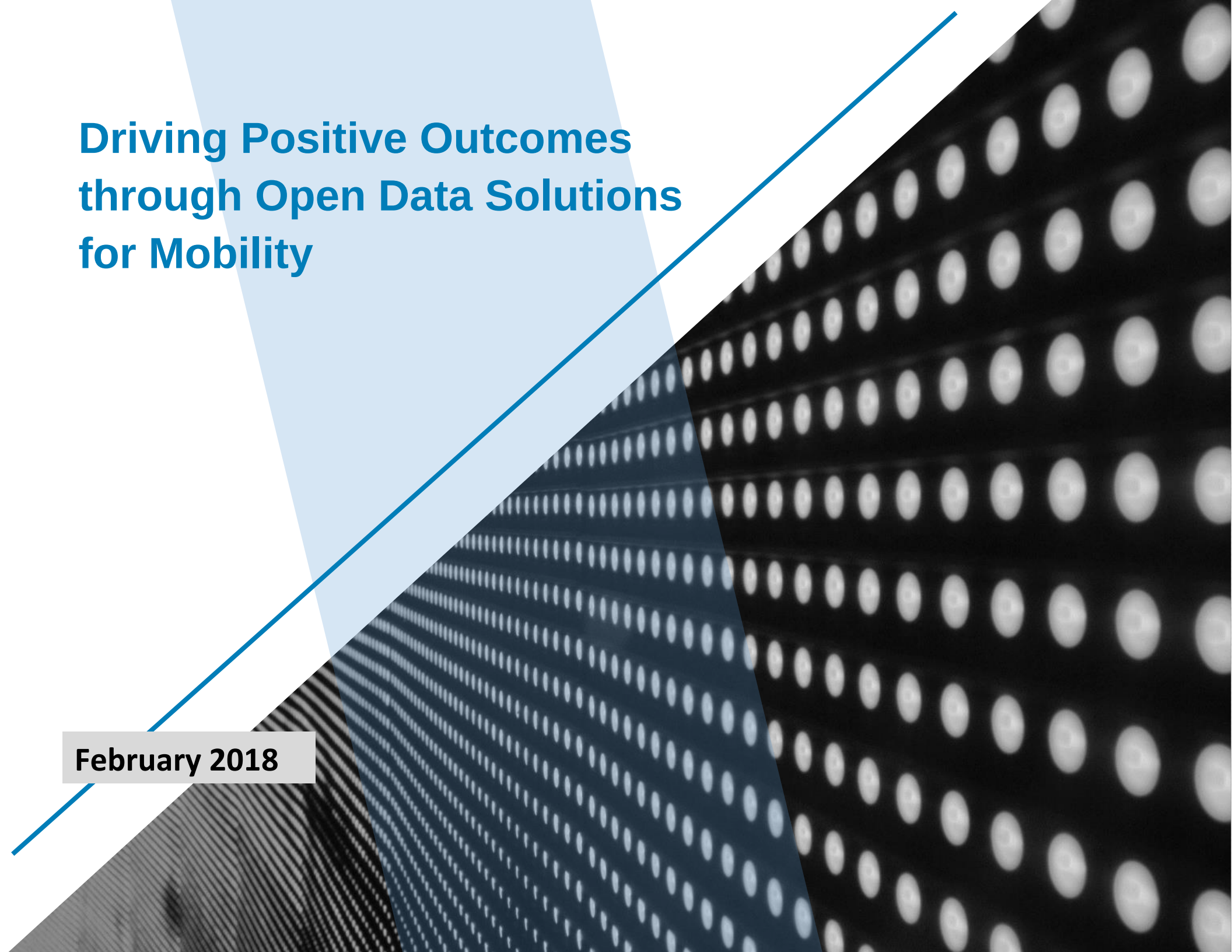
Driving Positive Outcomes through Open Data Solutions for Mobility



February 2018

Executive Summary

Our cities are increasingly complex systems; and we are asking more and more of them. At the same time, mobility is changing. The future of vehicles is electric, connected and autonomous. This will be incredibly disruptive for both our planned and our unplanned mobility systems. If managed well, however, these disruptions present amazing opportunities.

Open data can help mobility reach its potential. Open data not only inspires innovation, but also improves engagement, collaboration, and learning between government agencies and the public. Transit agencies are aware and have embraced these initiatives. And they are seeing the benefits associated with greater transparency.

But is there a next step? Transit agencies frequently look at open data as an end-in-itself, taking a hands-off approach to the ecosystem of developers that build from it. Can transit agencies drive outcomes with open data by taking a more active role?

Dell, Forum for the Future, LERO, OpenDataSoft and the Palo Alto Sustainability Office have come together to explore this potential. This work describes a set of recommendations for transit agencies interested in actively working with the community and the open data ecosystem on issues of social and environmental importance. These recommendations fall into three inter-connected areas:

- Development and measurement of performance indicators representative of positive social and environmental outcomes
- Internal capability building with respect to providing and using data
- Strategies for systemic collaboration with other public organizations, the civilian community and the commercial sector

By identifying and measuring key outcome indicators, owners of tomorrow's open data programs will be better able to communicate the full value of their mobility-related initiatives. With this in hand, we expect them to be able to expand their work, shifting from passive providers of data to active participants and guides, bringing their community and commercial sectors together in problem solving and innovation.

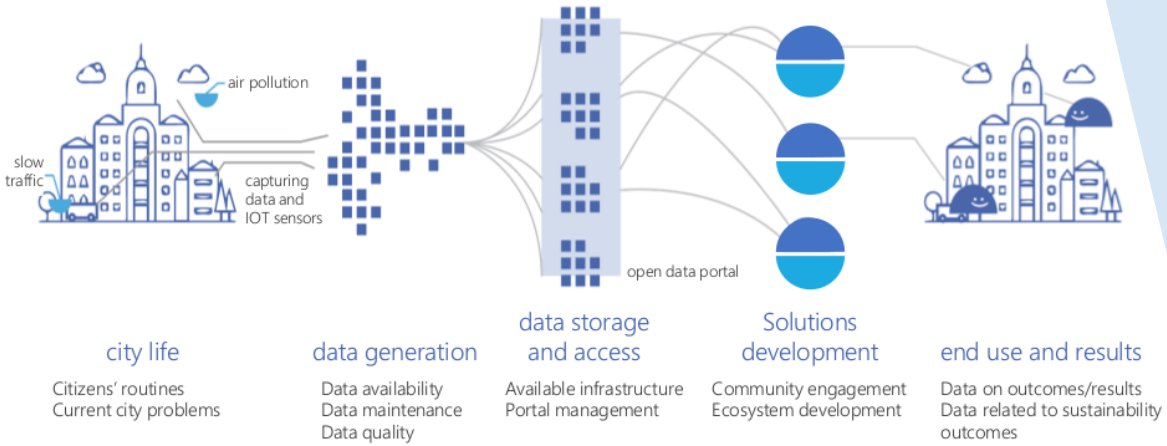
And, as efforts to drive outcomes are aligned between public organizations, members of the community, and the open data ecosystem, they will be able to exert more conscious control over the social and environmental impacts and outcomes from their mobility systems and programs. Thriving ecosystems building off open data will help drive sustainable mobility – the ability to meet society's needs to move safely and freely, gain access, communicate, trade and establish relationships without sacrificing other essential human or ecological values.

Open data, mobility and sustainability

The rise of open data for mobility systems and solutions

Since the first publicly-released transit data in 1998,[i] transportation organizations and transit operators have embraced open data. In 2005, the General Transit Feed Specification (GTFS)[ii] provided the first standard for public transit timetables. Today, websites collecting data on transit feeds have identified over 870 transit feeds in over 500 locations containing 2,275 transit operators.[iii]

Transit agencies publishing mobility-related data report a wide range of benefits, including better visibility of provided public services and empowering customers with respect to transit and trip decisions.[iv] In most cases, however, the benefits that are reported are qualitative and anecdotal. While there's significant data available on the performance of open data initiatives,[v] in terms of the number of available datasets and APIs, as well as the usage rate for open data APIs, there's little quantitative data available on the outcomes that result when public and private organizations use mobility-related data for value-added solutions and services.



Open data and sustainable mobility

Mobility systems require land and resources, can drive air pollution and carbon emissions, as well as affect personal well-being. At the same time, enabling mobility drives economies, providing access to employment as well as supporting business activities. The foundation of this report is a belief that open data is already making mobility systems more effective and sustainable. Our work, however, has identified challenges to scaling these positive impacts. By addressing these challenges, agencies and organizations can enable open data to support and drive even greater public benefits.

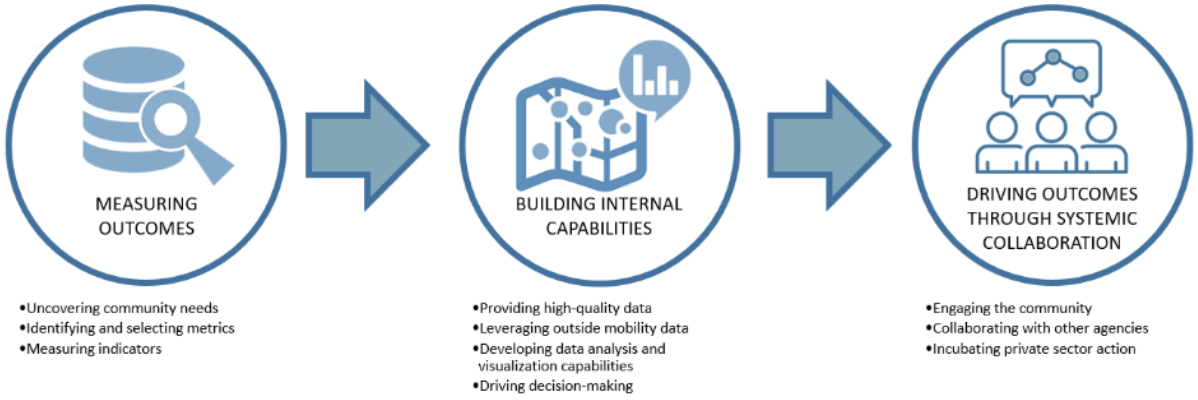
Transit agencies have embraced open data. As shown above, this has led to the development of new commercial ecosystems, collections of individuals, entrepreneurs, start-ups and larger businesses that see benefit from building value on open data.[vi] As of December 2017, City-Go-Round has identified 197 apps leveraging open data from 292 transit agencies worldwide. New insights into mobility issues, and the availability of transit-based apps, solutions, and initiatives, have driven changes to transit systems, improvements in transit system operations, and promotion of less resource-intense approaches to mobility.

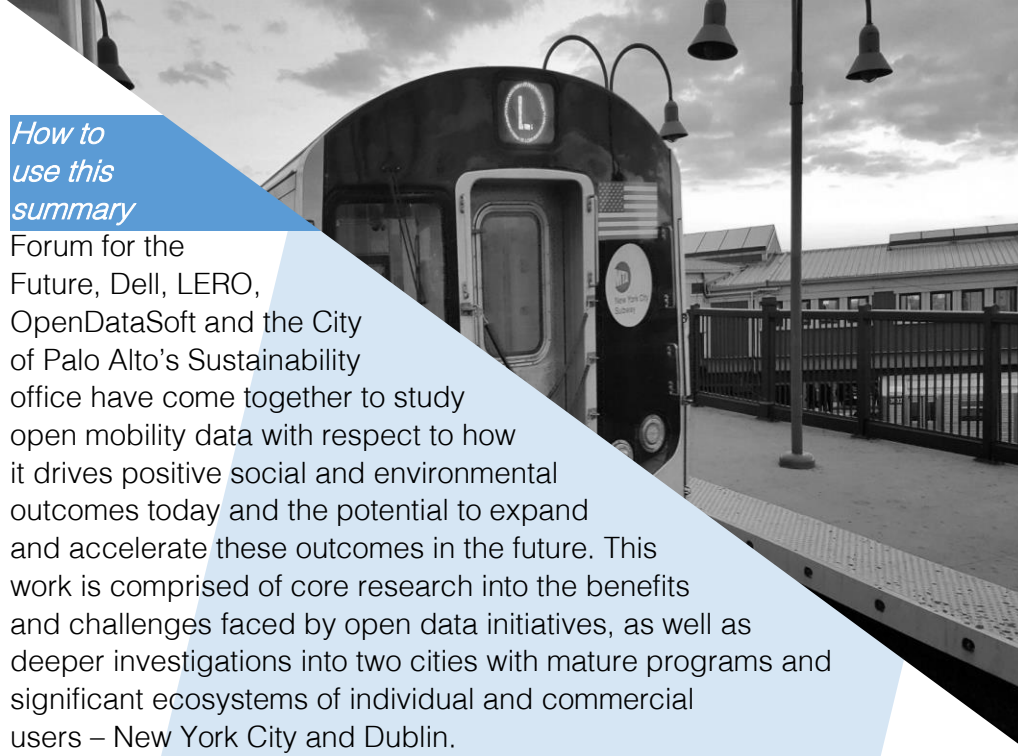
Despite these benefits, open data still faces challenges that limit its ability to reach its potential. Among the most important of these are data access, data quality, and overall program stability. Some of the most significant outcomes arise when the private sector builds on open data. When data is inconsistent, not accurate, or not timely, however, or there are doubts as to the long-term commitment of the

public agency to the program, commercialization or other use of the data is difficult.

Central to public commitment, including allocation of resources, is the perceived value of open data programs. While some benefits are seen today, the lack of data and analysis tying these programs directly to positive social and environmental outcomes means that these programs are typically undervalued. By bringing these programs closer to these types of outcomes, we hope to create an environment that drives additional support, resources and capabilities. In turn, we believe this would help open data initiatives expand and accelerate the benefits they provide to their communities for sustainable change.

Fully realizing these benefits, however, will require action. This includes identifying and measuring indicators representative of positive social and environmental outcomes, building capabilities internally, and taking a more direct, proactive approach to engagement with the individual and organizations comprising the open data ecosystem.





How to use this summary

Forum for the Future, Dell, LERO, OpenDataSoft and the City of Palo Alto's Sustainability office have come together to study open mobility data with respect to how it drives positive social and environmental outcomes today and the potential to expand and accelerate these outcomes in the future. This work is comprised of core research into the benefits and challenges faced by open data initiatives, as well as deeper investigations into two cities with mature programs and significant ecosystems of individual and commercial users – New York City and Dublin.

In this report summary, we are focusing on the prescriptive elements and recommendations from the full report, with inclusion of some background information. At the same time, we are aware that transit agencies can be very different with respect to capabilities and available resources. Some may already be considering or acting along the lines of our study, while others may be limited due to human, financial or policy constraints. Through review and selection of those recommendations most appropriate for a particular situation or environment, we believe agencies and organizations with transit system and mobility responsibilities can connect their programs more closely to social and environmental outcomes of interest to their community.

Measuring positive social and environmental outcomes

One of the more important conclusions of this work is that the lack of connections linking mobility-related open data to social and environmental outcomes leads to conditions where open data initiatives are both undervalued and underleveraged. Open data solutions for mobility, however, have immense potential to drive positive outcomes (i.e. public well-being from reduced commute time). By bridging the gap between these initiatives and outcomes of interest, we can better communicate their value and increase their effectiveness. This should result in improved internal and external support, as well as stronger outcomes.

Organizations looking to tie open data to social and environmental outcomes should consider three questions:

- Which important community needs are supported or addressed through open data?
- What indicators or metrics are available that can help assess or manage progress?
- Is available data today sufficient to support these metrics? If not, what additional data do we need and what do we have to do to collect it?

Understanding the needs of the individual and the community

Engaging with both individuals and businesses in a community to understand their needs is a common practice among transit agencies. That being said, this is an area where additional focus and efforts can provide significant dividends. In addition, in areas served by multiple transit agencies or operators, and/or data organizations, users and the commercial ecosystem will likely look at these organizations collectively as one system. Therefore, we recommend these agencies approach needs assessment engagements collectively.

Individuals in a community experience a wide variety of different situations and conditions, each leading to a different set of needs or different priorities for needs. There are many formal frameworks for identifying stakeholder needs. One approach of interest is Customer Journey Mapping (CJM)[vii] – a process for creating visual representations of user experience. Another approach of merit is a version of the Participatory Action Research[viii] framework used in a University College London case study on citizen engagement in Bristol, UK.[ix] We believe either of these approaches could be applied to improve mobility services and performance directly, or improve citizens' ability to access and consume transit-related data.

The commercial sector is also a key source for needs assessment. Businesses, regardless of size, rely on road, bus, rail and other transit systems to enable their employees to get to work. Stores and restaurants also rely on these systems for customer access. While

larger businesses frequently engage with their local governments, small and medium-sized business (SMBs) do not see as much attention despite being responsible for roughly half of the labor force.[x] As a result, when planning engagements for needs assessments, transit agencies may need explicit focus on the SMB community to ensure participation.

Collaborating to identify and select key outcome-related metrics

Typical metrics tracked by transit agencies and data organizations measure system performance or capabilities. To understand and drive outcomes, however, these organizations should look beyond typical metrics to leverage others that are more directly related to social and environmental outcomes.

This may be unfamiliar territory for transit agencies. Fortunately, there are many places they can turn to for assistance. Public sustainability officials will be more familiar with these types of measurements and outcomes. In addition, given the link between transit and well-being, transit agencies should collaborate with health agencies to help establish links between mobility-related metrics and health indicators. This may also be a situation where city management should be directly involved, as they are typically interested in or responsible for driving these types of positive outcomes.

One of our most critical recommendations in this study is for transit agencies and data organizations to commit to identifying and selecting outcome-related metrics, inclusive of the above-mentioned internal stakeholders.

During these engagements, there are a number of frameworks that can make a good starting point for explorations. Among these are the UN's Sustainable Development Goals (SDGs), the C40 Programme,[xi] the STAR Community Rating System,[xii] and ISO 37120, a standard for sustainable development of communities.[xiii] The framework that we believe is the best place to start, however, is the WBCSD's list of 19 Mobility Indicators.[xiv] These wide-ranging indicators address mobility in the context of social and environmental impact, with many directly related to issues of personal well-being. At the same time, the WBCSD's indicators are neutral with respect to transport modes and technologies.

wbcsd

Sustainable Mobility Indicators

1. Affordability of public transport for the poorest groups
2. Fatalities
3. Access to mobility services
4. Internodal integration
5. Accessibility for mobility-impaired groups
6. Mobility space usage
7. Air polluting emissions
8. Net public finance
9. Comfort and pleasure
10. Noise hindrance
11. Commuting travel time
12. Opportunity for active mobility
13. Congestion and delays
14. Quality of public area
15. Economic opportunity
16. Security
17. Emissions of greenhouse gases
18. Urban functional diversity
19. Energy efficiency

Measuring outcome-

Once social and environmental outcome-related metrics have been selected, attention needs to focus on collecting the data enabling measurement and analysis. While some of this data may be in hand, in most cases it will not be directly available. Transit agencies will have to develop specific plans and techniques to capture supporting data. This will require collaboration with other public organizations as well as the commercial ecosystem.

Because of the impacts and opportunities associated with mobility, calculating outcome-related indicators may require access to, or be supported by, datasets from other public organizations. This is particularly true for issues related to the environment or public well-being.

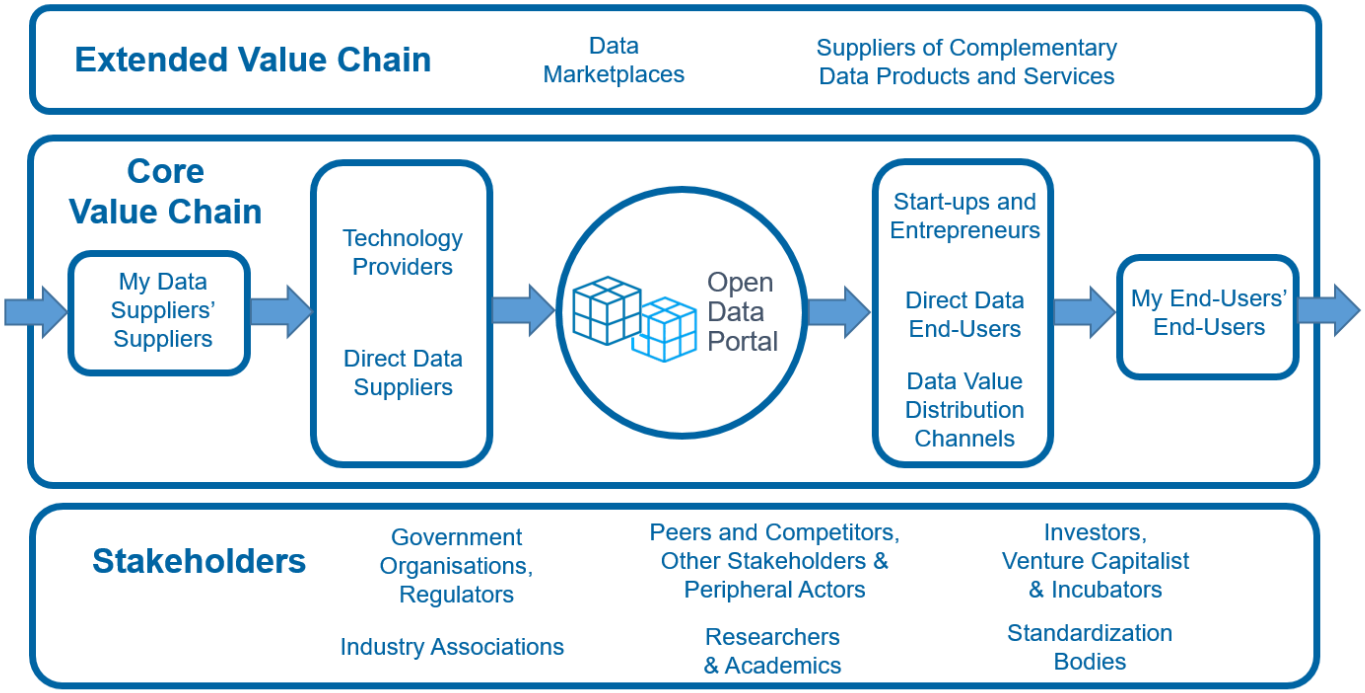
In many instances, solutions and applications developed by the commercial sector will drive desired outcomes. The general lack of information, however, as to who is using open data and how they are using it limits public organizations' ability to leverage this potential.

Commercial organizations may not be aware that data they have in-hand, or could collect through their business operations, can help establish the value both of the open data initiative on which they build and their own solutions. They may also not be aware of the role they can play in collecting additional data that assists with attribution of results to specific decisions, programs, solutions or initiatives. Establishing correlation between datasets is easy compared to investigating potential cause-and-effect relationships. The cause-and-effect relationships, however, are important for demonstrating value.

In addition, we see more and more instances of data collected by individuals that can help drive measurement of outcomes. Collection of this data, however, occurs within the ecosystem – providing another incentive for engagement.

Being able to measure outcomes and communicate social and environmental value benefits both the public agencies involved in open data and the commercial interests building of it. As a result, we recommend that transit agencies, once they have settled on key metrics, engage with the commercial ecosystem to communicate their needs and discuss how the users of their data can feed valuable information on outcomes back to their portals.

Open Data Ecosystem

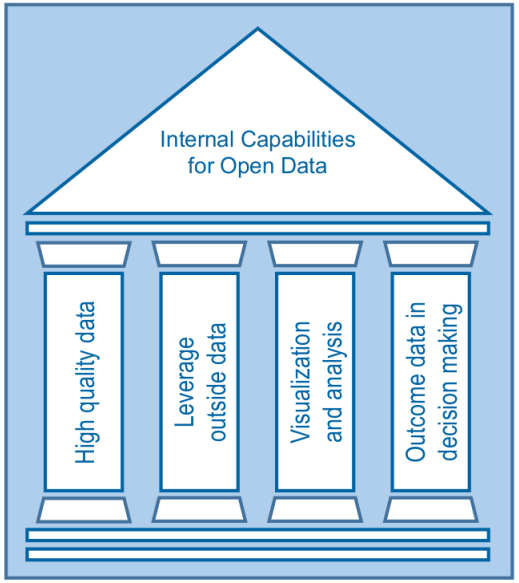


Building internal capabilities

Solely relying on the open data ecosystem to drive benefits limits the outcomes that can be achieved. Transit agencies willing to take a more active role should consider building internal capabilities to support the ecosystem as well as leverage open data directly for decision-making. This should improve the effectiveness of the ecosystem, transit agencies and public data analysis teams in driving outcomes.

Organizations looking to improve the effectiveness of their open data initiatives should consider the following questions:

- What data quality issues can affect the ecosystem's effectiveness and how can we address them?
- Can we make use of data produced by other organizations?
- Do we have the analysis and visualization skills to fully leverage open data? If not, how can we get access to these capabilities?
- How do we incorporate outcome data into our decision-making processes?



Providing high-quality data

Data quality is a wide term that covers many characteristics of data, including relevance, availability, consistency and timeliness.[xv] Developers in an open data ecosystem need high quality data to develop useful solutions. Building the capability to produce high quality mobility-related data will require the collective efforts of transit agencies and any data or IT organizations supporting or hosting their data efforts.

Transit agencies will naturally have a good feel for the type of data relevant to mobility issues. Engagement with other public agencies and developers in the ecosystem, however, may uncover additional opportunities or hidden data needs. In addition, as transit agencies work with other internal stakeholders to choose social and environmental outcome-related metrics, they may want to prioritize publication of related datasets, particularly when the data supports wider smart city initiatives that cross agency boundaries.

In particular, we recommend that transit agencies in regions with multiple organizations responsible for operating or managing mobility resources engage with these other entities to compare types of data being provided, as well as any standards in use, such as the one created by New York State.[xvi] Ecosystems of individual and commercial developers will face additional challenges if datasets across multiple agencies are following different standards or represent fundamentally different information. Like the case where multiple agencies in one government collaborate, multiple transit authorities in the same region should consider engaging external stakeholders collectively.

Open data managers, as well as transit agencies, can improve data timeliness and consistency in a number of ways. Whenever possible, data should adhere to known, relevant standards.[xvii] When relevant standards aren't available, data managers may need to create internal standards to support 'clean' data. They may also want to provide Application Programming Interfaces (APIs) where appropriate to enable ease of use and access.

Not all data issues are software-related. Resource and financial constraints can lead to issues with the hardware infrastructure used to capture and process data.[xviii] These can affect access to data, as well as timely production of data for certain real-time datasets. This underlies the importance of being able to demonstrate value in terms of positive outcomes, as capturing and communicating impact can assist with funding and support proposals to improve the infrastructure.

Leveraging outside mobility data

As open data initiatives mature, transit agencies may find that data that has been collected by other organizations can supplement their own mobility-related datasets. In some cases, these may be datasets provided by developers who have built off existing open data. It's also increasingly common for individuals to be providing data of interest through their smart devices, though this data is typically collected by third-parties, both commercial and non-profit.

This data may be very valuable, particularly if it's related to social and environment outcomes of interest to public agencies. As a result, these organizations need to be able, at a minimum to access this data and include it in analysis and visualization efforts.

Developing data analysis and visualization capabilities

It's clear that providing open data on mobility systems has benefits. These types of initiatives, however, offer much more when transit agencies commit to taking a more active role. Both the data generated internally, and potential data from the ecosystem can provide insights that drive decision-making and innovation. To take advantage of this, transit agencies will need to have access to data analysis and visualization capabilities.

Data analytics can help find insights in datasets that would otherwise remain hidden. It can also help in understanding and leveraging data coming back from the ecosystem. Visualization skills can also lead to new insights, but, in addition, they can be critical in communicating insights to individuals less familiar with the underlying data and issues.

Some transit agencies may already have access to these, whether directly or through a sibling organization. Some organizations have even created dedicated offices of data analytics.[xix] We recommend that transit agencies perform a skills assessment to determine the level of available data analysis and visualization skills. Agencies identifying a skills gap may address this either in-house or through consultancies.

Once a transit agency has either found, or arranged access to, data analytics skills, they should make sure those individuals are included in discussion of outcome-related metrics. They will be particularly helpful when combining datasets from multiple sources and agencies – for example, transit and health.

The trend towards dedicated analytics offices is significant. In fact, if a transit agency does not have access to these services, they may want to lobby internally to create that function within their local government.[xx]

Incorporating outcome-related data in decision-making and planning

Generating credible data on outcomes has value in itself, but its true potential is realized when transit agencies use that data to drive social and environmental results. This will require these organizations to "close-the-loop" by incorporating outcome data into their operational, strategic and governance processes.

Given that we are looking at the benefits from open data, it should come as no surprise that we recommend ensuring that outcome-related data and insights are as open as the data from which they arose. If the data and insights are available and transparent, the community and open data ecosystem can check results for themselves. This supports credibility of conclusions. In addition, the outcome data, itself, is as asset on which the ecosystem can build and innovate. This may, in turn, help further drive outcomes.

Outcome-related insights are likely to help transit agencies better serve their communities. As a result, we recommend transit agencies incorporate these into internal operations and strategic processes. At a tactical level, insights may suggest changes to transit routes or schedules. At a more strategic level, insights may drive broader changes to transit systems, such as added emphasis on alternate modes such as biking. A recent study shows that where bike trips (Citibike) are faster than taxis for shorter travel distances in cities like New York. This contributed to an 80 percent jump in bike commuting since 2010 and added a new socio-economic and environmental dimension to cities mobility dynamics.

Transparency on outcomes is particularly valuable when looking at higher-level issues of funding or governance. Public executives may not have time to drill down into specifics on operations or data analytics. Presenting results that are more in line with their concerns and interests will help transit agencies and organizations driving open data communicate the value of their programs. We recommend transit and data teams leverage outcome-related data in internal communications and discussions.

Driving outcomes through systemic collaboration

Transit agencies frequently see the publication of open data as an endpoint. Open data initiatives are created and maintained, but there is little focus on actively using these programs to proactively expand and accelerate impact. One of our higher-level recommendations is that transit agencies and data organizations take the next step after providing data, actively working to direct the ecosystem towards outcomes of interest and increasing its effectiveness by expanding its capabilities for innovation.

Organizations that are exploring taking this next step should consider the following:

- How can we empower the community to explore and use open data?
- How can collaboration with our peers in other public organizations help us drive outcomes?
- How can we guide and influence the private sector to focus on social and environmental benefits?

Engaging the community

The community is a generally underutilized source of energy, insight and innovation. By itself, however, the community may not be in the best position to drive results using open data. Transit agencies can build these capabilities within their community through education, events and initiatives designed to raise awareness and create opportunities for solution development.

Education about open data has direct benefits. As the community becomes more aware of the availability of information, it should also increase interest in, and public support for, these initiatives. Education can also help communicate challenges around open data, including guidance as to the limits of open data with respect to usefulness

Once the community has a working knowledge of available mobility-related data, transit agencies and data organizations can create crowd-sourcing activities for analysis, innovation and solution development. Civic organizations such as pedestrian or cyclist associations can be great places to start. The Big Apps challenge in New York City is an excellent example of these types of engagements.

Collaborating with other agencies

Cross-agency collaboration on open data takes two forms. Transit agencies can collaborate with other agencies within the same government, combining resources to uncover insights that cross agency boundaries. Transit agencies can also collaborate with other agencies, organizations and operators that have mobility-related responsibilities. These two types of engagements offer different potential benefits and should be approached separately from a strategic perspective.

Cross-agency collaboration on open data between city organizations is common, but is typically focused only on data standardization and the creation of meta-data directories. The potential for these collaborations, however, extends further. Transit agencies should be working with other city groups on selection of outcome-related metrics and analysis of related datasets. Agencies with public health and environmental responsibilities should be prioritized given the relationships between these areas and mobility impacts. When working on issues that cross boundaries between these organizations, they should consider co-hosting engagements with community and commercial stakeholders.

Collaboration between public organizations can extend even further. In areas served by multiple transit agencies, transit operators or other related organizations, these groups should consider collective problem solving and data analysis. This would include a collective and collaborative approach when engaging with individuals in the greater community or with the private sector. This may also include pooling available data analysis and visualization capabilities.

CASE STUDY: FIGHTING OBESITY AND DIABETES IN NEW YORK STATE THROUGH SYSTEMIC COLLBORATION

The New York State (NYS) Department of Health organized a Code-A-Thon to develop solutions tackling obesity and diabetes. The Code-A-Thon was based on the realization that – while health departments have huge amounts of granular data on this subject area – it is generally far more effective to try to solve complex problems such as obesity in cooperation with others. The health department decided not to try to develop solutions in a silo but instead capitalize on the power of partnerships and collaborate with other State departments, namely the NYS Department of Agriculture and the Departments of Parks and Recreation and Environmental Conservation.

The choice of partners was driven by strategic criteria: the NYS Department of Agriculture oversees the farmer's markets in New York State, the locations of which have been mapped across the state. Likewise, outreach to the Departments of Parks and Recreation and Environmental Conservation provided information about hiking trails, playgrounds, and more.

By combining health data with locations for fresh food, hiking trails and playgrounds for exercise, as well as other data sets, the departments could jointly develop a joint-up and long-term strategy to reducing obesity and diabetes through the application of a number of solutions driven forward by the different partners.

Case study based on an interview with Barbara Cohn, Former NY Chief Data Analyst

Incubating private sector action

One of the main tenets of open data is that, when relevant data is made public, an ecosystem will arise that creates additional value and opportunity for the community. This ecosystem of individuals, entrepreneurs, and business of all shapes and sizes can help drive social and environmental benefits. Their effectiveness, however, can be limited if they're not aware of how their efforts relate to public initiatives and goals.

Transit agencies looking to expand and accelerate impacts can support the ecosystem by understanding what drives different entities, advocating for community needs, creating an environment that supports innovation and nurturing fledgling solutions that demonstrate promise with respect to outcomes of interest.

Understanding private sector motivations and needs

The developer and commercial community have much to offer open data initiatives. Transit agencies and data organizations looking to get the most out of open data programs will want to encourage as much engagement with this group as possible. This requires a strong understanding of these organizations and what drives action within them.

In some cases, commercial entities are looking to improve the perception of their brands. In others, they directly market solutions built on open data. Some businesses will look at open data as a tool that helps them with operational issues, including support for employee commuting or customer access. And in some cases, organizations will want to participate for no reason other than open data and community improvement being aligned with their mission, culture or purpose.

Transit and data agencies working to encourage private sector participation should create a 'map' of potential commercial supporters, organized along the lines of these different motivating factors. This map will include local businesses, but may include organizations from outside the area as well. Once in place, this map can provide guidance as to how to approach these entities and encourage their participation.

Those members of the ecosystem building solutions may have more specific technical needs that need addressing. In some cases, transit agencies may have access to data that is not yet public, but could be useful for developers. In engagements with the ecosystem, transit and data organizations should discuss developers' needs and explore non-public datasets that could be useful if added to the open data program.

Advocating for community needs

Transit agencies looking to leverage open data to drive community and environmental goals may find that ecosystem influence on those goals is accidental and unpredictable. By taking a more active role in direction and guidance on goals and key metrics, transit agencies and data organizations can help the ecosystem better deliver value to the community as a whole.

A key role for public organizations with strong processes for identifying and documenting community needs is to advocate for addressing those needs with the private sector. This offers additional focus to participants in the open data ecosystem, who might otherwise be relatively unaware of key outcome-related metrics and the role they can play in driving progress to goals. As transit agencies engage with the private sector on open data, they should emphasize these goals and the value that addressing them will deliver to the community.

These organizations can also help direct and support the ecosystem through activities focused on raising awareness and stimulating innovation. Dublinked, a partnership between four local Dublin Authorities and the University of Maynooth, uses data challenges and competitions to spur innovative approaches to community issues. Transit agencies should consider similar

activities focused on awareness of, and solutions for, community needs. In addition, this is an area where collaboration and cooperation between multiple public agencies can amplify results and outcomes.

Driving scale-up of effective solutions

Mature businesses developing value-add solutions will be able to manage market development and scale-up on their own. There will be some solutions, however, that are developed by individuals or start-up companies. For those that show promise, their ability to scale-up may be limited by a lack of access to resources. In these cases, agencies that want to accelerate impact may have to assist these individuals and smaller entities.

One of the easiest approaches is to draft case studies showing how open data and particular solutions are helping agencies meet their goals, including sustainability or outcome-related goals. Transit agencies and data organizations can also help support fledgling efforts by working with technology incubators to provide space and other support for these entities. Financial support can also be a strong accelerator. Recognizing outstanding or particularly effective solutions through awards programs can provide that extra support, as can connecting entrepreneurs to venture capitalists and other potential sources of funding.

Transit agencies looking to help drive the development of smaller organizations may need to work with their internal legal teams and city management, however, to understand where they can, and cannot provide support – promotional, financial or otherwise.

Driving the future

Bringing open data and outcomes closer

At the beginning of this work, our goal was to identify and measure the positive social and environmental outcomes resulting when transit agencies embrace open data. Our initial finding was that there is clear evidence of significant positive outcomes and benefits, but results are anecdotal and qualitative in nature. In addition, while there is substantial data on the performance of transit systems as well as open data availability and use, the links to outcomes of interest are poorly defined or understood. So, the quantitative data that is available does not help with indirect measures of outcomes.

As a result, we began to look at approaches that would bring mobility-related open data closer to these outcomes of interest. Our discussions with industry professionals were clear – being able to clearly articulate and communicate the value of open data initiatives is critical. To that extent, we believe that by learning how to measure outcomes, building internal capabilities with respect to open data, and actively engaging the open data ecosystem on driving outcomes, we can accelerate and expand the positive impact mobility systems can have on our society and the environment and support the future that mobility promises to deliver.

Next steps

There's still a lot of work to do, however, to realize this future. While we have some clear guidance for transit and data agencies on how to drive outcomes with an open data culture, it's best to think of that as a set of starting points. Each of our recommendations will benefit from additional discussion, testing and depth. We're also strong believers in engagement. Much of this work is based on the notion that, collectively, we can uncover insights and drive results much more effectively than if we were working separately.

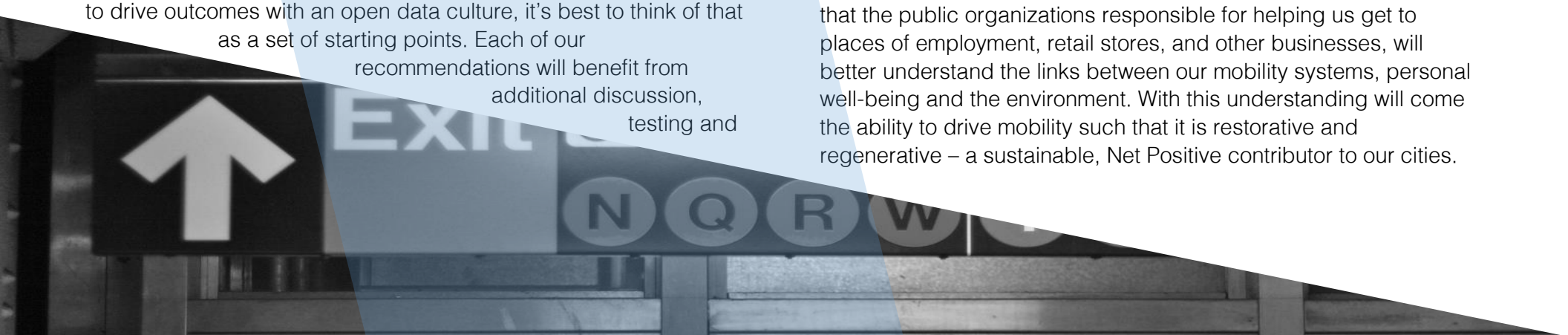
We'd like to investigate engagement and understand what it can deliver with respect to bringing civic society, the commercial sector and public organizations into alignment. And, perhaps most important, we'd like to explore how to bring together data from separate sources, both public and commercial, to understand and measure outcomes such as personal well-being and environmental health.

A vision for the future

Open data delivers today. But, it carries the potential for even more significant impact. It will play a critical role in helping transit agencies leverage future disruptions in mobility and be of even greater service to their community.

The recommendations in this report are architected to help reach this potential. We want the owners of tomorrow's open data programs to be able to measure and communicate the true value of open data. We want them to be able to make the most of the data they have. And we want them to be able to build collaborative partnerships that drive outcomes.

Our cities rely on mobility systems to function effectively. Our mobility systems, however, are not without impacts. With the types of tools and capabilities we discuss in this document, we expect that the public organizations responsible for helping us get to places of employment, retail stores, and other businesses, will better understand the links between our mobility systems, personal well-being and the environment. With this understanding will come the ability to drive mobility such that it is restorative and regenerative – a sustainable, Net Positive contributor to our cities.



Acknowledgements

We would like to acknowledge the participation of a number of leading organizations within both Dublin and New York including Dublinked, Dublin Dashboard, ParkYa, Derilinx and Smart Dublin, Connecthings, Citibike, MTA New York, Civic Data Design Lab, NYC Open Data, Adaptive Mobility and Grand Central Tech Hub from New York and City Sonar. We would like to thank them for their participation and providing support for better quality case studies in realizing this report.

---

[i] In 1998, Bay Area Rapid Transit (BART) released schedule data in a .csv format.

[ii] The General Transit Feed Specification (GTFS) was originally developed as a Google project.

[iii] Data from the Transitland Feed Registry and TransitFeeds.

[iv] Schweiger, Carol L.; Transit Cooperative Research Program; Transportation Research Board; National Academies of Sci., Eng., and Medicine. (2015). *Open Data: Challenges and Opportunities for Transit Agencies.* Washington, D.C.: Transportation Research Board.

[v] Open data initiatives are programs for making datasets that are typically only visible within an organization more accessible and usable to a wider, external audience.

[vi] Verhulst, S., & Young, A. (2016). *Open Data Impact - When Demand and Supply Meet - Key Findings of the Open Data Impact Case Studies.* GovLab, Omidyar Network. GovLab.

[vii] SmartCities. (2011). *Customer Journey Mapping, Smart Cities Brief No. 12.* SmartCities.

[viii] MacDonald, C. (2012). Understanding Participatory Action Research: A Qualitative Research Methodology Option. *Canadian Journal of Action Research, 13*(2), 34-50.

[ix] Balestrini, M., Rogers, Y., Hassan, C., Creus, J., King, M., & Marshall, P. (2017). A City in Common - A Framework to Orchestrate Large-scale Citizen Engagement around Urban Issues. *CHI '17: Proceedings of the 2017 CHI Conference on Human Factors in Computing Systems* (pp. 2282-2294). New York, NY: Association for Computing Machinery. doi:10.1145/3025453.3025915

[x] U.S. Small Business Administration, Office of Advocacy. (2015). *New York Small Business Profile.* Washington, D.C.: U.S. Small Business Administration.

[xi] C40. (n.d.). *C40: City Intelligence*.

[xii] STAR Communities. (2016). *STAR Community Rating System, Version 2.0.*

[xiii] ISO/TC 268. (2014, May). *ISO 37120:2014 Sustainable Development of Communities -- Indicators for city services and quality of life*.

[xiv] WBCSD Mobility. (2016). *Integrated sustainable mobility in cities - a practical guide.* Geneva: WBCSD.

[xv] PWC. (2015, May). *Open Data & Metadata Quality.*

[xvi] Open NY. (2016). *New York State Open Data Dataset Submission Guide v3.0.* New York State Office of Information Technology Services.

[xvii] For example, GTFS.

[xviii] For example, deploying more accurate sensors frequently has cost implications.

[xix] The New York City Mayor's Office of Data Analytics (MODA) is one of the premier examples. MODA works closely with the NYC Department of Information Technology and Telecommunications (DoITT).

[xx] Some cities have found very quick paybacks from creating these offices (need reference).