/gartnergroup/2012/04/24/mobile-business-intelligence-puts-data-on-the-road/>.

15. Bitterer and Sood, "Mobile Business Intelligence."

full potential. The advantages of tablets, though, are numerous and their use will surely increase with enhanced program capabilities.

The mobile software program we worked with in developing presentation examples for this report is called Roambi Analytics, an online mobile publisher that allows a user to create interactive visualizations for an iPad or iPhone from an Excel spreadsheet.<sup>16</sup> While the Roambi system was able to perform many of the tasks we sought to accomplish, we chose it for illustrative purposes only, not as an endorsement of a particular software program.

## Interactive Reports

New interactive publishing platforms allow users to create interactive mobile reports. These reports combine a written narrative with the interactivity of a mobile application. Throughout what

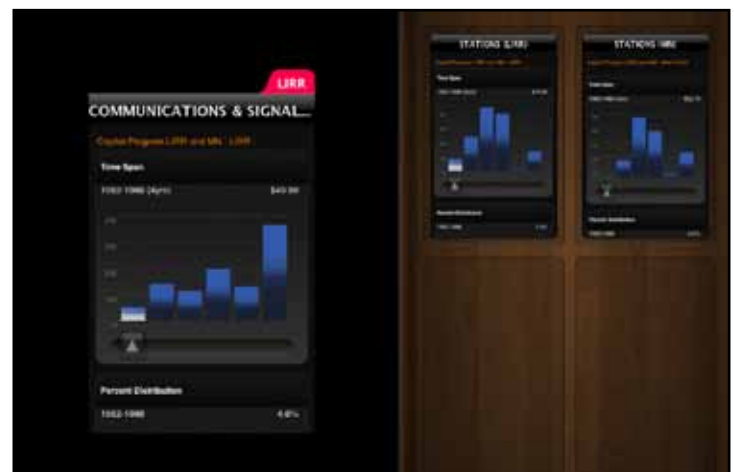


**Roambi Flow** allows a user to create a report on a mobile device where the graphs are interactive.

appears to be a typical pdf file, a reader can click on links to websites or video files and view interactive graphs or infographics. The iPad edition of National Geographic, for example, combines the text of its print magazine with interactive graphics and videos.<sup>17</sup> As the MTA moves to electronic versions of its Committee Board Books and reports, it should look to the numerous capabilities of interactive mobile documents in order to maximize the upgrade's potential.



**Roambi** is an app development program that allows a user to create interactive graphs. This “trend view” illustrates changes in MTA performance indicators over time. Graphs like this allow the user to see high and low points as well as breaks in the data.



A second view of the Roambi app sorts data into a card catalog. Here we have used the cards to be able to compare parallel aspects of LIRR and MNR capital programs. Similarly, each card could be a subway station so riders could compare different criteria like cleanliness, crowding, and wait times.

16. The Roambi app can be found at <http://www.roambi.com/Roambi>

17. The National Geographic app can be found at <http://nationalgeographic.com/apps/>

## MTA Stakeholder Benefits

### Internal Stakeholders

Internal stakeholders include managers and staff as well as board members of all the MTA agencies. Internal stakeholders also include contractors and vendors hired by the MTA.

While the number of MTA apps has increased in the past few years, most of those apps have been focused on schedule and locational data. The MTA should build on the success and the overwhelming positive response from the public for these apps and create its own apps that are targeted for internal uses. It is time to add improved data presentation capabilities for internal uses, employing a systematic analysis that targets the needs of the internal stakeholders, from individual managers to overall departments. The talents that have been so successful in app creation will be an asset as they turn inward to create strategies through which Mega Data can be broken down and made accessible to decision makers.

Asset management and improved data analytics can first be effective at the individual level. Whether a manager oversees operational, station, or maintenance data, the ability to easily access both recent and past trends can make managers more efficient and effective in their day-to-day work. Through analytic methods like data visualization, managers can see trends more quickly and understand them more intuitively than they could by looking at raw data. For example, a station manager might be able to better prepare for a snowstorm by tracking where slips, trips, and falls have happened in the past.

Data analytics can also help management make improvements across a series of stations. A software program that captures data from multiple departments, for example, could reflect the total rider experience at each station by displaying multiple metrics like ridership, service frequency, wait assessment, maintenance, capital improvements, injuries, and crime. If these data were then presented in a uniform way through a medium like data visualization, management could quickly identify stations that need attention as well as highlight stations that are excelling in a comprehensive way.

At the departmental level, asset management can also help the communicator departments become more successful in achieving their goals. Departments such as government and community relations, marketing, capital program management, planning, grants management, and the press office rely heavily on data to create the content of their reports, grant applications, and correspondence. These departments



could benefit from greater access to relational databases with visualizers, which would provide them with up-to-date operational, financial, and capital investment data when they need it.

Finally, more robust data analysis could help the MTA with its larger issues, such as the difficulty it has had in capturing the MTA system's economic value to New York City and the region. Gains could be made in this area by providing the Real Estate department with a map-based program that would illustrate the relationship between station lease values and station ridership or demonstrate the economic development around a station before and after station rehabilitation or service investments. Similarly, the sustainability department could demonstrate the city's reduced carbon footprint due to the MTA system and the value of its carbon credits energy initiative. Additionally, through the new General Transit Feed Specification (GTFS) feeds, the MTA has an opportunity to create a geographically correct depiction of the entire transit system that could operate in real time, which could increase awareness of connectivities that are not now apparent.

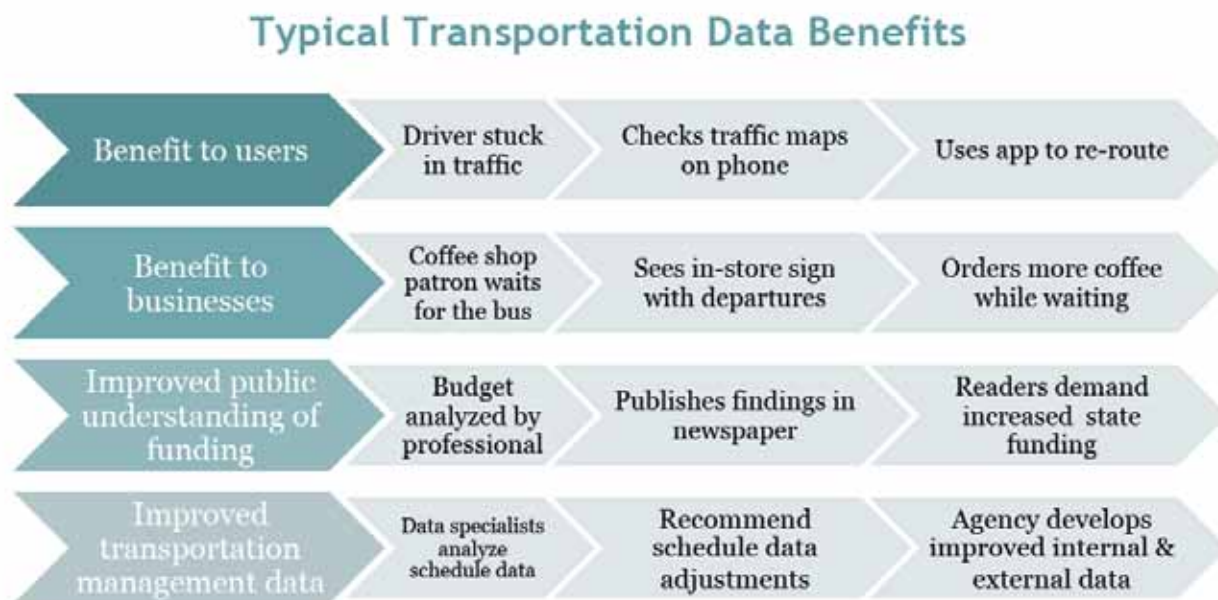
We believe it is time for the MTA's data analysis efforts to add to its outward-facing surface displays of information an inward-facing aspect with analytical efforts that dig deeper into the data and target the needs of the internal stakeholders. These internal analyses could communicate what has happened at the MTA and its agencies over the last ten years. Agencies could start from where they know they already have good data and from data sets where there is already a voiced interest. Establishing good asset management will result in the creation of organized data sets and will therefore allow data to be mined internally and increase opportunities for analysis. We understand, though, that the process of creating these relational databases is complex and requires agreement between agencies and among different departments within agencies. Conflicts between agencies will have to be resolved in order for the effort to advance. A change management philosophy that addresses these complexities by encompassing technology investments, a data governance process, and an investment in both the education and number of personnel is therefore a key factor to success. The PCAC encourages the MTA to continue with its ongoing efforts to create an asset management plan that addresses these cultural issues.

## External MTA Stakeholders

External stakeholders include everyone the MTA benefits. In addition to the riding public, external stakeholders include federal, state, and city agencies, elected officials, transit advocates, the media, and academic researchers. The influences of MTA benefits also extend to businesses and other economic

development drivers around transit stations and hubs.

One reason for the adoption of a consistent data management plan throughout the MTA is the need to tell many elements of the MTA story. One set of performance data points displayed as a graph can be interesting. It might, for example, allow the viewer to notice that one subway station has much higher or lower ridership than other stations in the system. But a series of insights like these strung together can form a story. Data analysis can help to answer the question of why one subway station has different ridership patterns than another, and how that difference relates to the stations around it and also to bus ridership and the local economy. That full, faceted story is currently missing in the public analysis of MTA data, but is exactly what is needed in order for the public to better understand the impact of the MTA system. Stronger data governance, management, systems, and applications would allow internal and external stakeholders to more effectively measure, evaluate, and communicate the impacts of capital and operating investments on service performance and risk over time.



This chart by Sarah Kaufman from *Getting Started with Open Data: A Guide for Transportation Agencies* The Guide can be found [here](#) or from the Rudin Center for Transportation Policy and Management at NYU Wagner.

In addition to rider benefits, the chart above highlights how data analytics benefit other entities. For example, a local coffee shop might see an increase in customers who are waiting for a subway if those



riders know how long a wait they have before the next train.<sup>18</sup> As riders and others better understand the public transportation funding, they may increase their advocacy for state funding, thus benefitting the transit agency and riders.

## Federal Mandates

Starting with ISTEA in 1991, all recent Federal Transportation Bills have mandated public participation. Public participation, though, can only be beneficial if the public has the resources to make decisions. The public can gain a better understanding of both the local and the overarching pictures through access to micro and macro data and trends. Interactive data visualizations can help the public to see the impacts of large and small changes and can lead to more effective public participation.

In MAP-21, the 2012 Federal Transportation Bill, there is an increased emphasis on implementing asset management through the use of improved performance measures. This new bill requires that transit agencies set and implement asset management goals. An enhanced asset management effort will further enable the MTA to satisfy many requirements of this new bill.<sup>19</sup>

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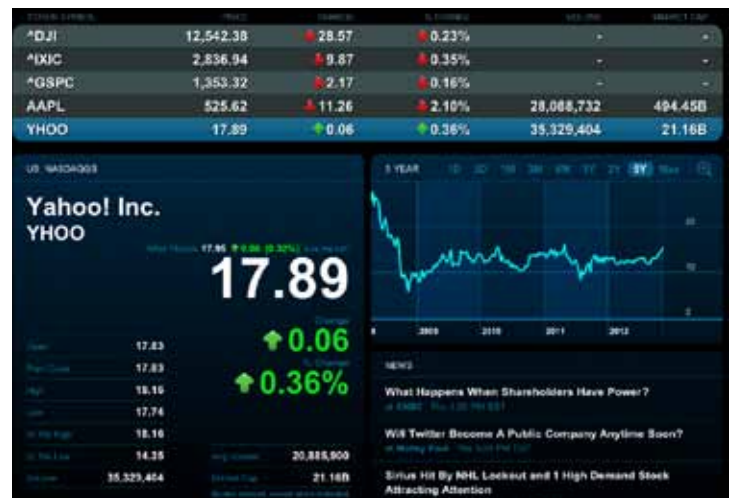
18. Sarah Kaufman, *Getting Started with Open Data* (New York: Robert F. Wagner School of Public Service, 2012), 3. From 2007 to 2011 Sarah Kaufman was the Projects Coordinator of Intelligent and Emerging Transportation Systems at New York City Transit. While at the MTA, Kaufman took on a number of roles including developer liaison, AppQuest contest organizer, social media coordinator, and chief moderator for the developer Google group. During her tenure she actively reached out to developers who were building applications from newly released MTA data. Information can be found in these articles: Michael Keller, "Exit Interview: MTA's Openness Wizard Talks Transparency," *The New York World*, March 6, 2006, and Nick Judd, "At the MTA, a Data Maven is Moving On," *Tech President*, December 5, 2011.

19 "MAP-21, Performance Measures, and Performance-Based Funding" Chicago Metropolitan Agency for Planning, accessed January 5, 2013, <http://www.cmap.illinois.gov/policy-updates/-/blogs/map-21-performance-measures-and-performance-based-funding>.

## Part III: Findings

While current accomplishments are highlighted in daily press releases, there is no place that an MTA Board member, transit advocate, academic, or elected official can go to look at the MTA trends over time. It is difficult for all stakeholders to see MTA trend lines beyond the one year period presented in “board books” and MTA website dashboards. There is no repository of data showing either 30-year trends, which would reflect the impact of the Capital Program’s 30 years of investment, or even 10-year trends that reflect the performances of operating agencies over the last decade. Analyzing these trends could begin to answer questions about how wisely capital dollars have been spent and what past investments have accomplished.

Currently, the MTA presents on-time performance (OTP) statistics (the percentage of trains that were on time in a given month or year), the Mean Distance Between Failure (MDBF) (how far trains and buses travel before breaking down), and ridership (the number of people choosing transit instead of another form of transportation). While these indicators are presented on the MTA website as a list and on a basic bar chart, they could be made more meaningful by visualizing the data by line, branch, or community, making the information more relevant to stakeholders and clarifying investment needs.



This interactive dashboard allows the user to put the Yahoo! stock in context. A similar dashboard could compare railroad or transit agencies.

Dashboard downloaded from [Yahoo! Finance App](#)



When looking at just one year of the trendline for Yahoo!’s stock, the price seems quite stable and even positive.



If the time period of the trendline is expanded to five or more years, it can be seen that between 2006 and 2012, the stock has declined.

With our concern for the lack of easily accessible trend data for MTA operating agency staff, we dug deeper to understand what was hindering that accessibility within the agencies. We focused on the MTA's technology departments, the cultures at the operating agencies, and the databases themselves. Below are our findings.

## IT Management Actions (2011-2012)

1. **A Snapshot of the Complexity of the MTA IT Departments:** The MTA and its agencies currently have 30 computer rooms, more than 2,000 servers and over 600 computer applications. Although many of the computer applications run on out-of-date legacy platforms that are time consuming and difficult to maintain and upgrade, these legacy systems contain invaluable data. The IT Departments continue to maintain and modernize many of the systems despite their obsolescence.
2. **The Open Data Task Force:** The MTA's Open Data Task Force will examine what data needs to be publicly available and identify the steps required to do so.
3. **The MTA's CIO Council:** The MTA-wide CIO Council began in the 1990s, but it was not until more recently that the Council has matured into an effective management program. The Council is now eager to address the need to create common platforms, standard software programs, and improve the long term planning efforts.
4. **Efficiency Actions:** \$71.7 million in MTA savings will occur between 2011 and 2015 due to efficiency actions taken by the CIO Council.
5. **New York City Transit Asset Management Program:** New York City Transit has begun an asset management improvement effort, designed to improve the Agency's processes surrounding its multibillion-dollar asset portfolio. This effort will be accountable to independent international standards.
6. **Enterprise Architecture Group:** For the past two years, an MTA-wide Enterprise Architecture (EA) group has been in place to better link strategic business planning with IT planning, technology standardizations, and information structures.

## Corporate Culture: Obstacles to Open, Visual, Interactive Performance Data

1. **Current Corporate Culture:** Although there are staff within the MTA and its agencies who are open to and enthusiastic about the possibilities for new technologies, during our interviews we were also aware of resistance.
  - The process of creating relational databases is complex and requires agreement among different departments within agencies and among agencies. These issues speak to long standing methodologies that are held by each group, and adjustments to them do not come easily. This challenge is acknowledged by the MTA and will be addressed in the future asset management program.
  - Many staff members carry a lingering skepticism as to the importance of data visualization and the impact it can have on creating greater efficiencies and vastly improving internal and external communications.
2. **Data Silos vs. Relational Databases:** The staffing, operation, planning, capital and financial data of the MTA's operating agencies are predominantly maintained in separate data silos, in separate departments.
  - The data silos limit the MTA's ability to fully evaluate the breath of their fiscal, capital, and operational efficiencies and investments as well as further complicates the fulfillment of data requests.
  - Valuable data contained in these silos are not included on the MTA website's Open Data portal, preventing outside stakeholders from adequately analyzing the MTA's fiscal, capital investment, and operational performance, which reduces the MTA's credibility.
3. **Siloed Data Inhibits Internal Data Sharing Between MTA and Agency Departments:** The MTA can not take advantage of its internal data network to allow sharing of data among employees in different departments because data silos make obtaining data labor intensive. Data-based collaboration, though, is essential to link the cause and effects of investments.

New data management positions may be required to build a data management system.

4. **Lack of Proactive MTA Technology Training and Conference Participation in All MTA and Agency Departments:** Training and conference participation budgets throughout the agencies have been severely reduced in recent years. Software application training of non-IT staff can help make the corporate culture respond more positively to new technology as well as introduce new and innovative business practices to staff.
5. **Lack of Adequate Staffing to Fill Data Requests:** Currently, data requests divert non-IT staff from other priorities. At the same time, the pace of data requests is increasing as advocacy groups, academic institutions, elected officials, and the press continue to seek data to answer questions and enhance research. This imbalance has caused frustration at the MTA and Agencies because fulfilling data requests distracts those in operations and operations planning from their primary responsibilities.
6. **Lack of Internal Data Visualization Capabilities:** Although much IT energy is expended to create a visually-based, rider-friendly environment externally, there is little effort to advance data visualization technology for internal purposes. Data visualization is not used sufficiently to identify problem areas, create a set of best practices, and study the conditions before-and-after investments. Databases are upgraded without adding visual components to them. A strategic vision for data analytics and visualization, which is supported by strong governance and standardized business practices for all MTA agencies, will be required to capture critical data in a structured format to support transit outcomes.

## IT Budget and Funding

1. **Budget Reductions:** While in the past tight budgets have improved the efficiency of business practices by placing new emphasis on compatible IT purchases across platforms and reducing redundancies in staffing, now a business case can be made to increase funding to improve the governance process.
2. **MTA Funding:** The Information Technology Infrastructure program is predominantly paid for through the MTA Operating Budget, not its Capital Budget, but this funding strategy has become out of step with current business practices. While software and hardware systems

become obsolete very quickly due to the speed of development, technology infrastructure investments continue to be useful over the long term and therefore can be a justifiable capital investment.

## Looking to the Future: Asset Management Planning

1. **New York City Transit:** Senior management at NYCT has taken the lead in creating a plan to incorporate asset management practices at its Agency. The plan includes a focus on corporate culture, optimizing business practices, and enhancing information technologies. It also recognizes the importance of educating members throughout the agencies of the benefits of an asset management program in order to ensure the program's success. NYCT is producing a management system template from which the other agencies can implement similar processes. This program should greatly enhance the MTA's data visualization capabilities.
  - **International Recognition:** NYCT's asset management plan will follow international standards like the British Publicly Available Specification 55 (PAS 55) for Asset Management, giving it a framework as well as a standard for independent international accountability.
  - **Financial Benefits:** The accurate and documentable asset management strategy for how, why, and where capital investment dollars are spent will optimize expenditures, by capturing life cycle costs and investment priorities in the decision making process. This information will in turn flow back into a communication that can accurately capture the value investments have provided to the city, region, and state.
  - **Communication Benefits:** This asset management scheme will be able to demonstrate operational savings that have occurred from capital investments.

## PART IV: Conclusions and Recommendations

### Conclusion

Every month, the MTA produces over a thousand pages of text and statistical information, bound into seemingly endless books of static black and white charts that take hours to decipher. And yet, even with close examination of these documents it is difficult to grasp how the investments in the MTA are performing. Data visualization is a tool that can be used to make this kind of information more accessible to stakeholders. In our research we found that some MTA Headquarters and Agency staff are already exploring what international practices are used to solve the same issue.

By way of illustration, while writing this report the PCAC produced an interactive mobile data visualization that presents three years of New York City Transit performance data in the context of time. Rather than comparing two single data points that correspond to the same month in two different years as is currently found in the MTA's committee books, we included data points from every month in a year over several years, allowing the data to be seen in a more complete context. The data visualization highlights the relationships between data points while condensing hundreds of pages of data, making it easier to comprehensively understand. Unfortunately, the only way to get to this endpoint on a larger scale is through reimagining how the MTA deals with and processes data. Through our visualization, we can see that the Federal Highway Administration concept that "visuals can make information instantly or intuitively understandable,"<sup>20</sup> applies directly to the scale and complexity of MTA information.

The MTA's information knowledge base, comprised of the Authority's business practices, corporate culture, information technology capabilities, and institutional knowledge, is underfunded, understaffed and under supported, leaving the MTA ill prepared to move into a technology-based future. While correcting this condition is daunting, it is not impossible. The MTA spends approximately \$25 billion on capital investments over each five-year Capital Program, yet little of this money has been used to document the value of these investments to its riders or to regional and state economies. The MTA's next five-year Capital Program will begin in 2015, making it imperative to think about providing future resources for data analysis efforts now. Making asset management a major priority will make the MTA more efficient and more reliable, and will lower costs, while helping to prepare data for use in data visualization.

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20. "What is Visualization in Planning?" FHWA Scenerio Planning and Visualization in Transportation, accessed December 20, 2012, [http://www.fhwa.dot.gov/planning/scenario\\_and\\_visualization/visualization\\_in\\_planning/](http://www.fhwa.dot.gov/planning/scenario_and_visualization/visualization_in_planning/)



In the course of our research we found that New York City Transit leadership has focused on a very well planned asset management program that addresses many of the issues we have identified in this report. We support the impressive multi-year effort that will be required in order to fully change existing practices, systems, and culture. In our recommendations, though, we will request that some specific short term goals be enacted in time for the next Five-Year Capital Program request in 2014 in order to address pressures that need to be alleviated before a full asset management plan can be enacted. In line with this notion, the PCAC believes that focusing on a series of specific projects with visualization-based outcomes will demonstrate the importance of utilizing data and data visualization.

Additionally, because the MTA's resources are limited, the PCAC believes a case must be made for the importance of funding information technology as part of an overall investment scheme which includes investing in strong governance and standardized business practices, as well as investing in the capabilities of MTA and agency staff. One goal for this investment would be to improve communication between MTA decision makers and stakeholders by demonstrating the direct relationship between the MTA's capital investments and its operational success, efficiencies, and value. A second goal would be to improve internal management and decision-making through a unified data and technology infrastructure and a new corporate culture of inclusion throughout all the agencies. Finally, the MTA can increase its transparency both internally and externally through the data visualizations that can be built on a more coherent database system. Without allocating capital resources at the MTA corporate level, it will be extremely challenging for agencies to implement an asset management program using the same resources allotted to existing infrastructure needs.

The MTA must become a more efficient authority through both hardware and software upgrades, technological training, and improved business methods. Budget cuts may have led to more streamlined departments, but now money must be invested in the governance process throughout the MTA family to reinstate and advance some of the resources that were cut. The future of the MTA must be more digitally oriented and technologically savvy for the agency to be efficient and successful. To start down this path, three things must be addressed simultaneously: data must be prioritized, data visualization must be utilized, and the MTA culture regarding IT departments and data management must be modernized.



## Recommendations

As the volume of transit data increases, the MTA has the opportunity to lead the way in demonstrating the financial and cultural benefits of investing in transit data. The current leadership at the MTA recognizes the need for an institutional culture change that will transform the current asset management philosophies. They will need to advocate for more informed decision making for both operating and capital needs, and promote improved communication between agencies and stakeholders by opening specific data and creating interactive data visualizations. This culture change must go hand-in-hand with an investment in asset management that will enable the MTA to more accurately track the successes and failures of the Capital Program, and an investment in the capabilities and capacity of personnel who will be required to make this change happen.

### Realize the Strategic Value of the MTA's Data

- Invest in technology systems.
  - ◊ Prioritize strategic IT investments to improve data management and analytics.
  - ◊ Remove databases from silo platforms and create relational databases to enable asset management and clear analysis of operational performance and capital investments.
- Invest in a uniform governance process.
  - ◊ Prioritize asset management across the MTA.
  - ◊ Prioritize whole-life cost analysis of investments and fit-for-purpose criteria to optimize asset values.
- Invest in people.
  - ◊ Invest in knowledge: increase information technology training and conference participation for all MTA and agency departments to broaden IT and data visualization knowledge throughout the MTA and increase exposure to new data analytic and visualization opportunities as well as departmental efficiencies.
  - ◊ Invest in capacity: hire appropriate staffing in all MTA departments to facilitate change management.

- ◊ Invest in the process of culture change: enable investments in technology systems and governance process to flourish.
- Highlight the business case for investing infrastructure dollars in the MTA's asset management plan by looking to the long term efficiencies and effectiveness gained from capital program investments.

## Improve Performance Reporting

- Explore experimental applications of Big Data, open data and data visualization in order to promote a better understanding of the MTA among internal and external stakeholders.
- Promote the importance of performance data in determining the economic impacts the MTA system has on the local, regional, state and national economies.
  - ◊ Link economic development to capital investments through before-and-after analysis for projects such as station rehabilitations and service speed and frequency investments.
  - ◊ Link the significance of the MTA's operational performance data with financial and head-count data in establishing the case for the Capital Program.
- Apply data analytics and visualization to improve performance reporting to the Board and stakeholders.
- Incorporate performance metrics into the 20 Year Needs Assessment, by demonstrating needs and successes through performance data when possible. Incorporate data visualization components into MTA databases to improve internal knowledge accessibility.
- Create a mobile application that can present interactive reports and data analytics in an easily readable and accessible format.
- Collaborate with university programs to assist with historic performance data uniformity work.

## Increase Open Data Efforts

- Continue to support the Open Data Task Force and create a timeline with priorities. Engage internal and external stakeholders, including the Open Data Community, in identifying the appropriate data sets for public release.

- Publish all performance and financial data already publicly released in MTA board books from 2000 to the present on the MTA open data portal by September 2013.
- Maintain internal metrics on dataset usage to determine spending priorities for work needed to make these datasets public.

## Demonstrate the Benefits of MTA Investments Through Data Visualization Projects

We are proposing that the MTA create a data visualization working group to complete three hierarchical projects that experiment with using big data analytic techniques and visualization tools by the end of 2013. The first visually displays previously published MTA data, the second incorporates these new data visualizations in MTA board books that are currently being digitized, and the third combines the electronic board books with other existing MTA data in an app that acts as a transparency portal.

1. Create an interactive mobile and/or desktop application that displays trend lines.
  - Translate operational performance and headcount trends of MTA performance indicators previously released in the MTA board books from 2000 to the present.
  - Allow users to identify trends by month and year.
  - Include relevant MTA financial data from the MTA's actual budgets in the interactive data visualization trends platform 2000 to present.
  - Where possible, tie performance indicators to branch or line locations.
  - Include trend lines for key indicators for each operating agency over the past ten years including information like total headcount, total number of trains run, and operating budget.
2. Create interactive mobile MTA Board reports.
  - Incorporate ten-year trend lines with text throughout digitized board books

- Include interactive charts.
  - Equip electronic board books with the capacity to access live web links.
3. Create a mobile MTA application to act as a transparency portal.<sup>21</sup>
- User could access a library of electronic board books.
  - Buttons on the app might allow a user to access performance analytics, capital program and other financial data, information on public hearings, and other documents currently available on the MTA website.



**Demonstration Project 1:** An example of an interactive mobile app that displays operational performance data.



## Demonstration Project 2: Transform MTA Board Books into interactive reports



### Demonstration Project 3: Create a master mobile app that allows users to access interactive reports

21 A good example of what we are looking for can be found in an app created by Stanford University, iStanford, which can be downloaded for free from the iTunes store. Accessed at <http://itservices.stanford.edu/service/mobile/apps>

Part V: Additional Information

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Appendix 1: What Concerns Does the MTA Have in this Discussion?

In writing this paper, the PCAC held meetings with all the MTA transit agencies. The following section addresses some of the concerns that were brought up at those meetings.

Has anyone done a cost benefit analysis for releasing data?

In 2011 the Transportation Research Board conducted a study to learn about the use and deployment of real-time transit information. Included in the goals of the study was to need to learn about the resources required to output data successfully, specifically on mobile devices. Unfortunately, the research team found that “the costs of providing real-time information are not well understood and have not been thoroughly studied.”<sup>22</sup> Twenty-eight transit agencies from around the world participated in the study, but only four offered an estimate of the number of labor hours per month required to provide real-time data and those estimates ranged from 15 hours over three departments to 520 hours over two departments.<sup>23,24</sup> Thus further study is required to understand the true time investment required.

The TRB study demonstrates that the direct and measurable benefits of making public sector information available freely and without restrictions on use typically outweigh the costs. Expenses include initial costs including the time and staff required for cleaning the data and setting up the initial site, and

22. Carol Schweiger, *TCRP Synthesis 91: Use and Deployment of Mobile Technology for Real-Time Transit Information* (Washington, DC: Transportation Research Board, 2011), 31.

23. Schweiger, *TCRP Synthesis 91*, 31.

24. Sarah Kaufman, *Getting Started with Open Data: A Guide for Transportation Agencies* (New York: Robert F. Wagner School of Public Service, 2012). 9.

ongoing costs include converting new data as it is created and making data fixes and updates as needed.<sup>25</sup> Benefits, though, include an increase in ridership and a more satisfied customer, both of which can lead to an increase in revenue. When one adds the longer term benefits that we cannot fully measure, and may not even foresee, the case for open access appears to be strong.<sup>26</sup>

## Who is in the Forefront of Data Visualization?

As we stated in our introduction, we were introduced to the power of visualizations by way of highway agencies. The Federal Highway Administration (FHWA) has long used visualizations like heat maps and roadway models to illustrate traffic patterns and congestion. Health care, too, is an industry that has made visualization a core component in its communications. GE, for example, uses interactive infographics to help physicians discuss breast cancer treatments and the cost of healthcare.<sup>27</sup> Additionally, industries like UPS prioritize IT development in order to grow and change.<sup>28</sup>

One of the first public transit operators to embrace visualizations was TriMet in Portland, Oregon. While they were pioneers, the transit organizations in cities like New York and Boston are catching up. Still, TriMet's approaches are worth looking at because they have embraced the importance of both external and internal management of data.

As early as 1997, TriMet, the local transit operator in the Portland, Oregon metropolitan region, installed a bus dispatch system (BDS) on its entire bus fleet. This system, which tracks bus location, passenger counts and others stop-level transit data, became a vital tool for transit planning.<sup>29</sup> The information it acquired was displayed both externally to its riders and used internally for operations decisions. The TriMet website includes an App Center, like that of the MTA, where users can download free and commercial apps created from TriMet's open data system. Also like that of the MTA, the TriMet website includes a performance dashboard that displays graphs of financial and operating performance over time and includes a link for users to add input about how to expand the indicators. These graphs include information on buses, MAX Light Rail, WES Commuter Rail and LIFT Paratransit Service<sup>30</sup> and serve as

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25. Kaufman, *Open Data*, 9.

26. John Houghton, *Costs and Benefits of Data Provision Report to the Australian National Data Service* (Melbourne, Australia: Victoria University, 2011).

27. "Data Visualization," General Electric, accessed July 10, 2012, [visualization.geblogs.com](http://visualization.geblogs.com).

28. Jeanne Ross et al., *United Parcel Services: Business Transformation through Information Technology* (Massachusetts: MIT Sloan School of Management, September 2002), 5.

29. M. Berkow, A. El-Geneidy, R. Bertini, and D. Crout, "Beyond generating transit performance measures: Visualizations and statistical analysis using historical data," *Transportation Research Record* 2111 (2009): 162.

30. "Performance Dashboard 2012", TriMet, accessed June 8, 2012, [www.trimet.org/about/dashboard.htm](http://www.trimet.org/about/dashboard.htm).

one aspect of TriMet's voice to its ridership.

TriMet's internal "Operations Dashboard," shows target and actual performance measurements for numerous aspects of bus and rail service. This dashboard is not for public consumption, but rather caters to operations planners and other decision makers. According to the TriMet Citizens Advisory Committee, this dashboard "provides a high level summary of performance, and allows senior Operations staff to identify where performance has been improving or worsening and take appropriate actions. Areas of focus include measures of customer service as well as metrics used to evaluate managers (absentee rates, unscheduled overtime and maintenance, bus standby time, etc.)."<sup>31</sup> Senior management uses these data along with monthly meetings to be aware of trends in a timely manner, and to make adjustments as needed. The PCAC sees visualization as one ingredient in the creation of a similar internal operations dashboard at the MTA.

In addition to internal and external visualizations, an increase in the importance of IT can be found in many transportation industries. For example, UPS, a transportation company that moves goods and information, rather than people like the MTA, is a similarly sized company to the MTA and therefore might be considered in its peer group. Beginning in the mid 1990s, UPS wanted to grow and redefine the company and knew that technology would be a critical component of that change. It therefore began to invest in information technology to build the necessary telecommunications infrastructure and improve business operations.<sup>32</sup> Their IT network needed to be able to accommodate 200 data elements for each of its 13 million packages shipped daily, with room in the system for continued expansion. In order to fully accomplish the task, UPS made changes in its process and organizational structure from the top down.<sup>33</sup> In spite of the trends toward an architectural strategy of decentralization, they instead focused on centralizing and standardizing IT throughout the organization to accommodate high transaction volumes.<sup>34</sup>

## Does asset management really work?

The London Underground is composed of 11 rail lines with 3 million daily riders. Their asset management scheme includes a comprehensive asset register, which measures conditions for all assets, the

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<sup>31</sup> Cynthia Chilton et al., "Citizen Advisory Committee on the Budget: Report to the Board of Directors" (April 13, 2011): 21.

<sup>32</sup> Jeanne Ross, *United Parcel Services*, 5.

<sup>33</sup> Mitchell Levy, "Case Study: United Parcel Service, Inc. (UPS)," Peachpit.com, March 2, 2001, accessed September 8, 2012, <http://www.peachpit.com/articles/article.aspx?p=20881>.

<sup>34</sup> Jeanne Ross, *United Parcel Services*, 6.

implementation of a “lost customer hours” metric that supports the evaluation of maintenance effectiveness and links maintenance to user cost, and a plan that aids in calculating agency and user costs of deferred maintenance on an annual basis.<sup>35</sup> Through the adoption of an asset management program, London Underground has realized maintenance efficiencies in the areas of fleet and depots, tracks, signals and operations, and stations.<sup>36</sup>

The transit system around Melbourne, Australia consists of commuter rail, intercity rail, and freight service. An asset management plan was established to monitor multiple conditions including mean time and distance between failure, asset availability, number of defects and planned versus actual work. The asset register tracks metrics like rail infrastructure and rolling stock conditions, and work performance and well as having an integrated, web-based inventory of rail infrastructure.<sup>37</sup>

### How many people really have smart phones?

As of March 2012, a majority (50.4%) of U.S. mobile subscribers owned smartphones, up from 47.8 percent in December 2011.<sup>38</sup> Transit customers in particular use mobile technology at a rate even higher than average, as is evidenced by statistics like those for Orange County Transportation Authority reporting in California where 75% of bus riders have cell phones and 64% have text-enabled cell phones.<sup>39</sup> Because smart phone use is trending upward, it is beneficial to invest in software development that will take advantage of its pervasiveness.<sup>40</sup>

### How do you prevent misuse of data?

One perspective on app development is offered by Sarah Kaufman: “Users will stop using apps with bad information, and the market will account for these less informative apps with lower ratings and bad reviews in their stores.”<sup>41</sup>

One way to protect operational data is by creating a dashboard. If open data is simultaneously interpreted

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<sup>35</sup> Bill Robert, “International Perspectives on Asset Management and SGR” (presentation to Federal Transit Administration State of Good Repair Roundtable, Washington DC, July 8-10, 2009).

<sup>36</sup> “Rail and Underground Asset Benchmarking Initial Report June 2011,” *Transport for London Board*, June 29, 2011.

<sup>37</sup> Robert, “International Perspectives.”

<sup>38</sup> Kaufman, *Open Data*, 10.

<sup>39</sup> Carol Schweiger, *TCRP Synthesis 91: Use and Deployment of Mobile Technology for Real-Time Transit Information* (Washington, DC: Transportation Research Board, 2011) 52.

<sup>40</sup> There are more than 285.6 million U.S. wireless subscriber connections, which is approximately 91% of the total U.S. population. (CTIA- the Wireless Association <http://www.ctia.org/advocacy/research/index.cfm/AID/10392>)

<sup>41</sup> Kaufman, *Open Data*, 10.



and displayed on the transit agency's website, that agency will be protected against groups who want to "lie with statistics" because the true statistics are clearly presented. In a dashboard, for example, an agency could display metrics and include their definitions, such as on time performance and costs per ride, as well as display metrics of other agencies for the purposes of benchmarking.

TriMet, for example, presents its historic data to the public as a series of graphs on their dashboard. From the TriMet dashboard, a user can download the underlying information as a table. Moreover on the page where users can download past monthly ridership and performance statistics, TriMet has included a quick list of ridership trends.<sup>42</sup> This list highlights what TriMet wants the user to learn from its data and this can readily become the facts that are disseminated first. In this way TriMet is simultaneously presenting its historic data and proposing a method for interpreting it. In addition to a dashboard system, the MTA could present their historic data at forums like a rider council or civic group meeting that provide an opportunity to educate the public as to how to understand the metrics.

### How do you staff and fund the effort?

The MTA is currently moving in the right direction in its approach to open data, but as data becomes more robust, we need to think more broadly about the next steps. Funds need to be specifically allocated toward maintaining data for the MTA as a whole and each operating agency. New positions need to be created to address both the cleaning of data and the internal creation of apps. These positions could be funded through the Capital Program, in the same way the Capital Program funds planning activities. MTA management should be responsible for the delivery of results in order to create accountability.

### How does data visualization benefit the riders and why is open data important to riders?

A 2010 study of thirteen transit agencies performed by MIT found that transit passengers value up-to-date, real-time trip information over schedule adherence. Real-time information allows the passenger to more easily integrate transit into their schedules and therefore helps to capture the choice riders. This potential increase in ridership and therefore revenue could offset the expenses of making information available.<sup>43</sup>

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<sup>42</sup> These dashboards can be found on the TriMet website at [trimet.org/about/dashboard.htm](http://trimet.org/about/dashboard.htm).

<sup>43</sup> Anthony Charles Rizo, *Implementation of Advanced Transit Traveler Information in the United States and Canada: Practice and Prospects* (Massachusetts: Massachusetts Institute of Technology, 2010), 56.

Releasing structured, clean data has numerous benefits including increased ridership, improved customer service, and a positive image for agencies, and free development of mobile applications, all of which translate to a better rider experience. Open data provides resources to a community of digital developers; with open data, developers can create apps that are more accurate. They can create applications in multiple languages or for people with vision disabilities, thus combating fear of being overwhelmed by the system. Apps could also be created with local neighborhood information. The greater understanding of the transit system that comes from the increase of knowledge may lead to greater rider advocacy and possibly better funding. For example, the recent release of real-time subway information for the A division lines led to the independent creation of an Android app similar to the MTA-released iPhone app. While open data should not be confused with transparency, the MTA should continue to move toward similar data releases.

The large-scale impact of a little more knowledge is evidenced in the introduction of countdown clocks in New York's subway system. Between 2010 and 2011 customer satisfaction surveys indicated an across the board increase in rider satisfaction in spite of service cuts, fare hikes, and a reduction in station agents. One reason for this overall satisfaction, the MTA found, was the introduction of countdown clocks because the clocks gave riders a sense of control.<sup>44</sup> Visualizations likewise can increase the amount of accessible information for evaluating system performance. Unlike countdown clocks, though, the knowledge resulting from visualizations can become a catalyst for change through increased funding and service improvements.

### How does make data more accessible internally benefit the rider?

Management-driven data might allow for system-wide ratings that would allow the rider to see their station and stop in relation to all the others. Knowing where the weak spots are throughout the system would allow for the agency to make targeted improvements and operate more efficiently. Rating information will cause riders to be more engaged in the data. They can begin to get answers to questions like, how does my train compare to another in terms of on time performance, or why is my train always late?

MTA executives at the decision level need to have access to the data necessary for good decisions through

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<sup>44</sup> "2011 MTA Customer Satisfaction Research Results: New York City Transit Subways," MTA website, accessed September 18, 2012, [http://www.mta.info/mta/pdf/2011NYCT\\_cust\\_satisfaction.pdf](http://www.mta.info/mta/pdf/2011NYCT_cust_satisfaction.pdf).

high level inquiries. Transparent internal data also allows for these executives to drill into questions brought to the forefront through visualizations. When data sets are more interconnected, answers can be found in new places, thus fostering more creative problem solving.

### How does historic data benefit the rider?

Looking at historic data would allow the agencies to create reasonable objectives. For example, if the commuter railroads propose a goal of being 99.5% on time, is that an attainable goal? Have any lines ever achieved this goal so far? If riders have a better perspective of how systems have performed in the past, their energies can go toward advocating for attainable goals in the future.

### How can this save the MTA money?

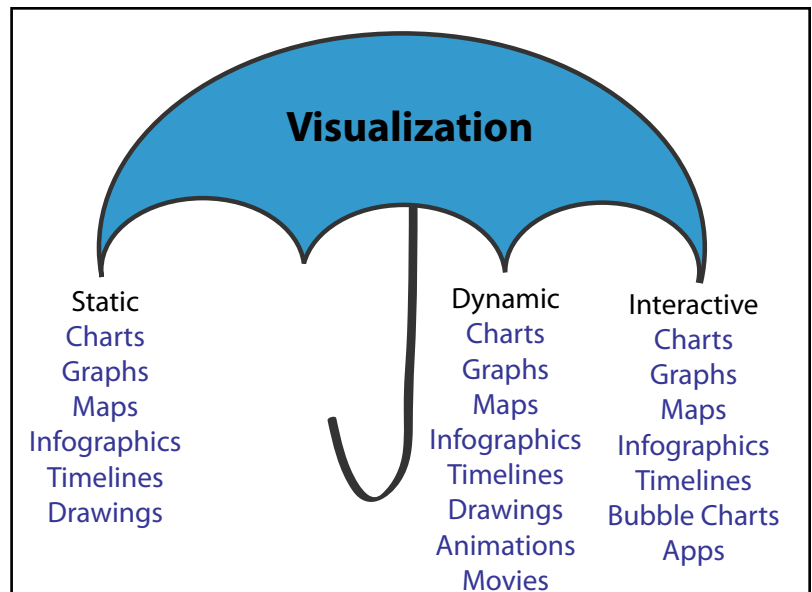
Opening specific data and creating some visualizations will save time now and therefore money in the future. If data is scheduled to be released at specified intervals, the MTA will not have to spend the staff time now required to collect and distribute the information that customers have asked for. In this way the FOIL request process can be made more efficient. Additionally, having all the data in one place will ease in the creation and implementation of new projects and programs and eliminate redundancies in data collection.

The recent GTFS feeds of the A division arrival information has great potential to save the MTA money. Although the MTA created the original iPhone App from the information, the Android version was designed by an outside party from the data released by the MTA.

## Appendix 2: Additional Visualization Explanation and Examples

### Explanations

A **static visualization** is a visualization that presents information in the form of a picture. That picture can be a simple bar chart or a detailed infographic. If that bar chart or infographic is animated to illustrate the change over time or steps in a process, for example, it is then a **dynamic visualization**. The Column Five video referenced in the data visualization section includes dynamic visualizations.<sup>45</sup> Finally, **interactive visualizations** allow the user to explore and interact with the data. This might be a map or a chart where a user can choose the set of variables to be depicted. An interactive visualization allows the user to have the most control over the data of all the visualization types. Mobile apps act like an interactive visualization in that they can transform a data set from numerical values into a visual that makes data more accessible by showing trends or grouping related data for comparison purposes. Apps benefit the MTA because they are customizable, and can be created to solve problems that are unique to each agency.



Visualizations can be static, dynamic (animated), or interactive, depending on what mode is the best fit for information you are trying to convey and the medium you are using.

In his blog, [eagereyes.org](http://eagereyes.org), visualization researcher Robert Kosara defines visualizations using three criteria: visualizations should be based on data, they should produce an image, and the result must be readable and recognizable.

Additionally, apps can be created as new issues arise. Because many app developers are independent of the transit agencies, mobile applications may be created to address needs beyond those targeted by the agency.

In addition to there being different styles of visualizations, visualizations vary in their relationship to the data that is displayed. A basic data visualization is not related directly to the content

<sup>45</sup> "Column Five Motion Graphic: The Value of Data Visualization," Column Five, accessed May 3, 2012, [columnfivemedia.com/work-items/column-five-motion-graphic-the-value-of-data-visualization](http://columnfivemedia.com/work-items/column-five-motion-graphic-the-value-of-data-visualization).

## The MTA in the Age of Big Data

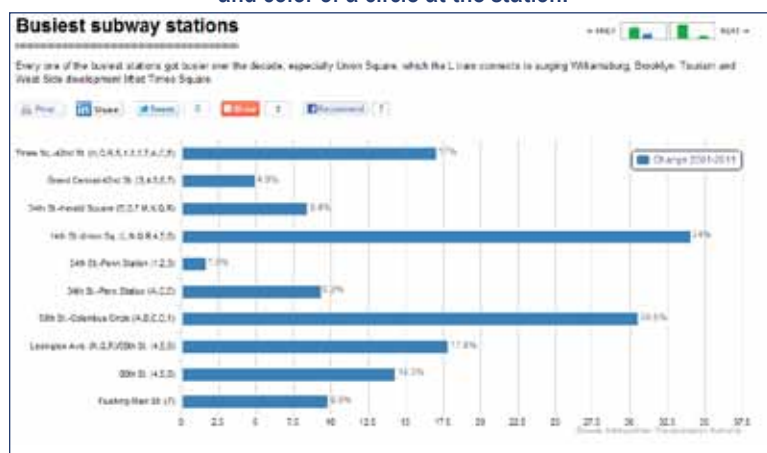
The three graphs below are all based on the same data and help to show how visualizations can help a viewer understand patterns.



(above) Busiest subway stations as a list from the [MTA website: mta.info](http://mta.info)



Busiest subway stations as an infographic from a graphic designer at [visualnews.com](http://visualnews.com). Here ridership is shown by the size and color of a circle at the station.



This basic bar chart shows the busiest subway stations through the change in riderships at each station between 2001 and 2011. From the "Stats and the City" series at [crainsnewyork.com](http://crainsnewyork.com).

it is displaying. It is instead created to simply display numerical information in a format more readable than a table, but not in a way that presents any conclusions. A pie chart, for example, always looks like a pie chart regardless of the variable it is displaying. A basic data visualization is one that you might create through Microsoft Excel, in that Excel takes any set of data and creates a similar looking chart. Basic visualizations can be static, animated or interactive.

An infographic, on the other hand, is frequently developed by a graphic designer and might have more of an editorial element than other visualizations, in that the infographic is guiding the viewer in a specific direction through the way that the data is displayed. An infographic can be based on numeric or non-numeric information, like events in a timeline, or a series of facts. It can be interactive, but most commonly infographics are static. Often, through its design, an infographic seeks to tell a story.

Interactive maps are an excellent way to display location-based information. Most people in the New York Metropolitan area are familiar with the MTA Transit maps and therefore using that geography as a base for displaying data allows a viewer to quickly understand the location reference. The MTA has begun using this type of map with its Weekender page on

the MTA website.<sup>46</sup> This site includes a subway map where stops are blinking to indicate planned work. A rider can click on any stop to find details on the scheduling changes.

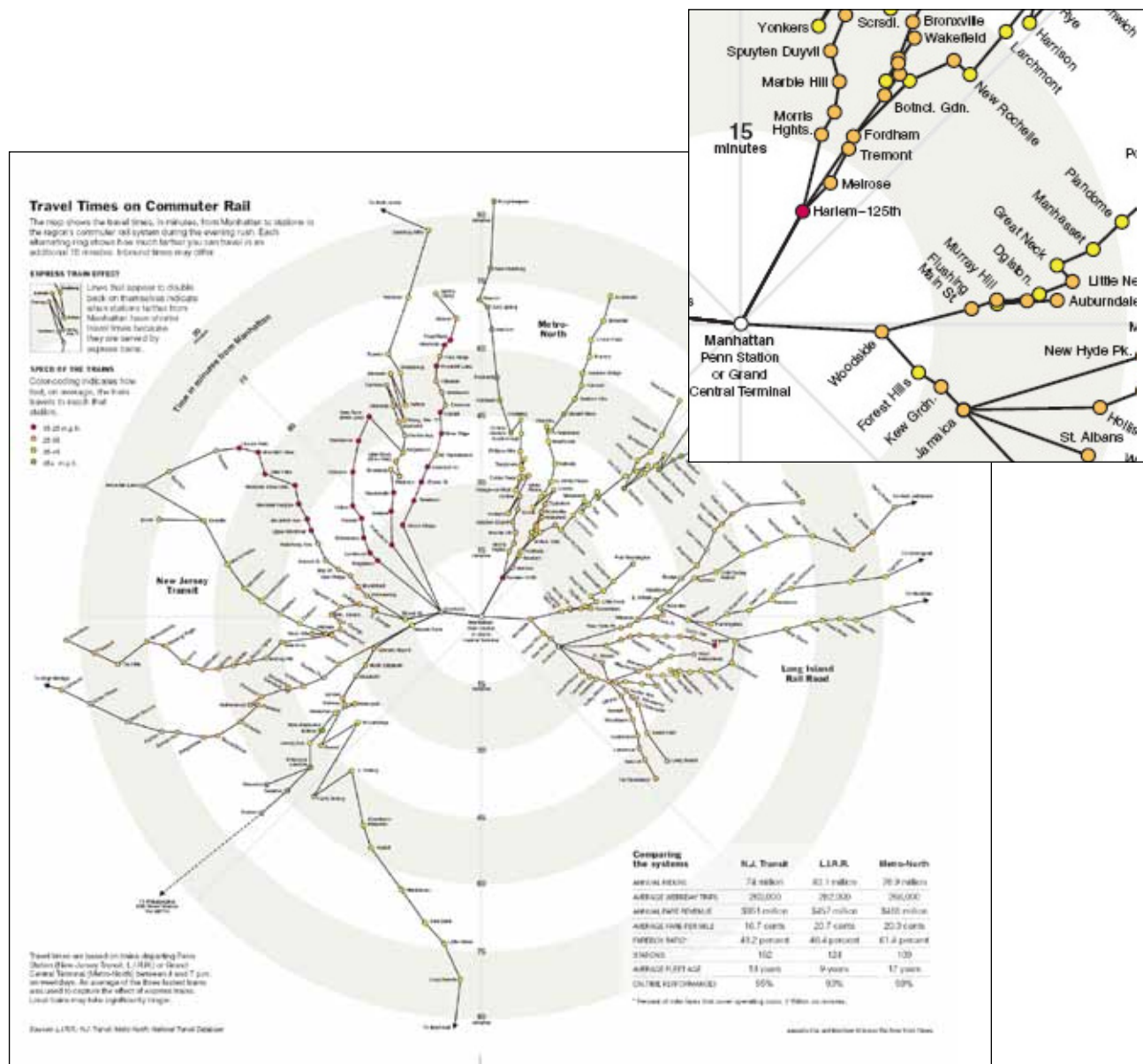
Beyond the visualizations discussed above, other types of visualizations include drawings, photo simulations, video, and animations. Although not all of these types of visualizations are discussed in this report we encourage the usage of any form of visualization that aids in the communication of information.

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<sup>46</sup> The **Weekender App** can be found at [www.mta.info/weekender.html](http://www.mta.info/weekender.html)



## More Data Visualization Examples



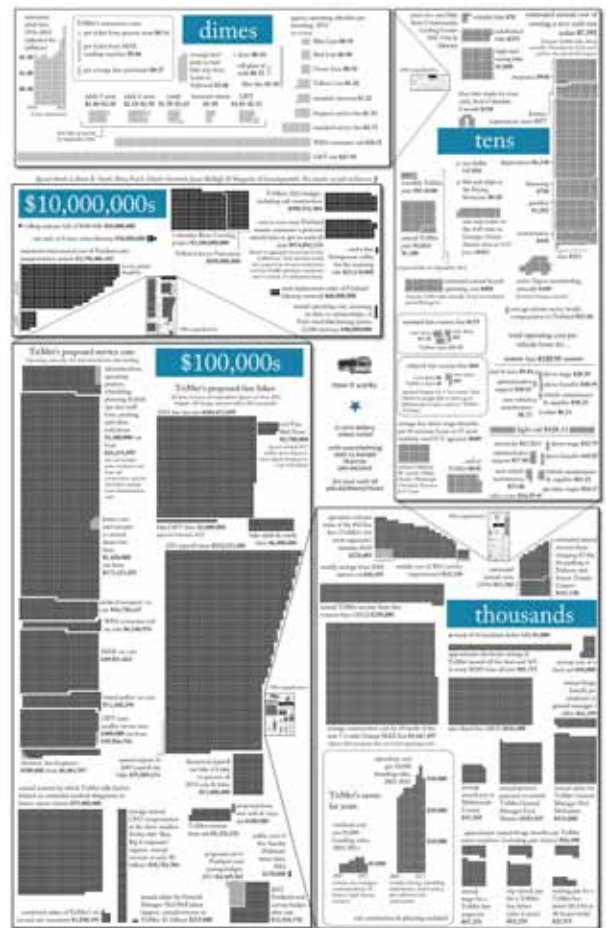
The New York Times has a team dedicated to creating data visualizations. They can be found by searching through the NYTimes itself, but a collect of them can be found at the small labs Inc. website: [www.smallmeans.com/new-york-times-infographics](http://www.smallmeans.com/new-york-times-infographics). This graphic maps commuter distances from Grand Central Terminal in terms of travel time rather than travel distances



Tyson's Corner Suburban Office Park

This image is from Choosing Visualization for Transportation and depicts a project funded by the Federal Transit Administration's Public Transportation Participation Pilot (PTPP) program. The web portal is designed to be your one-stop shop for effectively applying visualization tools and techniques in public involvement:

[choosingviz.org](http://choosingviz.org)



live the life. get the issues.

This graphic from [portlandafoot.org](http://portlandafoot.org) was designed to study how money is spent in the Portland, Oregon's transportation system



The **MTA Weekender App** helps riders visualize weekend service changes throughout the MTA subway system.



- Federal Highway Administration: The FHWA has a collection of interactive maps on their “noteworthy practices and innovative uses page,” [www.fhwa.dot.gov/planning/scenario\\_and\\_visualization](http://www.fhwa.dot.gov/planning/scenario_and_visualization)
- Public transportation visualized in various forms on the website [visualizing.org](http://visualizing.org). Helsinki public transportation and taxis in New York City and Vienna are seen as ribbons of light in one gallery: [visualizing.org/galleries/visualizing-transport](http://visualizing.org/galleries/visualizing-transport)
- Edward Tufte is a pioneer in the field of Data Visualization. His work can be found at his website: [www.edwardtufte.com](http://www.edwardtufte.com)
- “Help Make New York Better” is a group of mobile and web developers and others who want to improve New York’s transit network: [nytransitdata.org](http://nytransitdata.org)
- You can find apps in the city of your choice at City-Go-Round: [citygoround.org](http://citygoround.org)
- The [New York City Arts for Transit App](#) helps riders visualize art throughout the NYC subway system

## **Appendix 3: NYC Transparency Working Group Letter and Response**

Other transit advocates agree to the importance of a data culture change at the MTA. In June 2012, transit advocates sent a letter to MTA Chairman and CEO Joseph Lhota, which made recommendations for increasing the MTA's transparency. In early July, Chairman Lhota responded to the request. The foundation of the Chairman's response was the creation of the MTA Open Data Task Force, which he had approved, together with the GTFS-Real Time Feed project, at a meeting in late February 2012. The MTA's Open Data Task Force would be responsible for advancing, coordinating and overseeing MTA transportation initiatives. Although the Real Time Feed project has resulted in many outstanding apps, including the recent Subway Time, which gives real time service statuses for seven subway lines, the Open Data Task Force has been slower to come to fruition.

In accordance with the MTA's response, the Authority should prioritize updating currently available information. It should also prioritize opening performance and financial data that can aid in establishing the economic value of the MTA. In doing so, the MTA creates the opportunity to link economic development to operations planning through before-and-after analysis of investments.

Employing interactive data visualization is a key component to improving data efficiency and understanding. The federal government has encouraged transit agencies to incorporate interactive data visualization techniques into data presentations. As the volume of transit data increases, the MTA has the opportunity to lead the way in demonstrating the financial benefits of investing in data, which can highlight the true value of transit data.

## The MTA in the Age of Big Data

Citizens Union  
Common Cause/NY  
New York Civil Liberties Union  
New York State League of Women Voters  
NYPIRG Straphangers Campaign  
Regional Plan Association  
Reinvent Albany  
Transportation Alternatives  
Tri-State Transportation Campaign  
Women's City Club of New York

June 12, 2012

Joseph Lhota  
Chairman and CEO  
Metropolitan Transportation Authority  
347 Madison Avenue  
New York, NY 10017

### Re: Recommendations for Increasing the MTA's transparency

Dear Chairman Lhota:

Our groups write to thank you and the MTA for the steps you have taken to increase agency transparency – and to recommend further measures to increase the public's confidence and trust in the agency.

The MTA – and the riding public – have benefitted greatly from the MTA's past and current transparency initiatives. These include online posting of fiscal, budget and board briefing materials; making trip data easily available; actively encouraging application developers to create trip planning tools for smart phone and Internet users; live streaming and archiving its Board meetings; putting its Transparency section on the website's main navigation; and the Capital Program Dashboard.

We encourage you to apply this same approach of openness and innovation to other transparency efforts. By "transparency," we mean making it as easy as possible for the public to understand what the MTA is doing, what it is planning to do, how it spends money, and how it intends to spend money.

Greater transparency provides valuable benefits to the public and to the MTA. Greater transparency will help address unwarranted and erroneous criticism of the MTA. It will

also increase organizational efficiency – and reduce costs by improving the flow of information and eliminating archaic business practices. In this spirit, we offer the following transparency initiatives for consideration, following up a June 2011 letter we sent your predecessor:

1. **Put New Data Bases Online.** The MTA should make the databases listed below available online (preferably in a machine readable and machine searchable format in which they can be found via internet search engines and as downloadable files in an open digital format.) They should also be updated as data is received by the MTA. The databases should be available via API, like MTA bus and subway travel data, to encourage their use as analytic tools:

- **Transit Alerts:** The available digital archive of real-time "transit alerts" sent by email or text by the MTA to alert riders with information on specific delays;

- **Incidents:** The available digital archive of complaints and incidents (without personal identification);

- **Service Diversions:** Upcoming and real-time weekend service diversion information;

- **Clocks:** subway countdown clock information should be available online;

- **Lost and Found:** The number of items found and claimed losses (without identification) in the MTA New York City Transit "lost and found" database; and

- **Polls:** Current and ongoing rider opinion polls and surveys about quality of service.

- **PES:** While some performance measures are available on MTA State, the entire Passenger Environment Survey should be available as data on the developers resource page.

2. **Make fiscal and budget documents and Committee books machine searchable, and downloadable in CSV Format.** (And, for frequently updated and very large files, available via API.) The MTA produces numerous important financial documents, from its preliminary financial plans to its monthly budget watch. It's to the MTA's credit that so many documents are posted online. Unfortunately, many of these documents are only available in a pdf format, in which they are saved as an image. In this form, documents are not easily findable from the Internet, cannot be searched, and cannot be used by the public.

It is clear that the copious tables and charts in MTA fiscal documents are created using some form of spreadsheet or database. It is very simple to put these tables online in a CSV format, and the MTA has numerous technologists who can do so very quickly and

cheaply. Numerous state and city agencies provide fiscal or contractual data online that can be downloaded in a CSV format, including the city and state comptrollers, and NYC's Open Data site.

3. **Keep a complete electronically accessible archive of board and committee documents.** Currently Board and Committee materials are taken off the website after a few months. Anyone looking for earlier material must visit MTA offices after seeking permission to view the hardcopy documents. In addition, some material distributed to members at Committee meetings is never available on the website.

4. **Include all (or many) pre-2009 projects in the Capital Program Dashboard.** We applaud the MTA's online "dashboard" to help the public be better informed of the status of critical capital projects. But the dashboard is incomplete, tracking the current 2010 through 2014 projects, but only select projects that began during the 2005 through 2009 capital program and none before. It should include at least all ongoing projects, not just those starting in recent years. Indeed, a good argument can be made for including completed projects to give the public a fuller picture of the overall repairs to the transit system.

5. **Publish an annual directory of the MTA's computerized data.** It would be very helpful to developers, and the riding public, for the MTA to publish a directory of the publicly accessible computerized information that it, and its subdivisions, produce. Such a directory should include specific descriptions of the contents, format and methods of accessing such information, and the name, title, office address, and office telephone number of the official in each agency responsible for receiving inquiries about such information.

6. **Actively use e-mail and text messaging notices to inform the public of MTA projects and activities.** For example, your mega-project pages, such as for the Second Avenue Subway, 7 Line Extension, and East Side Access tell visitors who want updates: "As an interested member of the public, you can check out this website for updates, join our mailing list, call the Second Avenue Subway Hotline, send us an e-mail, and attend public meetings." We recommend that you allow the public to receive email or text notifications of the MTA activities they are most interested in. Many government agencies are using notification services to ensure specific stakeholder groups are kept well informed about issues that concern them.

7. **Consider further changes to mta.info homepage content and layout, such as making it easier to submit suggestions or complaints.** Leading government websites include comment forms on every page of their websites. Public feedback from such forms help agencies to continuously improve their sites and the information they make available.

3

Finally, we urge you to appoint a "Director of Transparency" or functional equivalent to ensure there is an official at MTA advancing, coordinating and overseeing MTA transparency initiatives. Both the MTA and its riders would benefit from the continuity and sustained focus.

We appreciate the MTA's consideration of our suggestions and will call to arrange for a meeting with your staff.

Sincerely,

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