INTEROPERABLE TRANSIT DATA

ENABLING A SHIFT TO MOBILITY AS A SERVICE

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ROCKY MOUNTAIN INSTITUTE

Rocky Mountain Institute (RMI)—an independent nonprofit founded in 1982—transforms global energy use to create a clean, prosperous, and secure low-carbon future. It engages businesses, communities, institutions, and entrepreneurs to accelerate the adoption of market-based solutions that cost-effectively shift from fossil fuels to efficiency and renewables. In 2014, RMI merged with Carbon War Room (CWR), whose business-led market interventions advance a low-carbon economy. The combined organization has offices in Snowmass and Boulder, Colorado; New York City; Washington, D.C.; and Beijing.

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EXECUTIVE SUMMARY

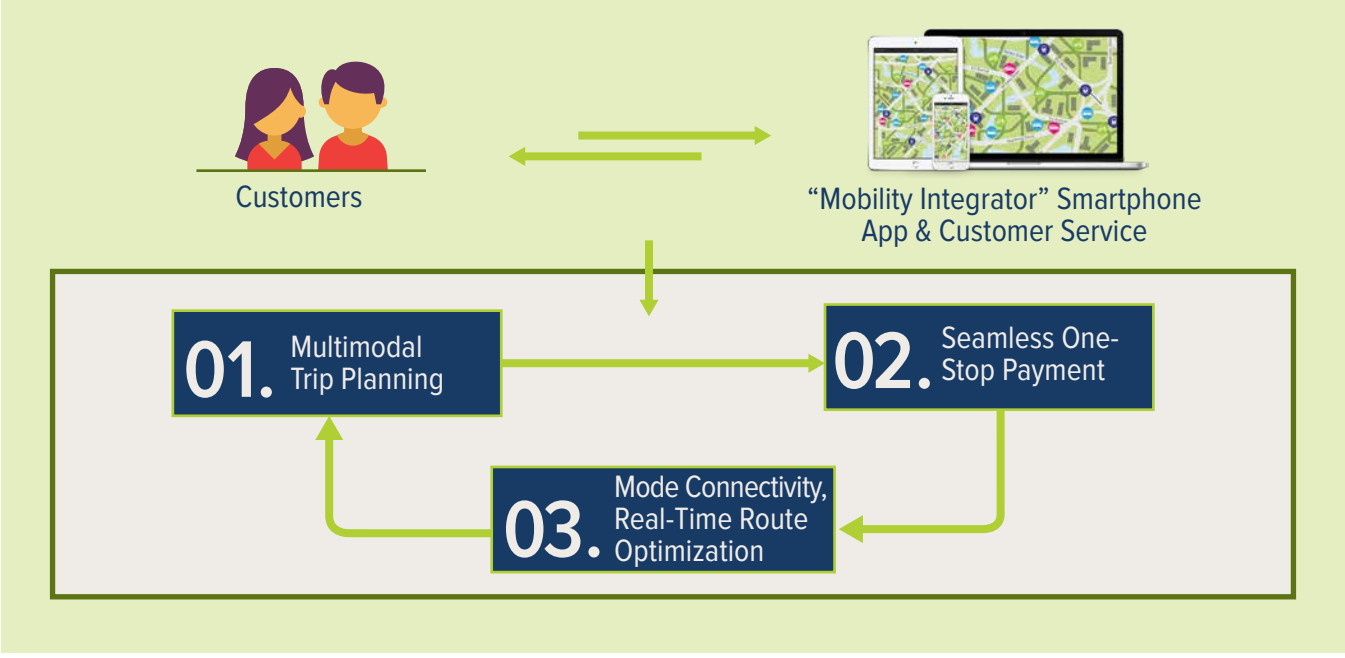
Personal mobility in the U.S. is dominated by personally owned vehicles, accounting for more than 80 percent of trips. Personally owned vehicles produce 15 percent of U.S. and 10 percent of global emissions, account for 30 percent of global oil combustion, sit unused over 95 percent of their lives, and consume 27 percent of income in U.S. median-income households. A mobility system dominated by—and often reliant upon—costly personal vehicles leaves many lower-income individuals and families without access to affordable mobility.

MOBILITY AS A SERVICE

Rather than using a personally owned vehicle, imagine a scenario in which people can order a ride to wherever they need to go and it arrives right on time, at the right-size to carry their luggage, and at a cost lower to both them and the environment. We call this "mobility as a service" (MaaS). MaaS can be thought of as the ability to schedule vehicles and travel on an on-demand basis depending on the travelers' needs, seamlessly getting people where they want, when they want, how they want.

Transforming personal mobility can unlock $1 trillion per year in business and consumer value and reduce annual emissions by 1 gigaton in the U.S. alone. However, currently consumers don't have easy access to information about all their transportation options. Even if they do know of the different options, decisions are most often based on convenience—which often times means they end up getting into their personally owned vehicle. Existing transit modes rely on separately financed transportation systems (e.g., bus/rail, car, bikeshare), deeply ingrained behavior (e.g., drive!), and a variety of subsidization programs that obfuscate the true cost and perceived convenience for each mode.

FIGURE ES1: HOW IT WORKS
Three interdependent components of "mobility as a service."

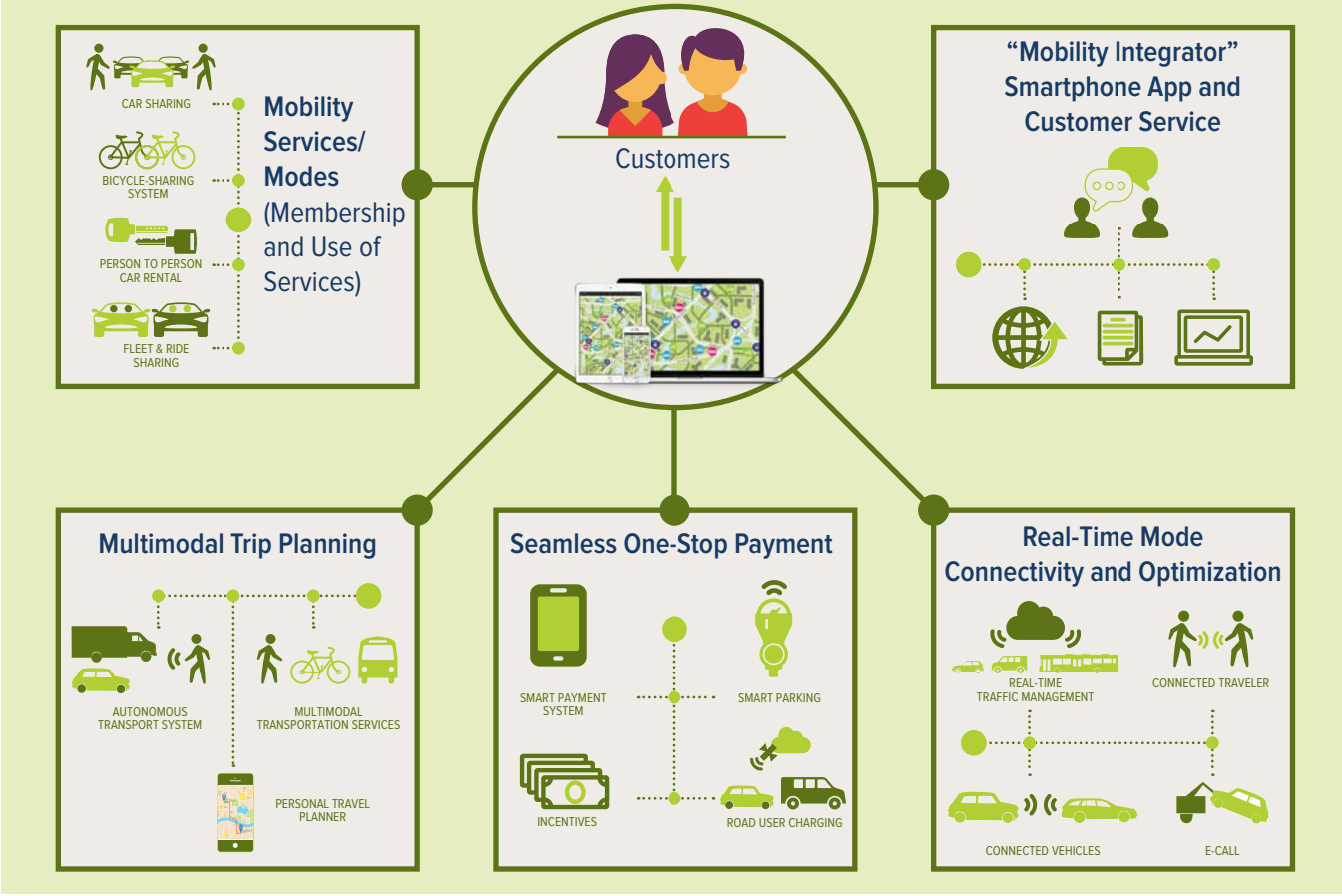


INTEROPERABLE TRANSIT DATA

In the fast-approaching world of MaaS, the whole transportation system operates as an interconnected, cooperative system meeting customer travel needs through a variety of transport modes. Infrastructure, technology platform, payment, transportation services, and transportation data analysis must all be capable of working together to achieve this solution. The whole MaaS system will rely on data being produced and consumed by all of the participants. Fortunately, much of the technology is already available and being deployed in transit, though often in separate, unconnected applications.

Broader, better, and more interconnected transit and transportation data, both for service providers and/or for the customers themselves—what we call interoperable transit data (ITD)—can provide the foundation for a better user experience and create increased ridership for transit agencies, greater lead generation for private transit providers, and better planning tools for city government. In other words, ITD can lay the foundation for a shift away from single-occupancy vehicle (SOV) trips to convenient and cost-effective mobility as a service. Working with transit data stakeholders to improve the interoperability of this data—such as the RMI-facilitated workshop that provided the basis for this report—is a critical component of the transition to MaaS.

FIGURE ES2: OPEN AND INTEROPERABLE TRANSIT DATA ENABLES "MOBILITY AS A SERVICE"



BARRIERS

While there are significant efficiencies to be gained through interoperable transit data, there are clear barriers to immediate action. These barriers are complex and in some cases interdependent.

Variability in resources and knowledge within public transit agencies is a significant obstacle to initial adoption and eventual market saturation of new standards. Another major barrier is the inconsistency of data licensing approaches and lack of regulation covering data sharing. And perhaps most importantly, lack of payment integration, particularly backend (behind the scenes) integration, is a recurring hindrance to all-in-one multimodal transit solutions.

SOLUTIONS

Overcoming these barriers is key to transforming our mobility system. Solutions include increased public-private partnerships, improvements in transit data reporting, integrated payment systems, facilitating data sharing between public and private companies and cities, and implementing demonstrations and pilot projects.

- **Encourage Public-Private Partnerships:** Regular public and private transportation provider collaboration can lead to improved service area coverage, increased market share through network effects, and better travel options for customers that do not requi=re single-occupancy vehicle trips.

- **Understand Metrics:** Clearly understanding the SOV energy, emissions, and cost impact metrics to compare against MaaS solutions is key to motivating employers to create travel incentives reducing employee SOV travel. The same metrics can be used to gain funding for environmentally friendly, healthful, and convenient transit projects, city redevelopments, and impactful public-private partnerships.

- **Establish Transit Data Best Practices:** Developing training, tips, and best practices can improve the quality and reliability of public transit data feeds for interoperable use.

- **Develop Integrated Payment Systems:** Creating the ability to seamlessly pay for various transportation providers through a single portal requires transit data interoperability and may be crucial to establishing the convenience necessary to reduce SOV travel.

- **Promote Data Sharing:** A forum for collaboration and sharing of best practices between public and private companies would be valuable to all transit data stakeholders.

- **Implement Pilot Projects:** Demonstrations and proof-of-concept iterations of integrated payment, new first-mile/last-mile services, new data standards, etc., can build support for implementation and scaling.

This report describes the barriers and solutions to interoperable transit data and lists a set of actions that both public and private sector transportation agencies can take to move towards greater transit data interoperability.

BACKGROUND

01

BACKGROUND

On June 16 and 17, 2015, Rocky Mountain Institute (RMI) hosted a two-day workshop focused on interoperable transit data in San Francisco, CA. By gathering 27 industry and public leaders (see Appendix F), the goal of the workshop was to quickly drive effective change in the accessibility and use of transit data (broadly defined to include data from both public and private transportation providers).

Workshop participants included industry-leading company representatives, a wide array of prominent academic and consulting professionals in the space, and influential public sector leaders administering, operating, and designing public transportation (see Appendix F). The group's composition allowed for the design of plans that aim beyond simply market-motivated solutions to solutions that also solve larger environmental and societal goals.

The participants first identified existing barriers to greater transit data interoperability. The focus of the workshop then turned to developing solutions to the most common barriers. This report describes the high-level solutions brainstormed by the participants. The specific action plans designed by participants to put those solutions into motion are detailed in Appendix D.

RMI places interoperable transit data at the foundation of a shift toward mobility as a service. It is one of five key tactical areas RMI's Mobility team is rolling out in collaboration with the cities of Austin, TX, and Denver, CO, as part of a comprehensive, multi-year mobility transformation program. RMI's ongoing transportation-related goals include scaling solutions to other cities and continuing to use transit data to lead the world towards a low-energy, low-emissions future.

Photo by: Piotr Wojnarski - Interoperable Transit Data Workshop 2015

MOBILITY TRANSFORMATION

02

MOBILITY TRANSFORMATION:
THE BENEFITS OF A NEW MOBILITY FUTURE

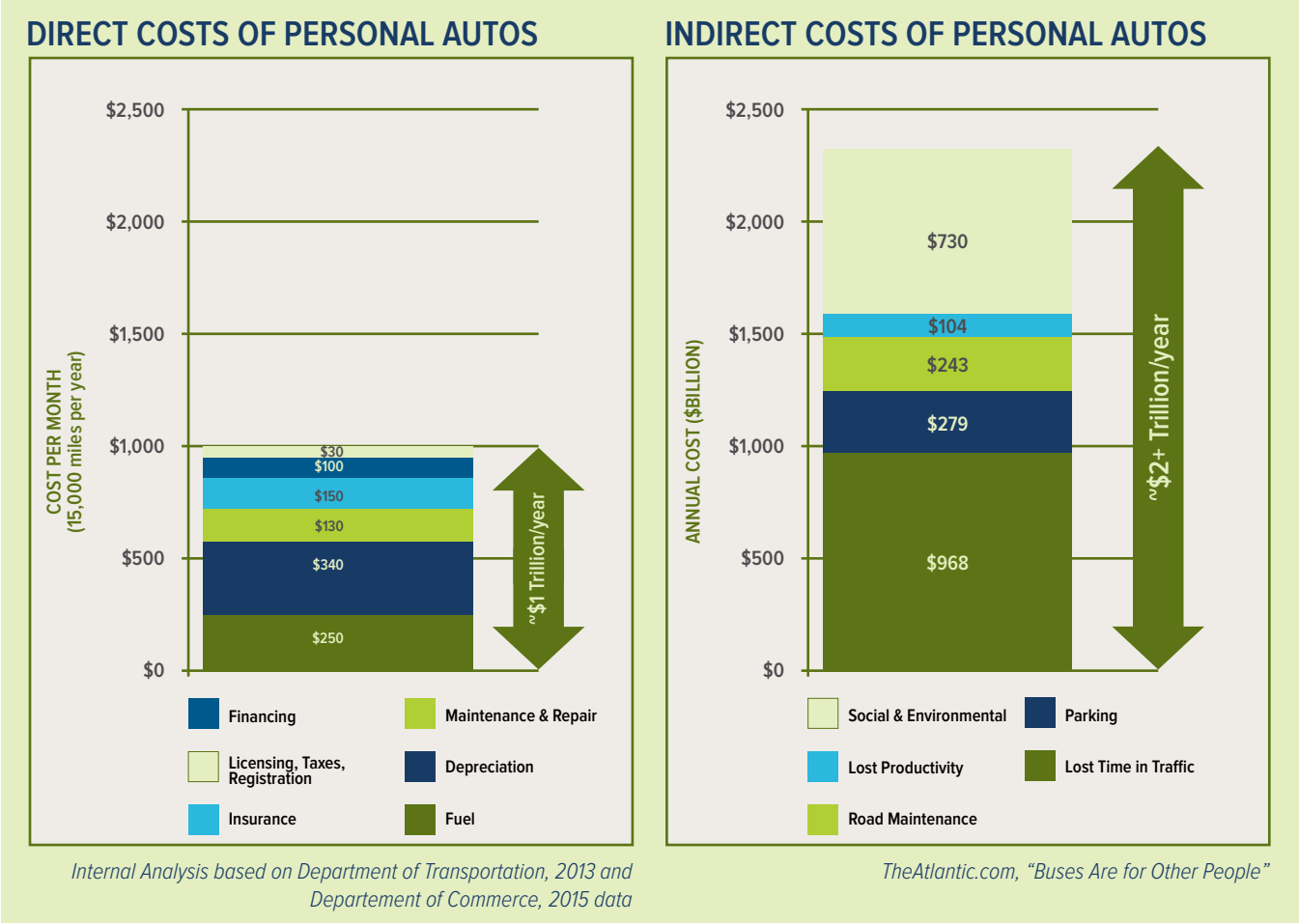
The current dominant means of travel in the U.S. is costly, dangerous, and oil-intensive. Travelers today make over 80 percent of their trips via personally owned internal-combustion-engine vehicles. Commuters traveling to and from their places of work use singly occupied vehicles 75 percent of the time. In contrast, walking makes up 10 percent of trips, with public transit only providing 2 percent of trips overall.[1]

Personally owned vehicles:

- Account for 15 percent of U.S. and 10 percent of global emissions
- Account for 30 percent of global oil combustion
- Sit unused over 95 percent of their lives[2]
- Consume 27 percent of income in U.S. median income households

This type of mobility system often requires that people rely on and purchase a costly personal vehicle, leaving lower-income families without access to affordable mobility. Beyond the prohibitive personal costs, the societal costs of SOVs are tremendous (see Figure 1).

FIGURE 1: THE DIRECT AND INDIRECT COSTS OF PERSONAL AUTOMOBILE OWNERSHIP



Internal Analysis based on Department of Transportation, 2013 and Departement of Commerce, 2015 data

TheAtlantic.com, "Buses Are for Other People"

MOBILITY OF THE FUTURE

Emerging technologies and societal trends are creating an opportunity for a new mobility future in which electrified (and eventually self-driving) vehicles operate within transit-friendly, walkable, and bikeable cities. In contrast to the current, just-in-case transportation system, mobility becomes a service, available when and where it is needed—just in time—allowing fewer vehicles to do the same job at lower cost.

The cost of mobility could be 80 percent lower than its cost today, unlocking $1 trillion in value for consumers, businesses, and municipalities; improving access across all levels of society; reducing congestion; and decreasing emissions by 1 gigaton per year. While technological and societal progress are laying the groundwork to make this vision possible, pioneering cities are required to drive this transformation.

An on-demand system built around the user connects customers with an integrated set of options and prices in which the entire trip is planned out via a variety of mobility services. Once a trip is selected the customer can book travel and is informed in real time of optimizations to the travel plans based on the customers' preferences (e.g., shortest time, least expensive, lowest carbon emissions).
There are three major categories of trends accelerating the shift to an on-demand mobility system.

- Shifts in societal expectations and desires
- The growth and interconnectedness of technology
- Government commitments towards an environmentally-friendly future

FIGURE 2: MOBILITY OF THE FUTURE

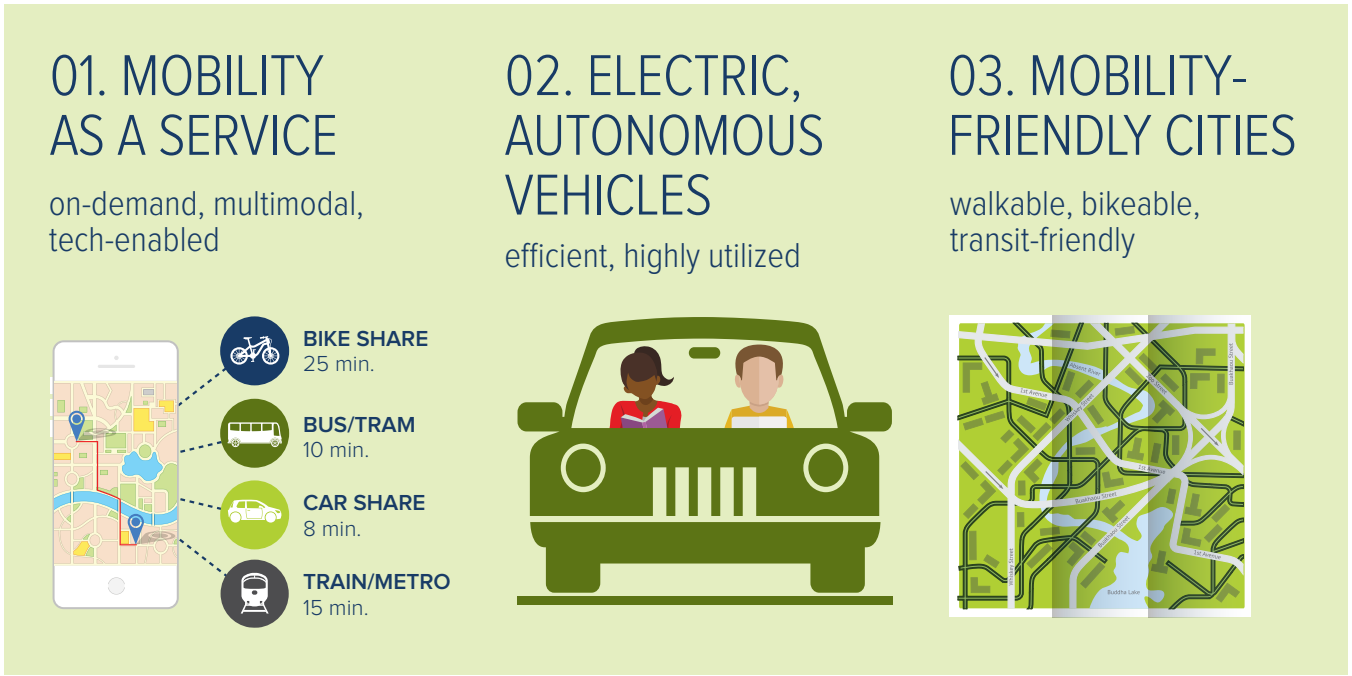


FIGURE 3: THREE MAJOR CATEGORIES OF SOCIETAL TRENDS ACCELERATING THE SHIFT TO AN ON-DEMAND MOBILITY SYSTEM

01. SOCIETY

Rise of the sharing economy

Social media ubiquity

Urban population growth

Flat per capita VMT & deferred vehicle ownership

02. TECHNOLOGY

Data explosion and processing capability

Self-driving, connected vehicles

Battery & sensor cost dropping

Smart phones

03. GOVERNMENT

Many cities, states, and the federal government enacting aggressive CO_2 reduction goals

Some enacting fossil-fueled trip reduction goals and programs

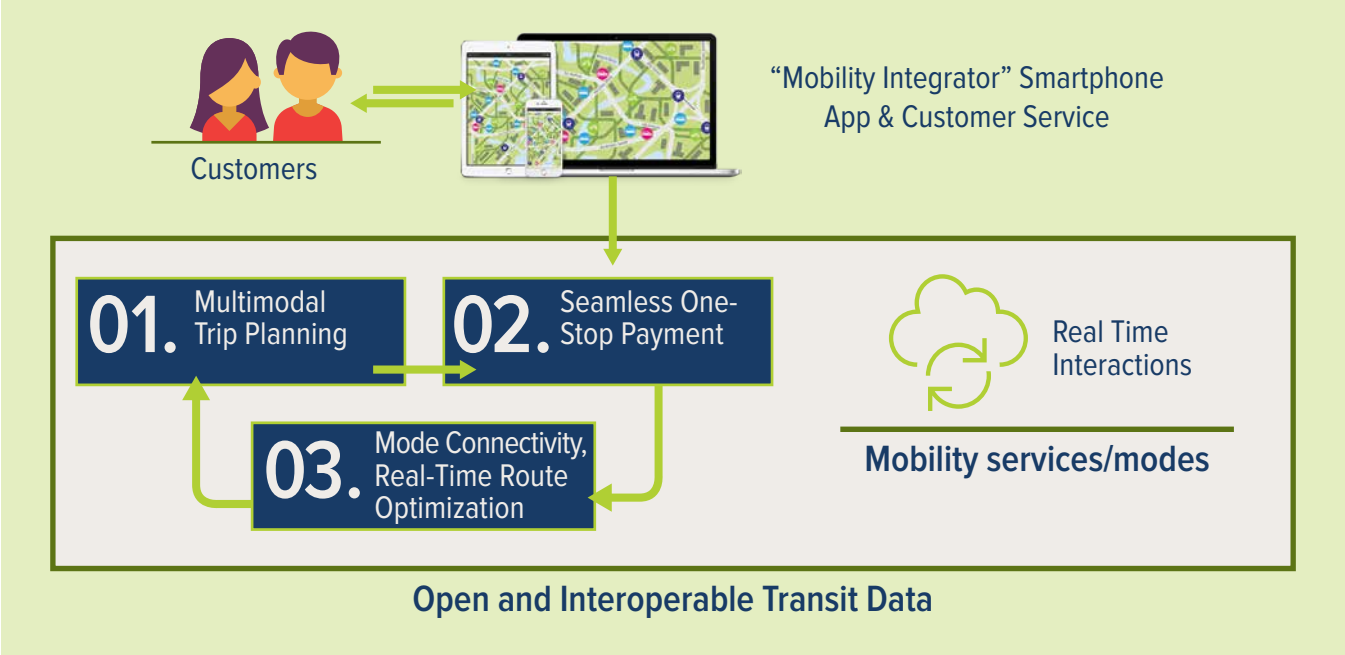
WHAT IS "MOBILITY AS A SERVICE"?

Rather than using a personally owned vehicle, imagine a scenario in which people can order a ride to wherever they need to go and it arrives right on time, at the right size to carry their luggage, and at a cost lower to both them and the environment. We call this "mobility as a service" (MaaS). MaaS can be thought of as the ability to schedule vehicles and plot routes on an on-demand basis depending on the travelers' needs, seamlessly getting people where they want, when they want, how they want.

Right now consumers don't have easy access to information about all of their options. And when they do know what their transportation options are, decisions are usually based on convenience, often meaning they end up getting into their personally owned vehicle. Existing transit modes rely on separately financed transportation systems (e.g., bus/rail, car, bikeshare), deeply ingrained behavior (e.g., drive!), and a variety of subsidization programs that obfuscate the true cost and perceived convenience for each mode.

Advances in technology are enabling new transit and mobility service offerings built on emerging, innovative technology. Soon, these service offerings will approach a level of interoperability at which a traveler's needs are met over a single interface delivering multiple mobility services. Services might be bundled into a product that resembles a mobile-phone plan package

FIGURE 4: HOW IT WORKS
Three interdependent components of "mobility as a service."

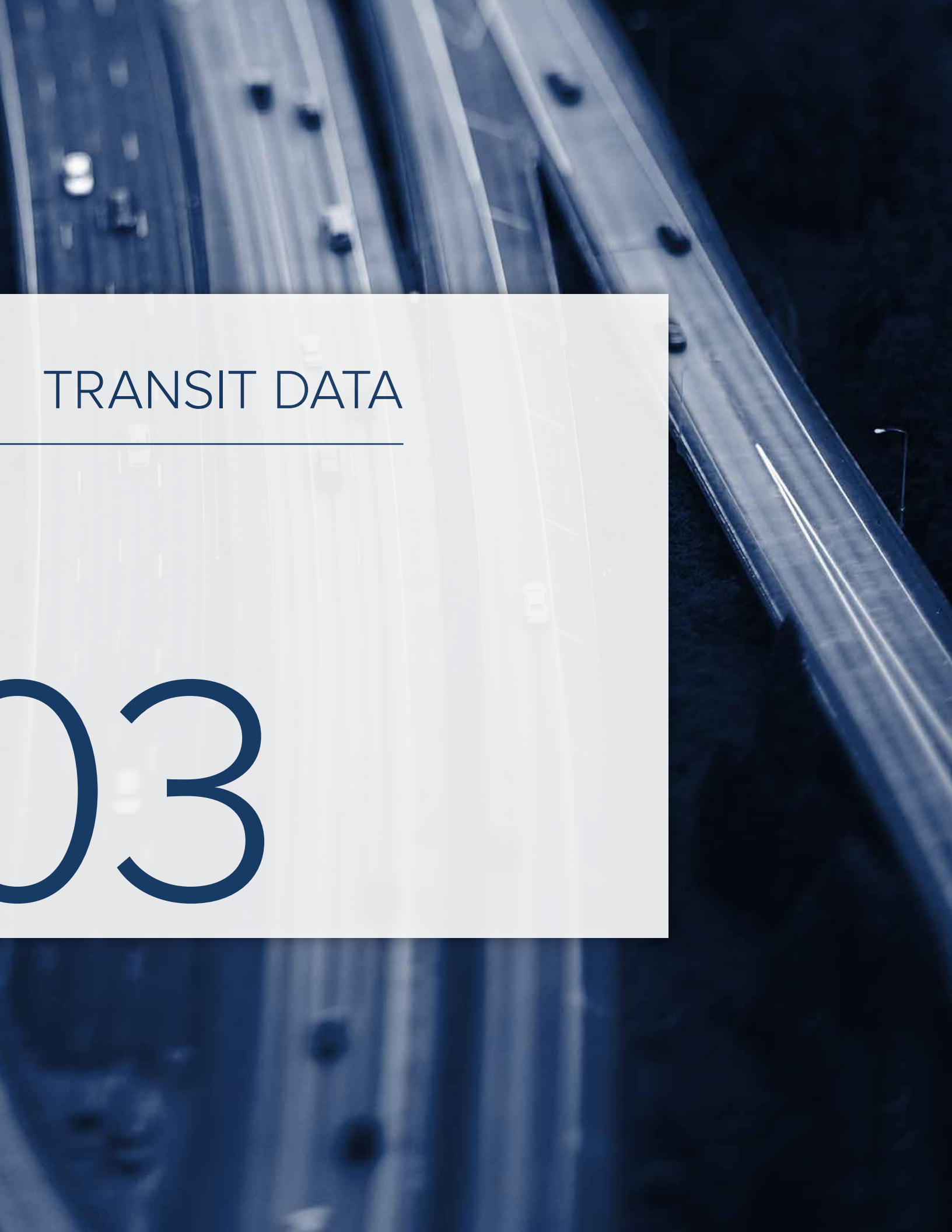


and incentivizes multimodal solutions over personally owned vehicles. This switches transportation from an asset-ownership model to a service-based subscription model, such as is already happening in the software industry and through vacation timeshares.

An interesting subset of MaaS is "commuting as a service" (CaaS). Commuters typically have an easily definable starting point, ending point, and time period associated with their trips making them perfect candidates for a service-based mobility solution. In a CaaS system, a specifically designed transport solution—perhaps a combination of public and private modes—transports the user to work and back. If for some reason the regularly scheduled ride is not available, a backup vehicle is dispatched to pick up the user, providing a degree of service reliability.

BENEFITS OF A MULTIMODAL MAAS FUTURE

Early research shows that better transit information and simple, clear, non-SOV options for consumers have the effect of reducing fuel consumption and its resulting greenhouse gas emissions.[3] As software technology and data analytics advance, this effect will become multiplicative. Emerging technologies like autonomous vehicles, which will bring further efficiency gains, will also rely on effective use of transportation data (e.g., through vehicle-to-vehicle and vehicle-to-network communication).



TRANSIT DATA

03

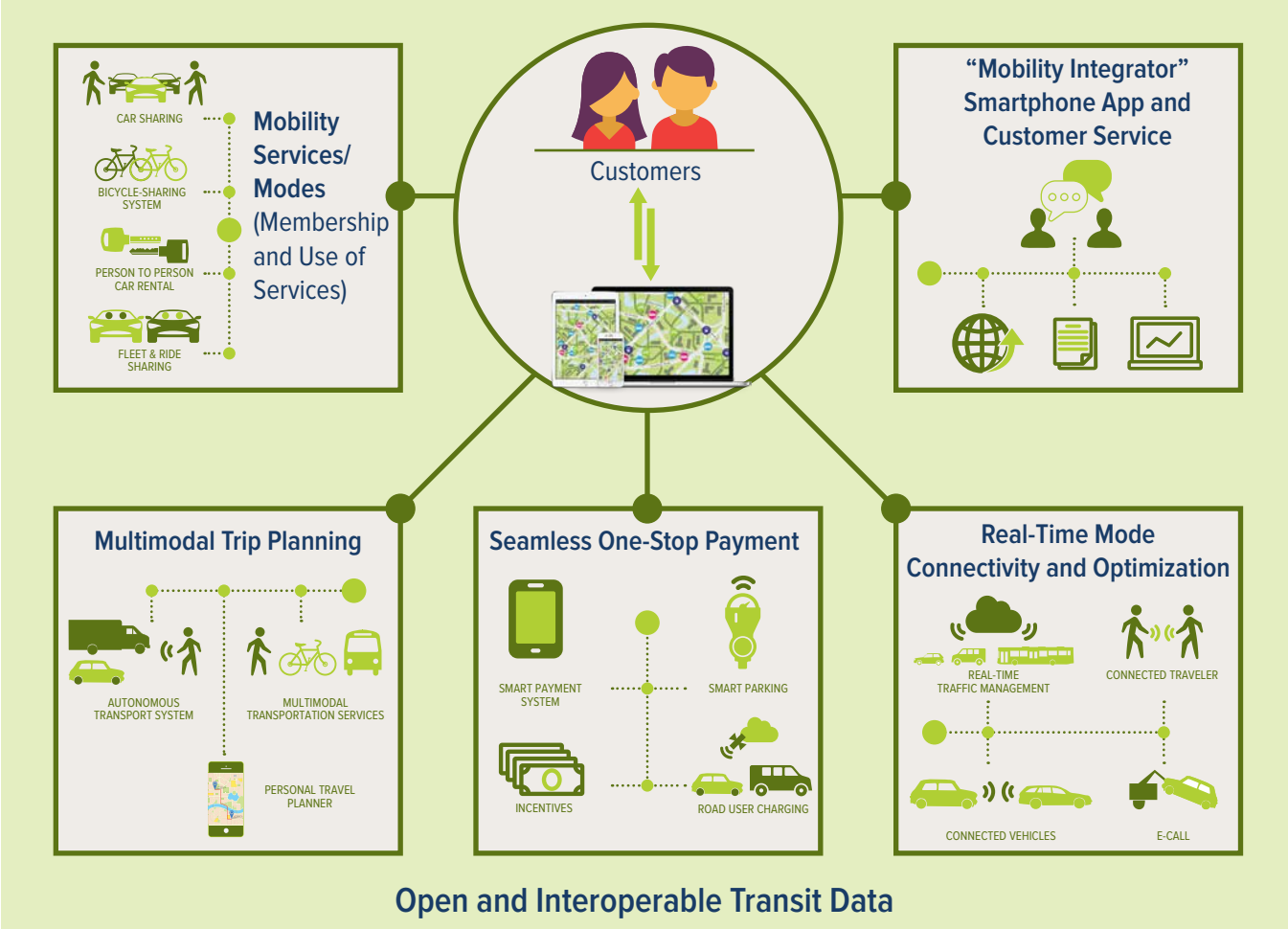
TRANSIT DATA:
THE CASE FOR INTEROPERABILITY

In the fast-approaching world of MaaS, the whole transportation system operates as an interconnected, cooperative system with a seamless customer booking and payment experience delivered for a variety of transport modes. Clearly, infrastructure, technology platform, payment, transportation services, and transportation data analysis must all be capable of working together to achieve this solution. The whole MaaS system will rely on data being produced and consumed by all of the participants. Fortunately, much of the technology is already available and being deployed in transit, though often in separate, unconnected applications.

Working with transit data stakeholders to improve the interoperability of this data—such as the RMI-facilitated workshop that provided the basis for this report—is a critical component of the transition to MaaS.

Interoperable transit data is the foundation upon which new, tech-enabled transit services and efficiencies are and will be built. This interoperable data has the potential to connect various transportation options seamlessly, paving the way for a transition to a multimodal transit system that is as reliable and simple as traveling in a personally owned vehicle, but cheaper and less environmentally harmful.

FIGURE 5: OPEN AND INTEROPERABLE TRANSIT DATA ENABLES "MOBILITY AS A SERVICE"



DATA SHARING: FOUNDATION FOR INNOVATIVE MOBILITY SOLUTIONS

Enabling interoperable transit data between public and private providers is a powerful step in shifting the entire mobility system towards one with drastically reduced cost, fewer negative environmental consequences, and improved socio-economic access to mobility services.

The combination of increasingly available data from sensors, technology-enabled transportation providers, and the growing interconnected nature of devices can be leveraged to reduce traffic congestion time, increase public transit ridership, and serve all people regardless of background, financial means, and car ownership status.

To achieve these benefits we need both public and private transportation providers to collaborate and share knowledge and data (see Figure 6).

There are also public and private transit data aggregators and providers. Examples include 511.org, Ridescout, Apple Maps, Google Maps, and Open Trip Planner.

The collaboration of these public and private stakeholders can result in solutions that enable better access to mass transit information, while at the same time incorporating new tech-enabled micro-transit services (i.e., private companies offering vehicle share and last-mile solutions[ii]) into a multimodal network of transportation options.

Broader, more reliable interoperable transit data will offer the immediate short-term benefits of increasing revenue and ridership for public and private sector transit providers while establishing a necessary foundation for more sophisticated technology-enabled transit services, and ultimately a shift away from SOV trips to convenient and cost-effective mobility as a service.

FIGURE 6: EXAMPLES OF PUBLIC AND PRIVATE PROVIDERS

PUBLIC (OR MASS)	PRIVATE (OR MICRO)
City and regional transportation departments	Carshare
Publically funded and operated buses, trains, streetcars, etc.	Bikeshare
Accessible transportation (e.g., dispatchable paratransit)	Transportation Network Companies[i] (e.g., Lyft, Uber, etc.)

[i] Transportation Network Companies (TNCs) provide prearranged transportation services for compensation using an online-enabled application or platform (such as smart phone apps) to connect drivers using their personal vehicles with passengers.

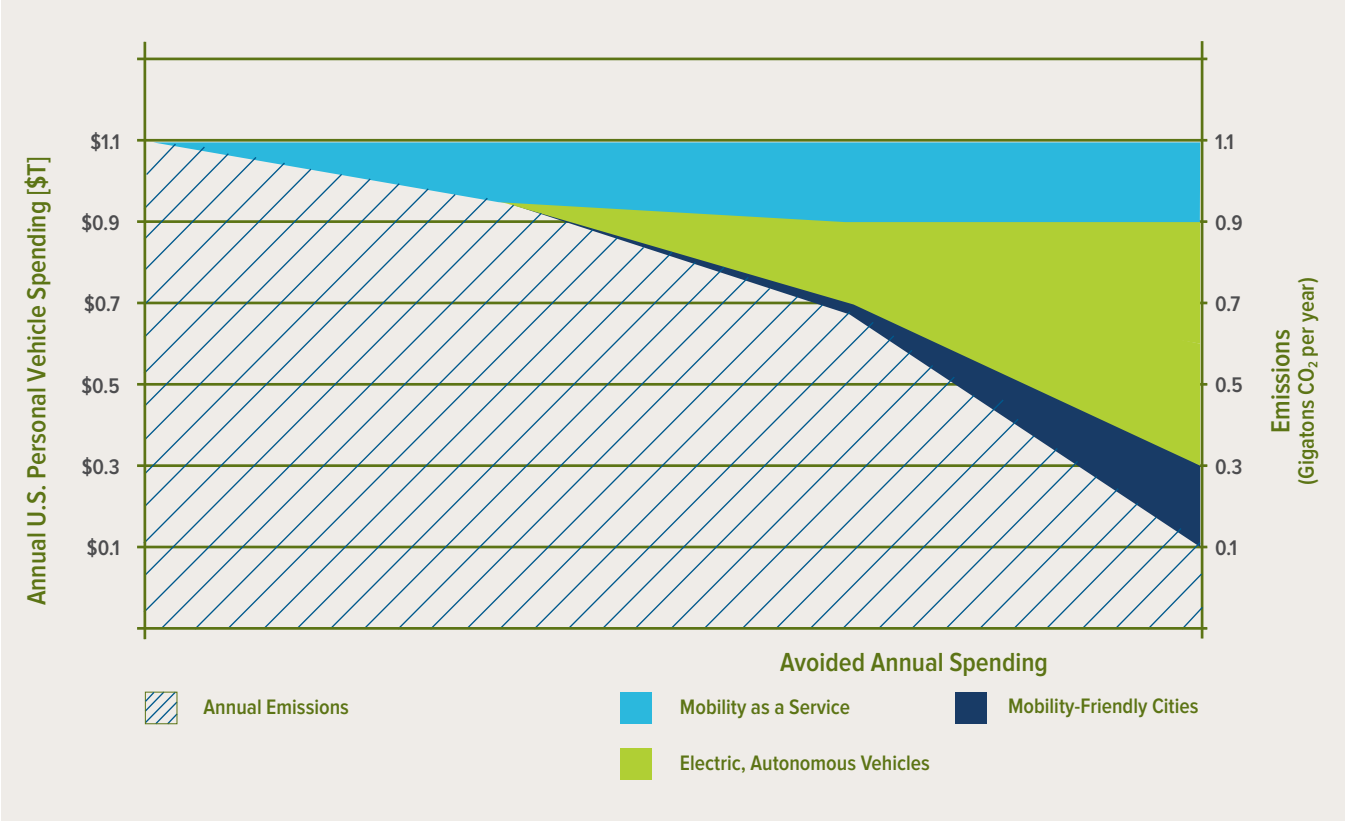
[ii] The last-mile challenge refers to how to get from a transit station to work or home, and is often a big obstacle to getting people out of their cars and onto public transit.

BUSINESS CASE FOR INTEROPERABLE TRANSIT DATA

There is also a strong business case associated with improving the interoperability of transit data. Providing real-time transit data to users of public mass transit has proven to increase ridership and offers up to a four times return on investment in the first year of use.[4] Other providers of transportation can operate more effectively with the availability of real-time data, and stand to see dramatic benefits from increased interoperability. Data protocols that allow for information sharing may deliver significant returns within individual industries, and have a multiplying effect when combined.

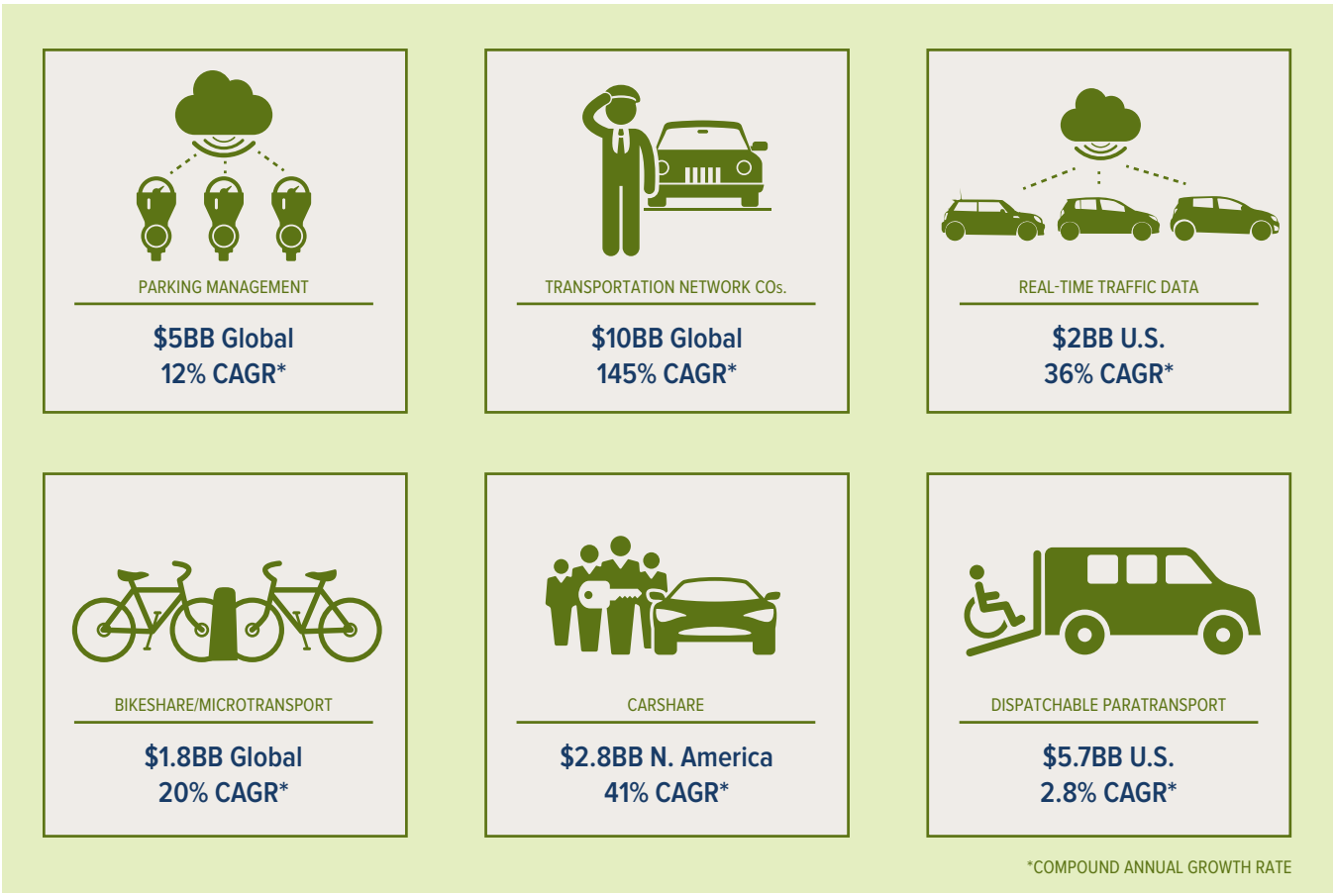
FIGURE 7: TRANSFORMING PERSONAL MOBILITY CAN UNLOCK ECONOMIC VALUE AND REDUCE EMISSIONS

Transforming personal mobility can unlock $ 1 trillion per year in business and consumer value and reduce annual emissions by 1 gigaton in the U.S. alone.



RMI Internal Analysis. Based on "Transforming Personal Mobility,"Earth Institute, Columbia University (2013)

FIGURE 8: TRANSIT DATA SUPPORTS GROWTH IN SEVERAL FAST-GROWING TRANSPORTATION MARKETS



Source: Federal Transit Administration, DOT

BENEFITS UNLOCKED BY INTEROPERABLE TRANSIT DATA

In addition to serving as a foundation for MaaS, improved transit data interoperability, particularly between private sector and public sector organizations, enables a variety of beneficial outcomes.

- **Better public/private coordination:** Cities and transit agencies can better coordinate with and complement private sector transit services to develop innovative service concepts that are well connected. This can lead to improved service area coverage, increased market share through network effects, and better travel options for customers.
- **Reduced regulatory risk:** Clear communication between the private and public sector can contribute to reduced regulatory risk faced by private transportation providers. For example, city governments can provide clear, welcoming policies and private transit services can provide low-cost, anonymized data that is of use to cities.
- **Transit equity:** Complementing public transit service with private,

technology-enabled transportation solutions can help meet transit equity and quality goals.

- **Increased market size through aggregation:** Data interoperability can help open up markets and customer bases that are currently disaggregated because there is no connection between service providers.
- **Better city intelligence:** Visibility of the impact of private transit services informs city and transit planning and management.
- **Visibility of options to customers, lead generation for transit providers:** Consumers can easily discover and compare as many of their choices at once as possible resulting in more leads for providers of the transit choices.
- **Accessibility to customers:** Smart mobility services can meet the diverse needs of customers and provide easy access to mobility.
- **Efficient use of public resources:** Intelligence on transportation system needs allows public agencies to allocate resources based on the real needs of customers.
- **Reliable travel:** With greater visibility on the status of transportation options, the public sector is better able to manage traffic incidents and rely on advanced data analytics to ensure a reliable transport system.
- **Better customer experience:** The customer experience can become a greater competitive differentiator if data-related challenges become a lower cost of doing business. Many companies would prefer to focus their energy on customer experience rather than data acquisition, handling, formatting, and processing.

THE IMPORTANCE OF TRANSPORTATION DATA

TESTIMONIALS FROM INDIVIDUALS IN THE TRANSPORTATION INDUSTRY AND PUBLIC SECTOR[5]

- "Large numbers of micro transit riders combine those trips with public transit. Thus fluctuations in public transit operations affect private operations and profitability. There is an opportunity to mutually benefit from greater integration across modes."
- "Without the ability to analyze comprehensive data we cannot understand how the transportation ecosystem is impacted."
- "There is no way to understand travel patterns, specifically ridership, under the current data availability schemes."
- "Mobility management efforts for our city rely on transportation data—both outside and that created by our fleet operations. It is important for effective customer service and ensuring operational (and thus financial) efficiency."
- "All forms of transportation data are major determinants of urban design, and thus any influence on transportation influences urban design, land use planning, and congestion management."
- "Transportation data provides our customers with on-demand transportation information and connections."
- "Transportation data is the key to public journey planning and analysis capabilities—it is what our jobs rely upon."
- "This data ultimately gets people where they are going by showing them all their available travel options."
- "Sharing of data allows us to more effectively provide our service and integrate with other providers for portions of a trip that are not met by our service."
- "We live in a world that moves. Transit systems, delivery vehicles, and on-demand fleets are moving through cities in unprecedented volumes. This movement is generating rapidly growing amounts of data in the process, creating an Internet of Moving Things."
- "Congestion and commuting is a painful experience that drains everyone on our staff. Our employees are less productive due to the current travel system."
- "Real-time transportation data is critical to provide a positive customer experience."

BARRIERS TO INTEROPERABILITY

04

BARRIERS TO INTEROPERABILITY

While ITD can provide great benefits to all parties involved—the public sector, private transport companies, and customers—there are clear barriers to immediate action. These barriers are complex and in some cases interdependent. Barriers include variability in resources and knowledge within public transit agencies, inconsistency of data licensing approaches, lack of regulation covering data sharing, and more. The following barriers to implementing interoperable transit data are impeding the transformation to mobility as a service.

RESOURCES AND KNOWLEDGE

Variability in resources and knowledge within public transit agencies is a significant barrier to initial adoption and eventual market saturation of new standards. A toolkit is needed to help transit agencies generate common, reliable, resilient data. Also, public sector incentives and skillsets—from operational budgets to sales cycles to compliance—are not geared toward taking advantage of private sector capabilities, which include seeking out return on investment, profitability, and customer acquisition/engagement.

LICENSING

Transit data are often covered by individual licenses and terms of service. This variety of licenses makes it time consuming for developers to review the limitations and uses of provided data, thus hindering the rate of proliferation and use of shared transit data. Data providers (both public and private) might be willing to share more data if they had access to data-sharing-focused best practices for how to license it. There are currently efforts underway (e.g., through Transitland) to standardize license language and offer online templates.

REGULATION

Regulation currently treats public transit and private transit very differently. For example, private providers are not recognized as fulfilling transit accessibility requirements laid out in Title VI of the Civil Rights Act of 1964.[iii] Thus private providers are not considered Title VI compliant, making them ineligible for public funding geared toward improving transit options. On the other hand, many private providers view the regulation of their services that may come along with accepting public funding as a potential hindrance to overall business development.

PAYMENT INTEGRATION

Lack of payment integration, particularly backend (behind the scenes) integration, is a recurring hindrance to all-in-one multimodal transit solutions. Lack of standardized fare generation presents a barrier to integrated payment. However, when private tech-enabled transit providers are presented with opportunities to share transit data or participate in payment integration they fear commoditization and brand dilution. Payment integration must work not only on public and private transit, but also on a combination of both.

Photo by: Piotr Wojnarski - Interoperable Transit Data Workshop 2015

[iii] Title VI prohibits discrimination on the basis of race, color, and national origin in programs and activities receiving federal financial assistance. http://www.justice.gov/crt/about/cor/coord/titlevi.php

SOLUTIONS

05

SOLUTIONS

Overcoming the barriers impeding the move towards more interoperable transit data is critical to transforming our mobility system. The following six high-level solutions to improve transit data interoperability are a synthesized summary of the specific actions developed in the workshop (see Appendix D). A leader is required to get all stakeholders to prioritize cooperation and then implement action. The leader could be a single stakeholder—a public agency seeking to meet its climate and infrastructure investment utilization goals or a major private mobility company that has the specialized expertise in operating and putting the data to optimal use—or a combination of multiple stakeholders.

ENCOURAGE PUBLIC-PRIVATE PARTNERSHIPS

Public-private partnerships are key to improving transit data interoperability. Regular public and private transportation provider collaboration can lead to improved service area coverage, increased market share through network effects, and better travel options for customers. This regular collaboration can lead to long-term relationship/partnership value for both public and private organizations.

For example, public and private transit providers may be able to evolve regulatory constructs by partnering to provide on-demand service in areas of low mass transit ridership, thus alleviating expenditures on unused public routes while still providing Title VI compliant service. See Appendix C for more information and examples of how the public and private sector can collaborate.

DEVELOP INTEGRATED PAYMENT SYSTEMS

Creating the ability to seamlessly pay for various transportation providers through a single portal is crucial to transit data interoperability. Seamless booking and payment integration would drive revenue for public and private transit providers, improve the customer experience, and lead to the adoption of more non-single-occupant-vehicle (SOV) trips. Simplified public transit fares (e.g., offering a flat fare) may solve many of the technical barriers to implementing standardized fare generation and integrated payment while boosting ridership.

Actions:

- Standardize fare generation or simplify fare structures
- Urge the federal Department of Transportation (DOT) to require public agencies to adopt one form of payment capability across all transportation modes.
- Integrate public transportation payment with third party applications.
- Encourage public transit agencies to procure an open payment system.
- Pull together cross-agency and private stakeholders (e.g., bikeshare company, metro transit authority) to launch pilot demonstrations of open payment system.

Photo by: Piotr Wojnarski - Interoperable Transit Data Workshop 2015

ESTABLISH TRANSIT DATA BEST PRACTICES

Improving transit data reporting is another way to help move towards more interoperable transit data. This includes improving data reporting within existing standards (e.g., enabling public agencies to improve the quality of their data), enhancing existing standards to make them more sophisticated, and developing all-new standards.

Actions:

- Identify "common denominators" among stakeholders for transit data best practices under the existing standard prescriptions.
- Publish agreed-upon best practices and methods and adhere to them.
- Embed best practices in requirements for participation in technology provider platforms.
- Develop a new data standard that encompasses best practices and expands to include greater data sets and complexity, and that is capable of representing necessary complexity in the increasingly connected mobility world. Possibilities include:
  - Identifying incentives or plans for transit agencies to provide higher-quality transit data
  - Creating rules/best practices for smaller agencies and companies to provide properly formatted transit data (e.g., GTFS, GTFS-RT, or GTFS-SUM)
  - Developing a new data standard (e.g., enhancing GTFS or replacing it with an all-new standard) that encompasses the complexity needed to make multimodal travel data convenient for customers to use regularly
  - Assisting public agencies with adoption of the new standard by providing skills training

IMPLEMENT PILOT PROJECT

Demonstrations and proof-of-concept iterations of integrated payment, new first-mile/last-mile services, new data standards, etc., can build support for implementation and scaling of real-world projects. A first step could be developing a "commuting as a service" pilot project. This entails deploying a multimodal commuting system along a select corridor. This pilot project should make it compelling to avoid SOV commuting trips, reduce greenhouse gas emissions, and demonstrate the potential of public/private collaboration.

Actions:

- Define the opportunity for employers, commuters, and the city.
- Determine the corridor and project scope (e.g., how many routes, employers, origins and destination, and transportation providers involved).
- Engage employers for employee origin data and incentive program design and participation.
- Engage residential areas, real estate companies, and developers for participation in data sharing to illustrate the value of new commuting options (e.g., increased land/building value, quantity and value of jobs accessible from the building).
- Define and build the customer experience model including technology applications, rider experience, and cross-employer collaboration.
- Determine availability and applicability of existing and needed transportation demand management (TDM) benefits to SOV-alternative transit options.[iv]
- Offer integrated multimodal commuting service based on what public and private providers can offer.

[iv] Transportation demand management is the use of strategies to encourage sustainable use of transportation infrastructure and maintain its optimal performance by managing demand through travel choices.

UNDERSTAND METRICS

Clearly understanding the SOV energy, emissions, and cost impact metrics to compare against MaaS solutions is key to motivating employers to create travel incentives reducing employee SOV travel. The same metrics can be used to gain funding for environmentally friendly, healthy, and convenient transit projects, city redevelopments, and impactful public-private partnerships.

Actions:

- Provide an enhanced TDM survey (one that includes productivity impacts/concerns) to employers.
- Integrate survey results with existing data from any previous studies.
- Use outcomes to compare the impact a pilot project (described below) would have on productivity, TDM, and multimodal travel.
- Share these results with additional employers to build a larger network of employees participating in SOV-reduction incentives.

PROMOTE DATA SHARING

Agreeing to a set of retrospective data that private companies are willing to share with public agencies and cities would help make effective city planning and transit decisions.

Actions:

- Build a list of data to offer city officials.
- Request a wish list of data from a metropolitan planning organization/transit agency working group.
- Refine conversation with private transportation providers to narrow and standardize which report types can be built into a kit for regular sharing of limited data with cities.

Photo by: Piotr Wojnarski - Interoperable Transit Data Workshop 2015

CONCLUSION

06

CONCLUSION

Rapidly emerging technology in transit data and mobile technology presents an opportunity to dramatically improve the efficiency, transparency, and user experience associated with existing transportation infrastructure. Ultimately, this is not only an opportunity for cities and transit agencies to provide convenient, less congested travel for their constituents, but also a rapidly expanding multi-billion-dollar transportation market for technology companies. Discussions with industry experts in the Interoperable Transit Data June 2015 workshop confirmed the value of and interest in ensuring the availability, exchange, and interoperability of robust transit data.

For both businesses and cities, existing barriers currently prevent the realization of that value. Facilitated by RMI, workshop participants identified the most pressing barriers. Among the most significant barriers discussed were a lack of shared resources and knowledge regarding transit data, challenges around the clarity and interoperability of data licensing, an unclear and uneven regulatory environment, and disaggregated transit mode information and payment. These barriers impede value for the participants and limit the beneficial impact of new technology on transit for consumers.

Following a discussion of the most pressing barriers, workshop participants discussed possible solutions and went on to develop near-term action plans to put those solutions in motion. Just as these barriers all contain private and public sector components, the proposed action plans to solve for them all involve the collaboration of private and public sector actors. With varying degrees of ongoing involvement by RMI, these action plans are now being implemented.

The scale of impact for new transit data and technology is potentially enormous. This can be seen in the global adoption of Google and Portland TriMet's pioneering work on GTFS that began in Portland, Oregon, in 2008 through private-public collaboration. GTFS is now voluntarily in use in thousands of cities around the globe impacting the transit mode choices of hundreds of millions of commuters. The ambition of the plans discussed in the workshop, whether to greatly expand the functionality of transit data or to introduce a new kind of integrated payment system, is potentially as large as GTFS in its impact, and even greater in market and emissions-reduction opportunity. RMI and transportation industry leaders have argued that the future of transportation is one where mobility is available just in time rather than one where underutilized resources sit unused, waiting for utilization just in case. The coordination, visibility, and decisions involved in this fast-approaching just-in-time mobility future will depend on a transit data system far more interoperable than our current one. Building this interoperability now will serve as a foundation for the far more efficient, affordable, clean, and convenient mobility of the future.

Photo by: Piotr Wojnarski - Interoperable Transit Data Workshop 2015

APPENDICES

APPENDIX A:
INDUSTRY OPINION OF ITD POTENTIAL—SURVEY RESULTS

Prior to hosting the Interoperable Transit Data workshop, RMI asked potential attendees several questions regarding their outlook, opinions, and hopes for the future of multimodal travel via interoperable data. Following the workshop, RMI asked attendees to answer a set of questions to gain insight into the impact the meeting had on stakeholders.

The survey contained both quantitative and qualitative questions.

COMPARISON OF PRE- AND POST-WORKSHOP SURVEY RESULTS

Only about half of the number of people that attended the workshop answered the post-workshop survey compared to the pre-survey. Fortunately, both surveys had a representative group of organizations participate. However, because of the disparity in participation, the results below need to be taken in context. It is difficult to draw crosscutting insights from these results since the personal opinions in the post-workshop survey are weighted much more strongly than in the more diverse pre-workshop survey.

FIGURE A1: WHICH OF THE FOLLOWING PUBLIC-PRIVATE COLLABORATION TOPICS ARE MOST LIKELY TO LEAD TO ACTIONABLE AND VALUABLE NEXT STEPS?

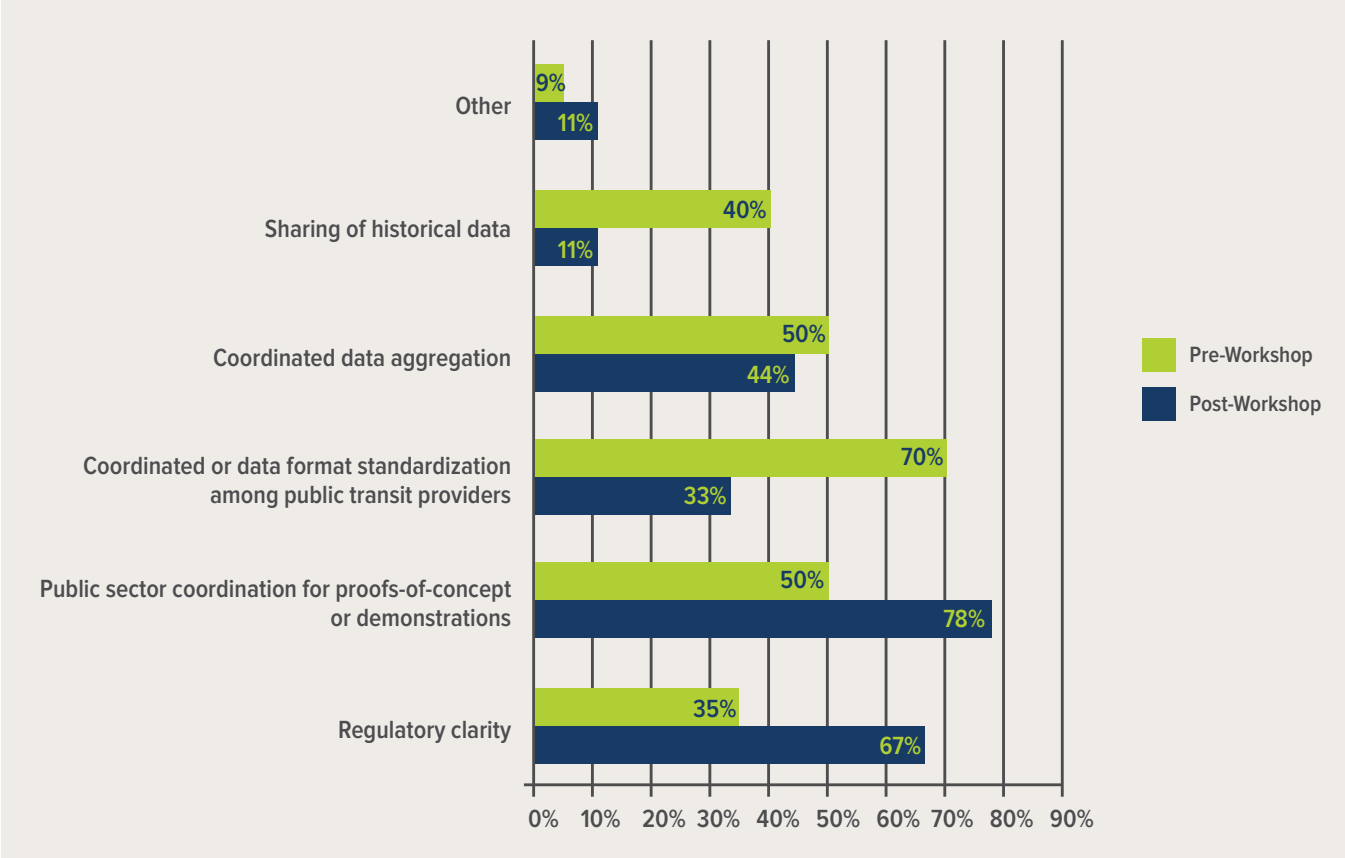


FIGURE A2: HOW QUICKLY DO YOU BELIEVE MAAS COULD ACCOUNT FOR 20% OF ALL TRIPS IN SAN FRANCISCO?

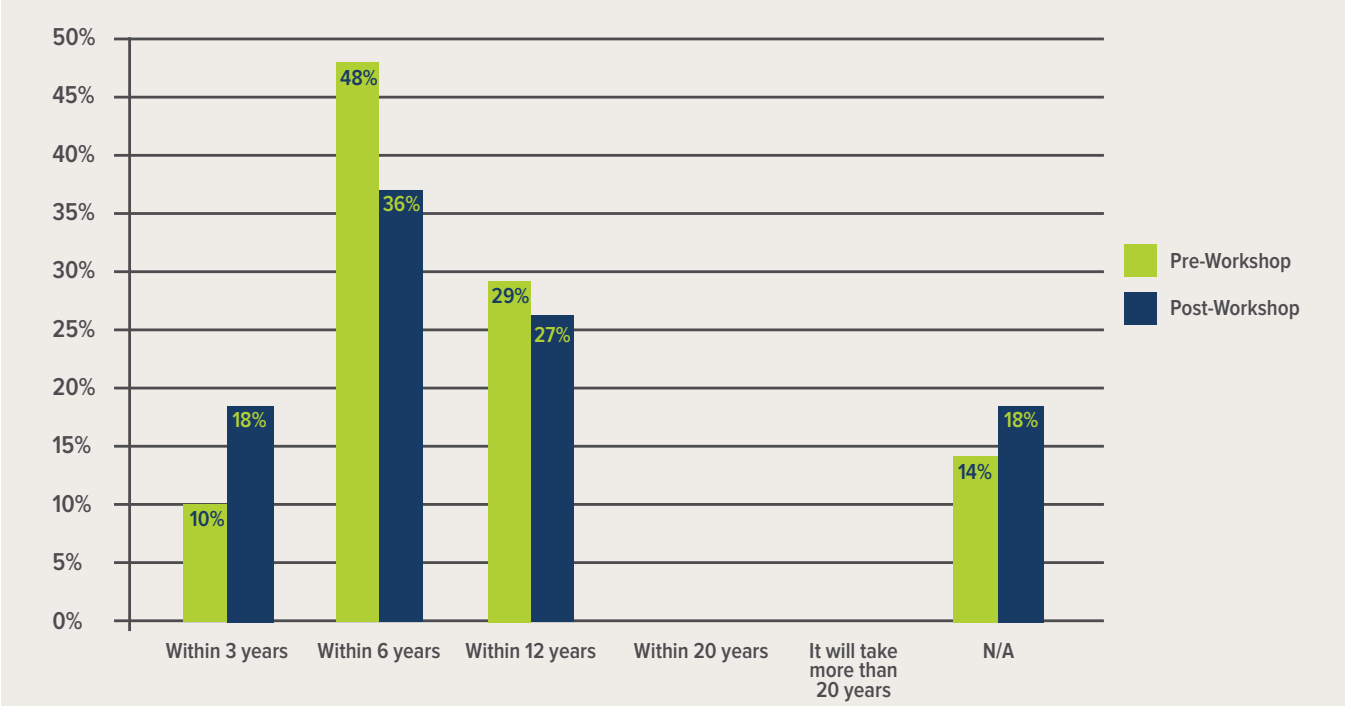


FIGURE A3: WHAT ROLE WILL PRIVATE-PRIVATE COLLABORATION PLAY IN THE DEVELOPMENT OF MAAS?

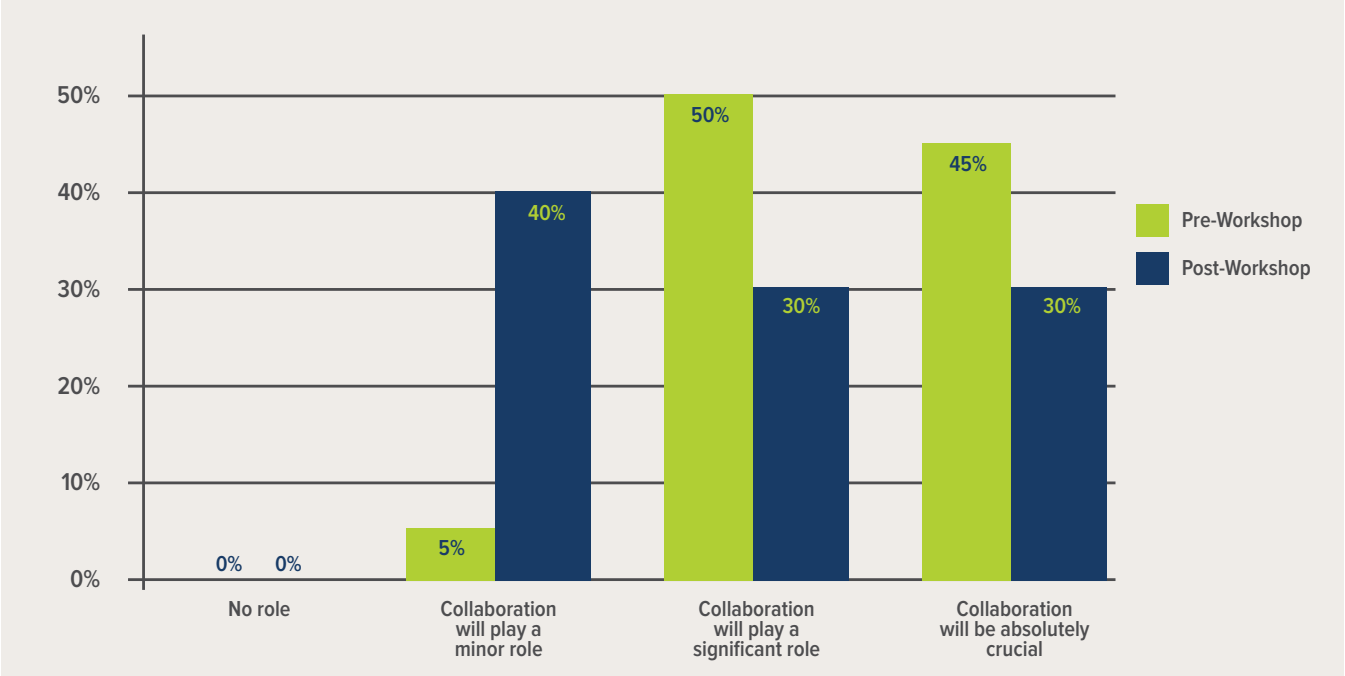


FIGURE A4: WHAT ROLE WILL PUBLIC-PRIVATE COLLABORATION PLAY IN THE DEVELOPMENT OF MAAS?

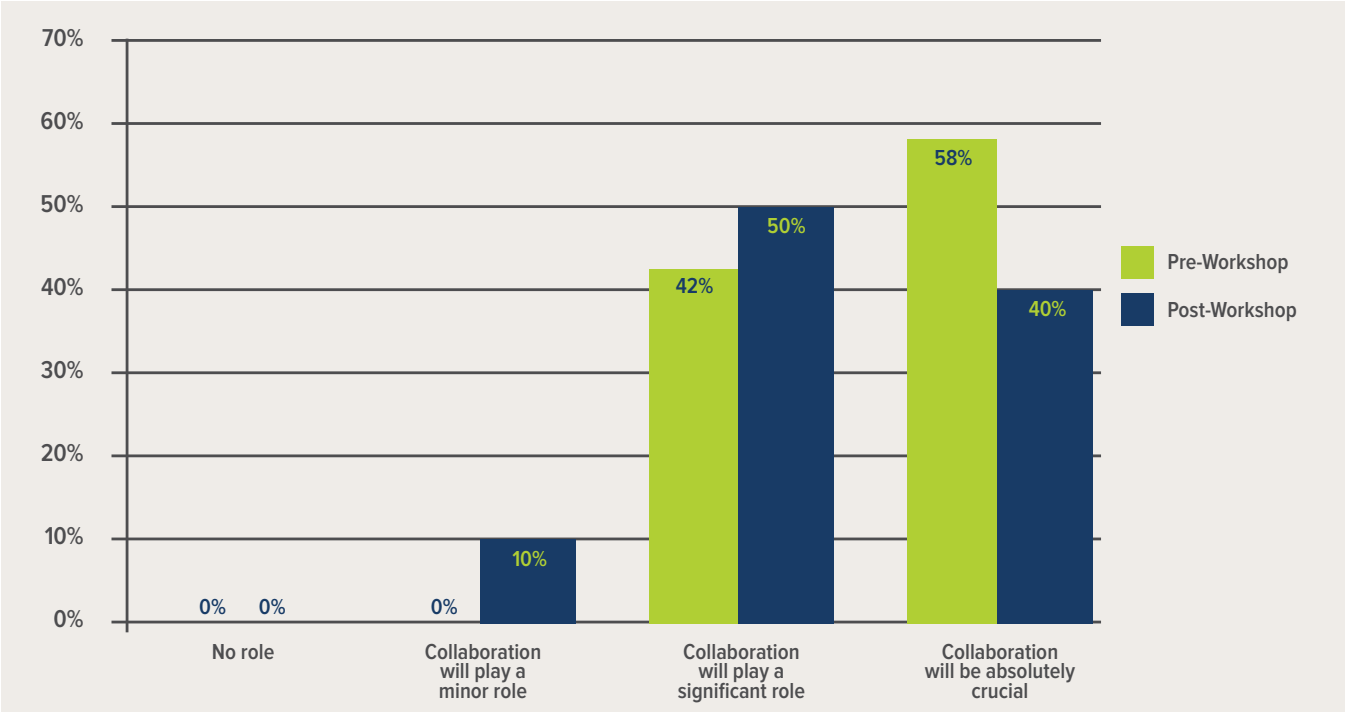
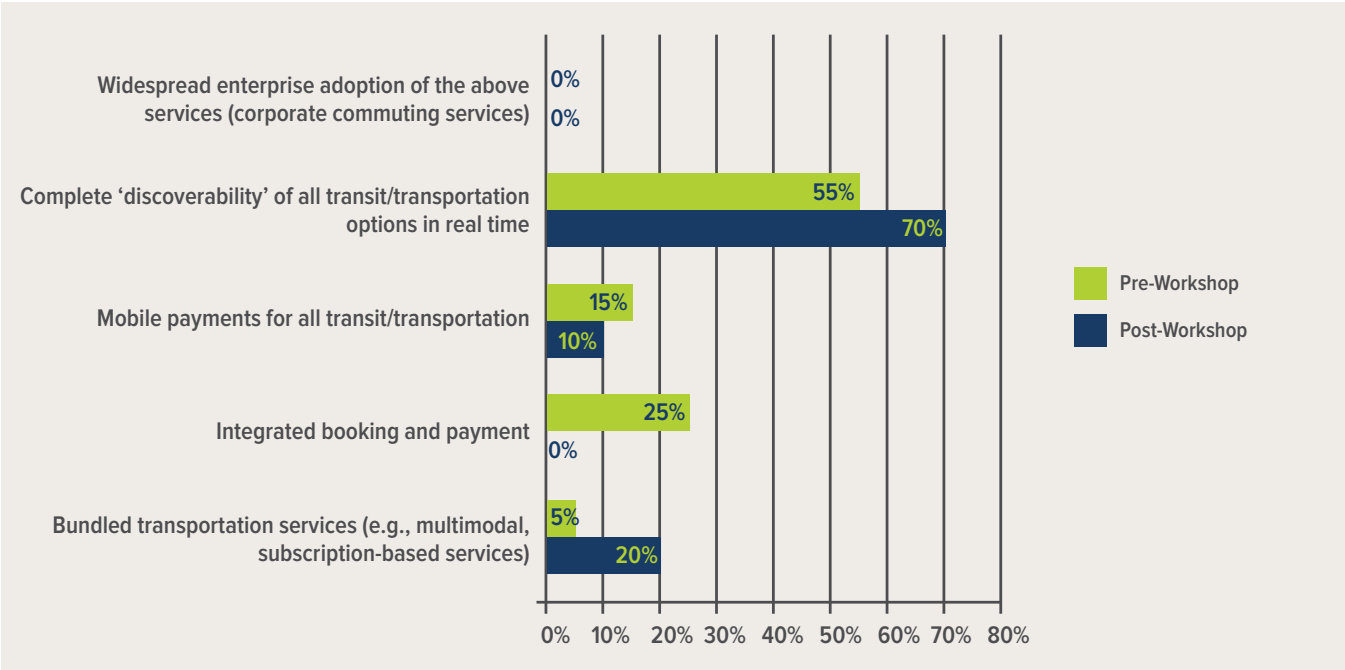
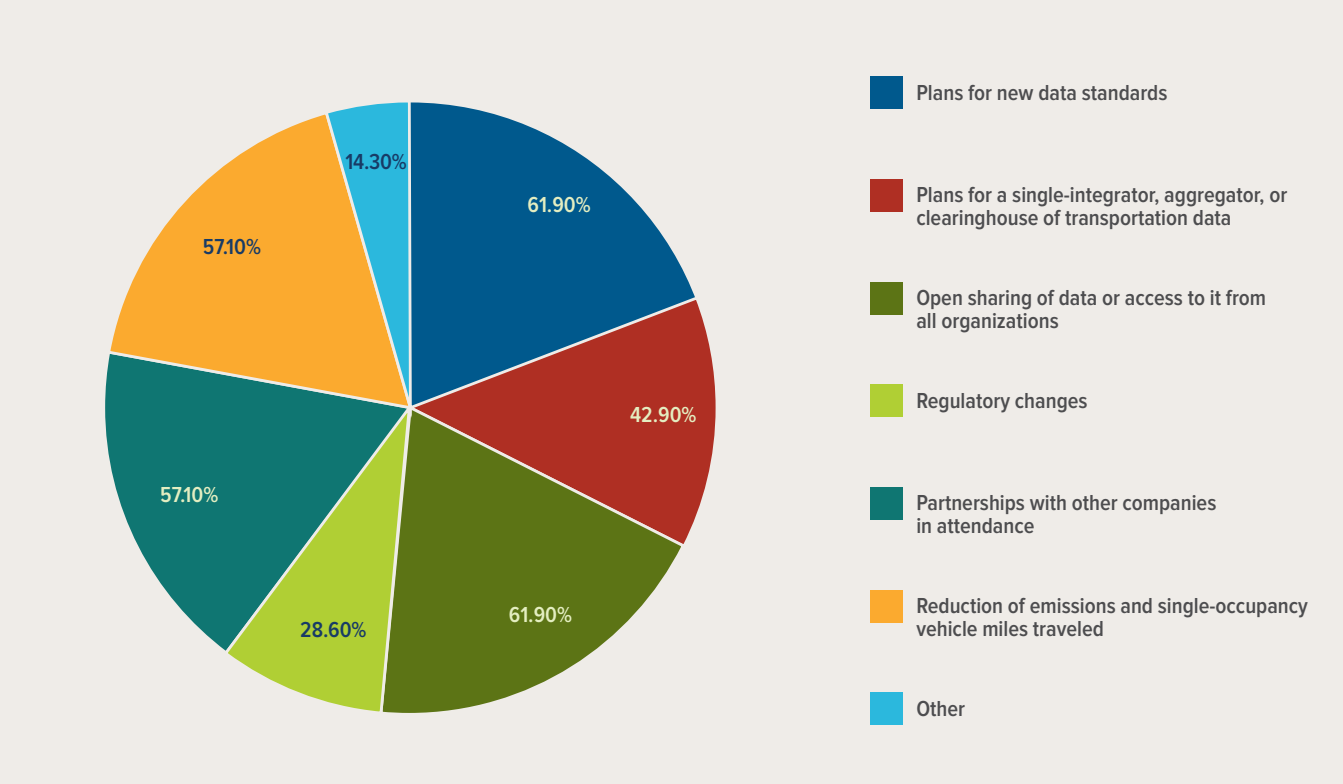


FIGURE A5: WHICH OF THE FOLLOWING ELEMENTS OF MAAS DO YOU BELIEVE IS THE CLOSEST TO REALIZATION?



APPENDIX B:
DESIRED WORKSHOP OUTCOMES

FIGURE B1: WHAT TYPES OF RESULTS DO YOU WANT TO SEE FROM THIS WORKSHOP AND ITS FOLLOW-ON WORK?



APPENDIX C:
PUBLIC AND PRIVATE SECTOR COLLABORATION

A session in the workshop required public and private sector participants to come up with concrete ideas of what they are interested in receiving and what they are willing to offer from the other party. The list of ideas included specific sets of data, resources, pilot project commitments, and financing/support suggestions.

FIGURE C1: PUBLIC AND PRIVATE SECTOR COLLABORATION

PUBLIC SECTOR

OFFERS

- Open access to public data, staff, and public resources
- Universities to offer analysis, metrics building, and in-depth research
- Allowing climate incentives to go towards private companies to match their contribution to reduce regional GHG emissions and VMT
- Support creation of best travel options/modes to customers as long as GHG/VMT reduction goal is met
- Establish transit agency to serve as broker of transportation options regardless of provider or sector
- Creation of fee-bate programs
- Platform to aggregate public and private data, though skillsets to operate and maintain it are best found in private sector
- Coordinated city and transit agency information to create better customer experience

INTERESTS

- Private transit data (complete trip details, user surveys, crowdsourced information, real-time availability and discoverability of providers in area)
    - Even retrospective data could be useful for city planning purposes
    - Rich dashboard with ability to adjust incentives and fees as necessary based on displayed data
- Advice, best practices, example solutions, transit data guidance
- Pilot projects
- Practical, cost-effective ways to eliminate SOV miles
- Congestion relief assistance
- Climate neutral solutions
- Highly utilized transit modes in all directions
- Quick wins to help "sell" importance of data projects to internal teams
- Data protection: personally identifying information (PII) protection
- Partnership with large private corporations to help provide political pressure and motivation to change necessary regulations/make innovative change
- Single app that includes customer notifications of travel options, commuting benefits available for use, and parking payment options

PRIVATE SECTOR

INTERESTS

- Pilot project participation
- Quality data: especially real-time transit, traffic, road closure, incident information, most popular ride periods (when customers demand rides)
- University internships and talented graduates; and collaboration programs
- Meeting an overall mobility goal without constraints on provided service type
- Leverage within transit authorities (e.g., regulatory support, program pilot approval, etc.)
- Vertical integration (e.g., public sector handles and routes requests, private sector provides transportation)
- Filling the gap in mass transit
- Subsidization programs, especially targeted towards certain populations, to supply first and last mile solutions (e.g., parking fees paid by SOV drivers useable towards micro transit riders)
- Bundled subscription and ride programs
- Enhanced customer experience regardless of travel mode through coordinated travel information

OFFERS

- Two-way exchange of data
- Specifically will provide services available, wait times, fares, heat maps of time of day of usage and geographic utilization
    - Ride volume/utilization data can be used to understand competitive advantage so will not be offered–however, aggregated data including percentage of ride volume per zip code or county can be shared
- Next-level ideas for transit data formats and capabilities
- Pilot project participation
- Technical expertise and best practice ideas to create seamless travel experience
- Real-time transit data analysis experience
- First and last mile solutions to integrate with mass transit
- Discounted ride credits
- Internship opportunities
- Distribution platform

APPENDIX D:
ACTION PLANS

The culminating event of the ITD workshop was the creation of specific action plans to improve transit data interoperability. Participants brainstormed possible solutions to barriers impeding the pursuit of mutual value propositions. The action plans described in the list below come directly from the workshop as opposed to the more synthesized high-level solutions described in Section 5. The worksheets used during the working sessions are recreated here as well to provide more detail and context for each action plan development session.

1. INTEGRATED PAYMENT SYSTEMS

Theme: Create the ability to seamlessly pay for various transportation providers through a single portal.

Action:

1. Draft letter of support to the U.S. Department of Transportation (DOT) that advocates requiring public agencies to adopt one form of payment capability across all transportation modes.
2. Integrate public transportation payment with third-party applications.
3. Encourage public transit agencies to procure an open payment system.
4. Pull together cross-agency and private stakeholders (e.g., bikeshare company, metro transit authority) to launch pilot demonstrations of open payment system.

Who: Discussion participants, private transportation providers (bikeshare, carshare, ride hailing), payment companies (e.g., credit card companies), and technology providers

Resources: U.S. DOT, American Public Transportation Association, Eno Center for Transportation, Volpe, publicly documented means of integration with payment systems and third-party applications

FIGURE D1: SESSION TOPIC: INTEGRATED PAYMENT ACTION PLAN

Ideal outcome of this opportunity: The ability to move payment between participating parties seamlessly.

ACTION	WHO?	RESOURCES NEEDED
1. Draft a letter to U.S. DOT asking the federal government to support, and require, one common system standard used to pass tokens between parties representing payment for transportation service. • Describes a standard method of payment. • This letter should acknowledge the work being done in Washington DC and New York on this topic. 2. Make API available to allow integration of payment systems. 3. Transit agencies procure the open payment system. 4. Pilot new system in various locations and pull together stakeholders to ensure system success.	1. Workshop participants (transportation network providers, carshare, bikeshare companies) 2. Transit agencies 3. Payment systems and all participants above	1. DOT and VOLPE 2. Publicly documented API by all service providers (e.g., GTFS-SUM) 3. Public/private partnership to implement payment system 4. Stakeholder engagement (APTA, ENO)

TIMELINE

THIS WEEK	3 MONTH	6 MONTH	9 MONTH	12 MONTHS +
• Build network of signatories to letter and parties supporting this effort.	• Transit agencies speak with DOT regarding • Letter sent to DOT	• Transportation network provider API available	• Pilot transit agency implements open payment system (e.g., Washington DC, Chicago, California, Portland)	

2. IMPROVING TRANSIT DATA REPORTING

THEME: Develop training, tips, and best practices to improve the quality and reliability of public transit data feeds for interoperable use.

Action:

1. Begin email chain among discussion participants to identify common denominators for transit data best practices under the existing standard prescriptions.
2. Publish agreed-upon best practices and methods to adhere to them.
3. Embed best practices in requirements for participation in technology provider platforms.
4. Begin work on second phase of this effort (data standards action plan below) to develop a new data standard that encompasses best practices and expands to include greater data sets and complexity.

Who: Discussion participants, five additional C-level representatives from other organizations, Urban Transportation Associates (UTA)

FIGURE D2: SESSION TOPIC: DATA STANDARDS ACTION PLAN

Ideal outcome of this opportunity: All public and private transit providers produce high-quality, reliable transit data for use by constituents and third parties.

ACTION	WHO?	RESOURCES NEEDED
• Create incentive for agencies to provide high-quality data • Clarify existing standards, best practices, and benefits of following best practices • Standardize fare generation (API-based) • Create standard for provision of handicap accessible sidewalks, locations (Open Street Maps to release or crowdsource) – city owned? • Create rules for smaller players to generate GTFS data (Trillium has a GTFS editor or GTFS tool) • Alliance between mobility providers to create standard that accommodates all modes (STANDARD and APIs), fixed-point NODES, and on-demand ZONES • How to craft transit data from a customer perspective	• Leading transit data handlers in the private sector • Private sector transit data consultants • Public sector transit data aggregators • RMI	• Someone to bring agencies to the table (illustrate value through use cases) • Engage additional cities • Make part of spec, prove it through use cases • Create working group, engage cities • Engage smaller players • Additional mobility provider input

TIMELINE				
THIS WEEK	3 MONTH	6 MONTH	9 MONTH	12 MONTHS +

3. TRANSIT DATA BEST PRACTICES

Theme: Take the best practices identified in the previous action plan forward to develop a new, comprehensive, and extensible data format that is capable of representing necessary complexity in the increasingly connected mobility world.

Action:

1. Follow-up discussion between RMI and participants to see if there are opportunities for progress on the transit data best practice work stream. Possibilities include:
   - Standardizing fare generation or simplifying fare structures
   - Identifying incentives or plans for transit agencies to provide higher-quality transit data
   - Creating rules/best practices for smaller agencies and companies to provide properly formatted transit data (e.g., GTFS, GTFS-RT, or GTFS-SUM)
   - Developing a new data standard (e.g., enhancing GTFS or replacing it with an all-new standard) that encompasses the complexity needed to make multimodal travel data convenient for customers to use regularly
2. Assist public agencies with adoption of the new standard by providing skills training

Who: Discussion participants.

Resources: Continued collaboration between these participant organizations, regular meetings (in-person or virtually), a forum to develop joint work products, and a neutral repository/organizing entity to broker the knowledge generated in a way that delivers value to all participants.

- Shared document already created and shared to begin the discussion, facilitators need to be identified
- Understand cost related to encouraging best practices

FIGURE D3: SESSION TOPIC: TRANSIT DATA BEST PRACTICES

Ideal outcome of this opportunity: There is a need, but this is not a 100% solution. It's a plan for developing a set of suggested best practices. Ideally, with the participation of major players on both private and public sides, best practices could be broadly adopted.

ACTION	WHO?	RESOURCES NEEDED
• Create an email chain or Google doc between the working group members • Publish agreed-upon practices • Make it a part of GTFS changes • Embed the best practices in requirements	Participants (all): • 5 C-level representatives from leading transit agencies and private sector organizations	Google doc • RMI to monitor progress, possibly to ensure that it's initiated

TIMELINE				
THIS WEEK	3 MONTH	6 MONTH	9 MONTH	12 MONTHS +

4. "COMMUTING AS A SERVICE" PILOT: CORRIDOR SELECTION AND IMPLEMENTATION

Theme: Deploy a multimodal commuting system along a select corridor to demonstrate the value of MaaS. This pilot project should make it compelling to avoid SOV personal trips, decreasing greenhouse gas emissions.

Action:

1. Define opportunity for employers, travelers, and city.
2. Determine scope of corridor and project (e.g., how many routes, employers, origins and destination, and transportation providers involved).
   - Note: The workshop team chose a specific corridor in the Palo Alto area on which to base this discussion.
3. Engage employers for data and participation.
4. Engage residential areas and real estate companies, and developers for participation in data sharing to illustrate the value of new commuting options (e.g., increased land/building value, quantity and value of jobs accessible from the building).
5. Define customer experience and build model.
6. Determine availability and applicability of existing and needed transportation demand management (TDM) benefits to SOV-alternative transit options.
7. Offer integrated multimodal commuting service based on what providers, both private and public, can offer.

Who: Discussion participants

Resources: Real estate company data on resident dynamics, information on existing public transit options in corridor, buy-in and data from large, affected employers

FIGURE D4: SESSION TOPIC: CORRIDOR SELECTION AND IMPLEMENTATION PROJECT, DAY 2

Ideal outcome of this opportunity: Deploy multimodal commuting system along a select corridor to demonstrate value of mobility as a service, Eliminating greenhouse gas emissions from driving, and making it compelling to avoid personal driving.

ACTION	WHO?	RESOURCES NEEDED
1. Define opportunity (i.e., data on trips, etc.) • Build model • Establish transportation demand management for S.U.M. (tie to parking cash-out) • Credits for transit • Focus on interoperability of data 2. Determine scope (e.g., regional) 3. Engage employers for data, participation, prioritize; engage real estate companies; engage residential areas 4. Define experience we want to offer • Offer service based on what providers can do • Need replicable process design • Incorporate public transit and other existing options (additional modes)	• Tech-enabled transit provider • Follow-up: by all parties • Employers in corridor • Leaders within TMA	• Real estate companies' data • Tech employers downtown • For whom value proposition is clear • Metrics on percentages of commuter versus non-commuter travelers • Large employer data: • Where does everyone work? • Live? • Where are credits needed to access other modes? • Must overcome barriers of privacy concerns and proprietary data sets • Value proposition statement for employers

TIMELINE

THIS WEEK	3 MONTH	6 MONTH	9 MONTH	12 MONTHS +
• Actions (1) and (2) • Incorporate other modes (throughout timeline) • Replicable Process Design (throughout timeline)	• Action (3) • Incorporate other modes (throughout timeline) • Replicable Process Design (throughout timeline)	Action (4) • Incorporate other modes (throughout timeline) • Replicable Process Design (throughout timeline)	• Incorporate other modes (throughout timeline) • Replicable Process Design (throughout timeline)	• API • Fully integrated with multimodal planner for wider choice (24–36 months)

5. UNDERSTANDING METRICS TO MEASURE IMPACT

Theme: Clearly understanding the SOV energy, emissions, and cost impact metrics to compare against MaaS solutions is key to motivating employers to create travel incentives reducing employee SOV travel. The same metrics can be used to gain funding for environmentally friendly, healthy, and convenient transit projects, city redevelopments, and impactful public-private partnerships.

Action:

1. Provide an enhanced transportation demand management (TDM) survey (one that includes productivity impacts/concerns) to employers.
2. Integrate survey results with existing data from any previous studies.
3. Use outcomes to compare the impact a pilot project (described below) would have on productivity, TDM, and multimodal travel.
4. Share these results with additional employers to build a larger network of employees' participation in SOV-reduction incentives.

Who: Discussion participants

Resources: Tools for engaging employers and a way to address proprietary concerns

FIGURE D5: SESSION TOPIC: METRICS, DAY 2

Ideal outcome of this opportunity: Clearly understand the drive-alone (SOV) energy, emission, and cost impact; focusing on metrics of interest to employers that can move them to action.

ACTION	WHO?	RESOURCES NEEDED
• Scale existing Stanford TDM survey to other employers • Enhance survey to include the value of productivity • Integrate other available data • Corridor comparison (do a comparative analysis) • Must consider equity (economic access–percent of income per miles traveled) to succeed in reducing energy use/emissions	• Academic researchers	• Employer engagement, commitment to participate • Address proprietary barrier • Need to understand what was driven before (whole mobility package) and after implementation of new mobility options • Cost of vehicle miles traveled (e.g., $/trip including system cost, $/unit of GHG-abatement)

TIMELINE

THIS WEEK	3 MONTH	6 MONTH	9 MONTH	12 MONTHS +

6. RETROSPECTIVE PUBLIC-PRIVATE DATA SHARING

Theme: Develop a set of agreeable retrospective data that private companies will share with public agencies and cities to help make city planning and transit decisions.

Action:

1. Begin a conversation between RMI and interested/willing private transportation providers to build a list of data to offer city officials.
2. Request a wish list of data from a metropolitan planning organization/transit agency working group.
3. Refine the conversation with private transportation providers to narrow and standardize which report types can be built into a kit for regular sharing of limited data with cities.

Who: A small working group of representatives from metropolitan planning organizations and transit agencies; discussion participants could be a starting point

Resources: Continued coordination and communication by RMI staff

FIGURE D6: SESSION TOPIC: RETROSPECTIVE DATA SHARING (WITH CITIES)
Ideal outcome of this opportunity: Planner/agency decisions are informed by TNC data.

ACTION	WHO?	RESOURCES NEEDED
• Clarify what data is valuable to cities and agencies • Cities provide something in return in exchange for access to some form of TNC data • Build kit/report types or an API that facilitates the sharing of TNC data with transit agencies	• MPOs, public transit agencies • TNCs	• Continued communication and coordination – RMI may be able to help on this front

TIMELINE

THIS WEEK	3 MONTH	6 MONTH	9 MONTH	12 MONTHS +
	• Reach out to MPOs, TNCs	• Do a "wish list" exchange between TNCs and working group of MPOs • Build 'kits' to make the exchange of data as easy as possible		

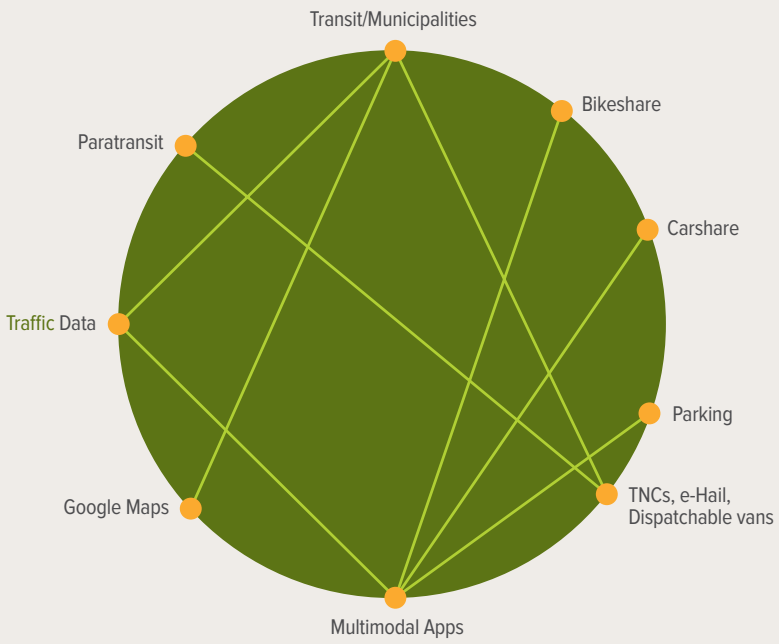
APPENDIX E:
WORKSHOP FORMAT

The Interoperable Transit Data workshop was designed to bring together key private and public transit data stakeholders to identify cost-effective and beneficial ways in which transit data interoperability could be improved.

The first day of the workshop was primarily attended by private sector companies with discussions focused on opportunities for collaboration within the private sector, along with several leading transit agencies. The second day of the workshop incorporated representatives from public sector organizations—nonprofits and academia—with discussions focused on collaboration between the private and public sectors, in some cases building on plans developed on the first day.

The majority of the transit data solutions that came out of this workshop were developed in smaller sub-groups of participants. These ideas were then taken a step further in subsequent larger group discussions and developed into more sophisticated action plans.

FIGURE E: HIGH-VALUE CONVERSATION EXAMPLES



- **Transit agencies and Transportation Networking Companies (TNCs):** Transit agencies are interested in anonymized historical TNC data, while TNCs are looking for regulatory predictability.
- **Transit agencies and Google:** Once again, Google has an opportunity to help lead efforts to set new standard formats for transit data.
- **Transit agencies and Traffic data:** Traffic data companies already have business relationships with cities—any opportunity to strengthen that relationship is welcome.
- **Bikeshare and Multimodal apps:** Any opportunity to improve discoverability is boon to bikeshare. More services improve multimodal app.
- **Carshare and Multimodal apps:** Lead generation opportunities are appealing for carshare. More services improve multimodal apps.
- **Parking and Transit agencies:** Both parties can benefit from greater awareness of occupancy at park-and-ride facilities.
- **TNCs and Paratransit:** TNCs may be able to profitably provide lower cost, better service paratransit. Dispatch costs, reliability, and driver costs incurred by the city could be greatly reduced.
- **Multimodal Apps and Traffic Data:** Multimodal apps could provide additional crowd-sourced data in exchange for traffic data to present to users, strengthening multimodal app function and traffic data quality.

AGENDA DAY 1

Time	Format	Description
8:00 - 8:30 am		Breakfast provided
8:30 - 9:00 am	Plenary	Event kickoff, goals, and introductions
9:00 - 9:30 am	Plenary	Keynote speech: Timothy Papandreou, Director, Strategic Planning & Policy, San Francisco Municipal Transportation Agency
9:30 - 10:00 am	Plenary	Breakout group session overview and personas discussion
10:00 - 10:55 am	Breakout	Interoperable transit data values, barriers, and solutions - Session 1
10:55 - 11:05 am		Break with refreshments and snacks
11:05 - 12:00 pm	Breakout	Interoperable transit data values, barriers, and solutions - Session 2
12:00 - 1:00 pm		Lunch provided; Attendees vote on afternoon special focus topic
1:00 - 2:30 pm	Plenary	Share breakout group results and incorporate open feedback; Uncover common themes for further problem solving
2:30 - 2:55 pm		Break with refreshments and snacks
2:55 - 4:00 pm	Breakout	Committing to actionable next steps; Special focus topic session - Session 3
4:00 - 5:30 pm	Plenary	Share breakout group action plans and incorporate additional attendee support; Closing remarks, introduce day 2, and outline RMI support activities
from 5:30 pm		Happy Hour at Stock and Trade, 2036 Lombard St, San Francisco, CA 94123 (between Webster St and Fillmore St, Marina/Cow Hollow)

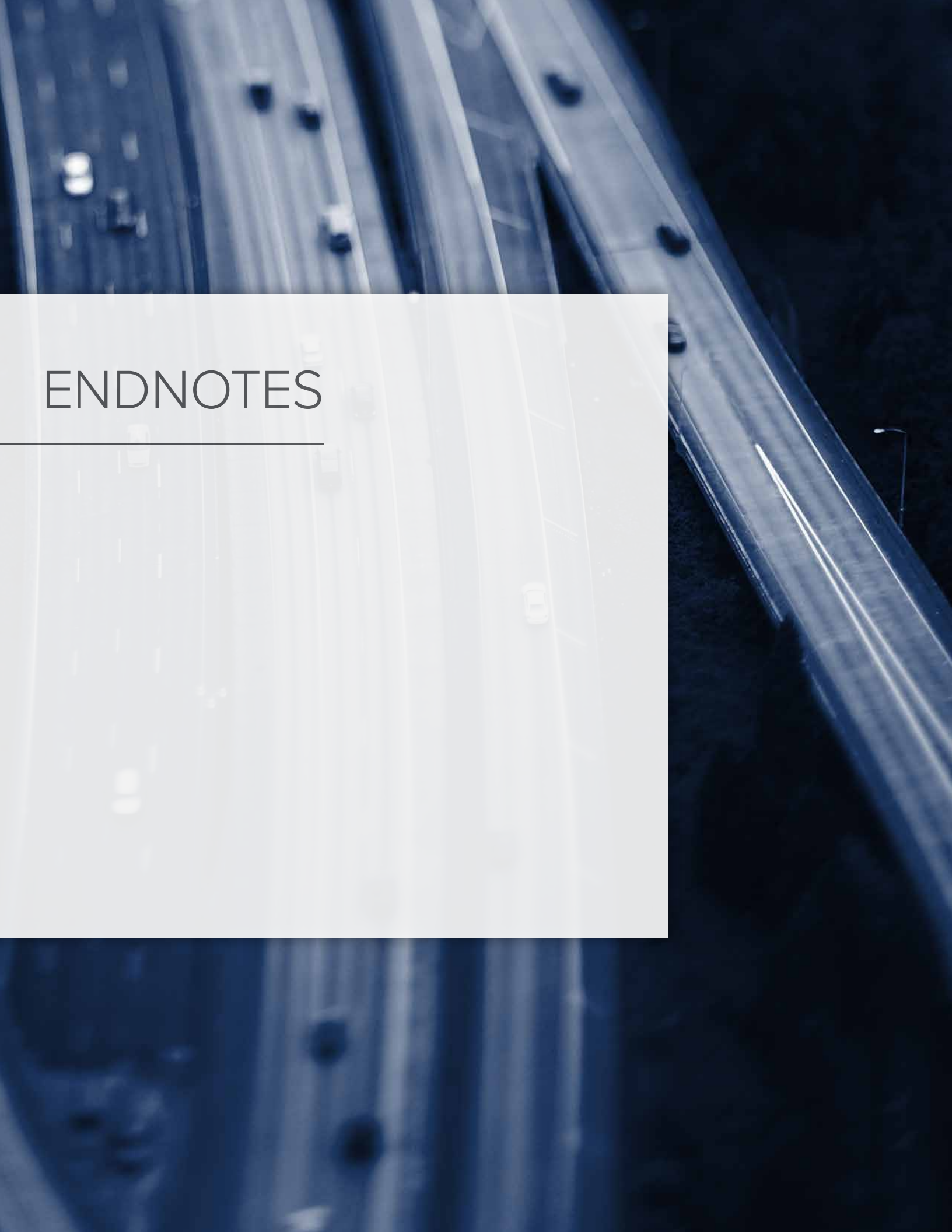
AGENDA DAY 2

Time	Format	Description
9:00 - 9:30 am		Breakfast provided
9:30 - 10:00 am	Plenary	Day 2 kickoff, goals, and introductions
10:00 - 10:40 am	Plenary	Present day 1 outcomes and feedback from attendees
10:40 - 10:50 am		Break with refreshments and snacks
10:50 - 11:50 am	Breakout	Round robin: “How can public agencies and cities better complement private sector data interoperability efforts?”
11:50 - 12:40 pm	Plenary	Share breakout group results and incorporate open feedback; Uncover common themes for further problem solving
12:40 - 1:40 pm		Lunch provided; Attendees vote on common themes to focus on
1:40 - 1:50 pm	Plenary	Breakout group session overview
1:50 - 2:50 pm	Breakout	Understanding the value, barriers, solutions, and committed action steps - Session 1
2:50 - 3:50 pm	Breakout	Understanding the value, barriers, solutions, and committed action steps - Session 2
3:50 - 4:00 pm		Break with refreshments and snacks
4:00 - 5:20 pm	Plenary	Share breakout group action plans and incorporate additional attendee support
5:20 - 5:30 pm	Plenary	Closing remarks and outline RMI support activities

APPENDIX F:
PARTICIPANT LIST

A total of 27 unique participants joined the workshop over the course of the two days. Participants and their organizations are listed alphabetically below.

Nisar	Ahmed	Data and Technology Specialist	Metropolitan Transportation Commission
Joy	Bonaguro	Chief Data Officer	City of San Francisco
Gary	Carlin	Director of Business Development - Public Sector	INRIX
Steve	Carroll	VP of Strategy	RideScout
Emily	Castor	Director of Transportation Policy	Lyft
Lindsey	Cimino	Strategic Communications	Uber
Regina	Clewlow	Lecturer and Post-doctoral Fellow	Stanford University
Andrew	Collier	Lead on GTFS-SUM Development	RideScout
Kim	DeRose	Manager of Partner Operations	Urban Engines
Paige	Fitzgerald	Head of Global Communications, Policy and Creative Partnerships	Waze
Gil	Friend	Chief Sustainability Officer	City of Palo Alto
Matt	George	CEO and Founder	Bridj
Dan	Grossman	VP - West	ZipCar
Jeff	Maki	Senior Director of Client Strategy	Control Group
Catherine	Manzo	Senior Director of Sales and Customer Engagement	Streetlight Data
Ben	Matranga	Assistant to the Mayor	City of San Francisco
Tim	McHugh	Chief Technology Officer	Portland TriMet
Max	Muller	Senior Director of Maps Data Platform	Apple
Timothy	Papandreou	Director of Strategic Planning and Policy	SFMTA
Ryan	Poscharsky	Strategic Partner Manager for Maps	Google
Steve	Raney	Principal	Cities21
Susan	Shaheen	Director of Innovative Mobility Research, Transportation Sustainability Research Center	UC-Berkeley
Gerry	Tierney	Principal	Perkins + Will
Ellis	Verosub	Senior Engineering Manager - Maps	Apple
Ritesh	Warade	Associate and Transportation Planning Consultant	IBI Group
Kansas	Waugh	General Manager	Bay Area Bike Share
Kevin	Webb	Principal	Conveyal



ENDNOTES

ENDNOTES

[1] 2009 National Household Travel Survey, http://nhts.ornl.gov/2009/pub/stt.pdf

[2] Donald Shoup, *The High Cost of Free Parking*, APA Planners Press, 2011.

[3] Eric Jaffe, "The Best Evidence Yet that Real-time Arrival Info Increases Transit Ridership," Citylab – *The Atlantic*. March 9 2015. http://www.citylab.com/commute/2015/03/the-best-evidence-yet-that-real-time-arrival-info-increases-transit-ridership/387220/

[4] Ibid. and internal RMI analysis

[5] Interoperable Transit Data: Enabling a Shift to Mobility as a Service, RMI Workshop, June 2015