THE DIGITAL ROAD TO SAFETY

PUBLIC-PRIVATE KNOWLEDGE SHARING TO IMPROVE ROAD SAFETY

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EXECUTIVE SUMMARY

America's roadway network is one of the country's most essential infrastructure systems. Whether traveling by car, bus, bike, or foot, over 140 million workers use the country's streets to get to work, and millions more depend on them for a range of personal trips to stores, schools, and other destinations.[1] Every business, meanwhile, relies on roadways to get their products to and from markets. As such, ensuring roads are safe for all travelers is a national priority.

Unfortunately, the country's roads are often unsafe. Over 40,000 people die annually in traffic crashes according to the most recent federal estimates, and the number is rising.[2] Combined with non-fatal incidents, unsafe roads cause over $800 billion in net societal losses per year.[3] As the country's population and economy continue to grow—putting more vehicles and people on the roads—designing safer streets and improving the supporting law and policies will help ensure road incidents do not grow in tandem.

Cutting-edge data can be a foundational tool to deliver improved road safety, especially in cities. The widespread deployment of sensors—from smartphones in people's pockets, to in-vehicle GPS trackers and navigation devices, to environmental monitors on buildings—offers new ways to capture real-time data on how people travel. Many of the most promising datasets are the sole property of private firms, though, making them critical partners to public agencies responsible for designing and delivering safer streets.

Fortunately, road safety is one of those rare policy areas today with near perfect alignment of objectives between the public and private sectors. While the public sector—in collaboration between cities, states, and the federal government—endeavors to ensure all individuals travel safely between their key destinations, the private sector also relies on safer streets to maximize business outcomes, whether it's more efficient product deliveries, a healthier workforce, or reduced insurance claims. Everyone wins with safer streets.

The challenge, then, is to design policies that promote improved data sharing among public, private, and civic entities. Those systems must address concerns of data privacy and cybersecurity, creating a culture of appropriate transparency and trust between all parties. But it's also not enough to simply have more data—those systems must also create findings that lead to safer street design, management and usage. Nor does the entire challenge rest on the public sector: as government staff design and implement new policies, private sector staff must be patient, willing collaborators, and absorb some risk.

If designed effectively, however, the returns are almost priceless: eliminating hundreds of billions in economic losses and protecting families from injuries and loss of life. Moreover, purchasing, installing, and operating such systems costs far less than the avoided economic losses. Now is an ideal time to scope a new kind of public-private partnership focused exclusively on data exchange and system design.

Using the results of an expert workshop held at The Brookings Institution in May 2017, this brief explores the connection between city road safety and data from a variety of public, private, and civic perspectives. It finds that while data can certainly improve the design and management of city streets as well as behavioral and business practices, the barriers to wide scale sharing and new system adoption are equally significant. Moving forward, governments at all levels and their private sector peers will need to rethink data standards, procurement policies, measurement techniques, as well as privacy and cybersecurity to maximize road safety.

01 Road safety in the modern city

The United States is a driving nation, supported by a vast network of interstate highways, wide local roads connecting cities and suburbs, and large swaths of detached single-family homes.[4] Today, cars account for more than 85 percent of trips to work, with only about 10 percent of commuters walking, biking, or taking public transit.[5] The U.S. easily has the highest vehicle miles traveled (VMT) per capita compared to similar advanced economies; the average American drives nearly twice as far as the average driver in the next international peer, Italy.[6] Although VMT declined following the Great Recession—marking the longest historical dip in American driving habits—it has begun to climb again.[7]

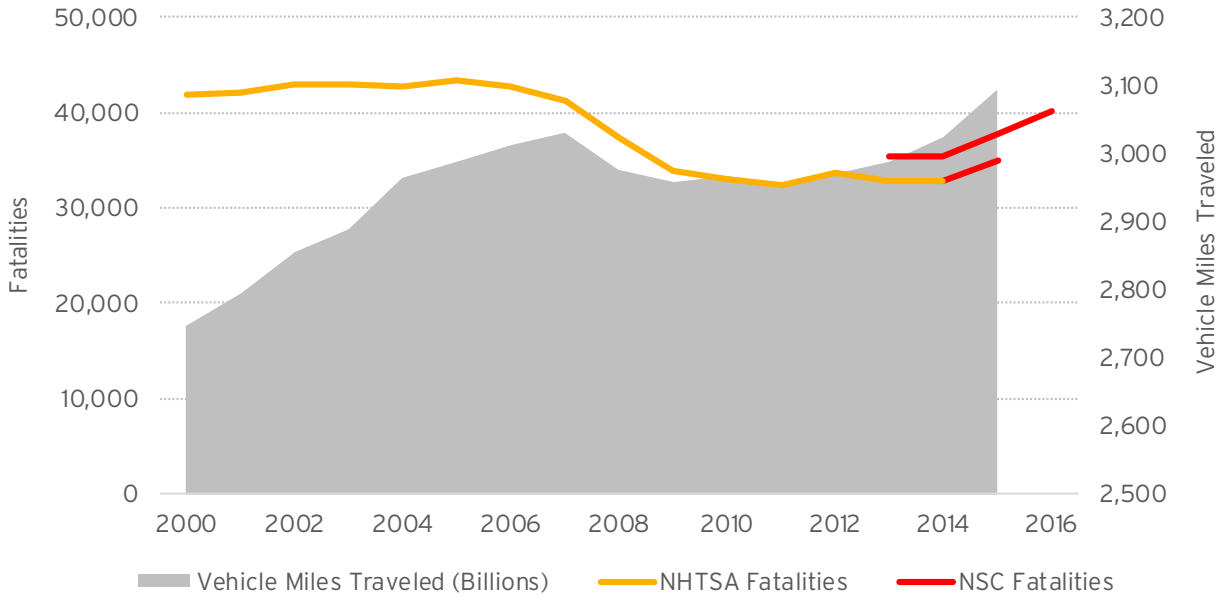
With so many users on the road every day, safety is crucial to both the country's collective health and its economy.

Unfortunately, the country's road safety record is heading in a troubling direction. After four decades of steady declines, highway fatalities in the U.S. rose dramatically in 2015. The National Highway Traffic Safety Administration (NHTSA) estimates that road crashes caused 35,092 deaths and 2.4 million injuries in 2015, and 2016 is on pace to look even worse. As Figure 1 shows, the number of fatalities increased rapidly as VMT rose post-recession. This trend holds in many states and cities as well. For instance, Florida saw a 23 percent increase in fatalities, despite only an 8 percent increase in VMT over the past two years.[8]

This deteriorating safety record is likely rooted in a variety of higher risk exposures. It points to a toxic mix of more cars on the road, cheaper gasoline prices and an increase in the most

FIGURE 1

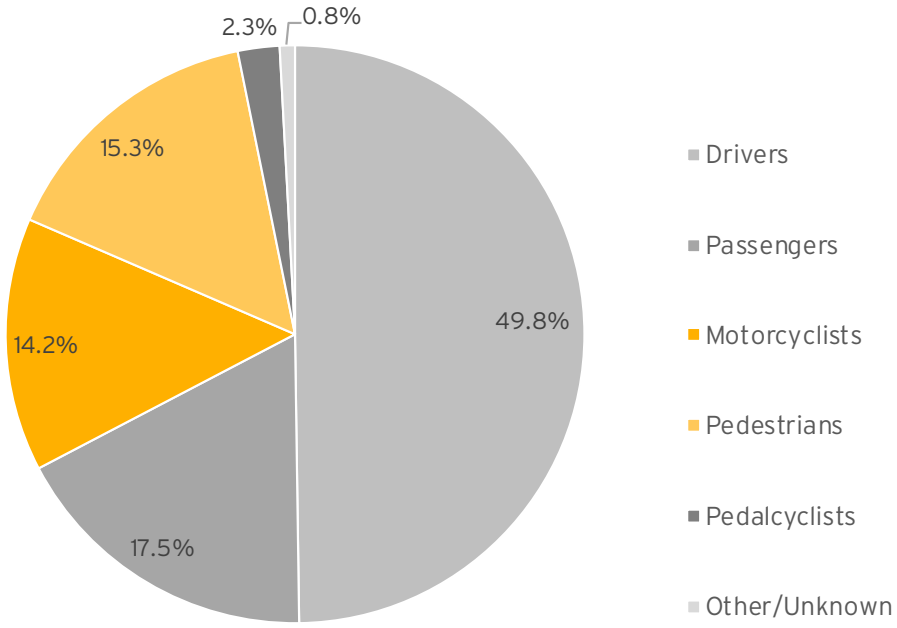
Fatalities and Vehicle Miles Traveled, United States, 1994-2016



Source: NHTSA Fatality Analysis Reporting System and NSC Motor Vehicle Fatality Estimates
Note: NHTSA and NSC figures differ because the NSC counts traffic and nontraffic (those not on public highways but in parking lots, private roads, driveways, etc.) deaths that occur within a year of the crash, consistent with data compiled by the National Center for Health Statistics (NCHS); while NHTSA only counts traffic fatalities that occur within 30 days. This enables NHTSA to issue a "final" count in its Fatality Analysis Reporting System (FARS) approximately eight months after the reference year.

FIGURE 2

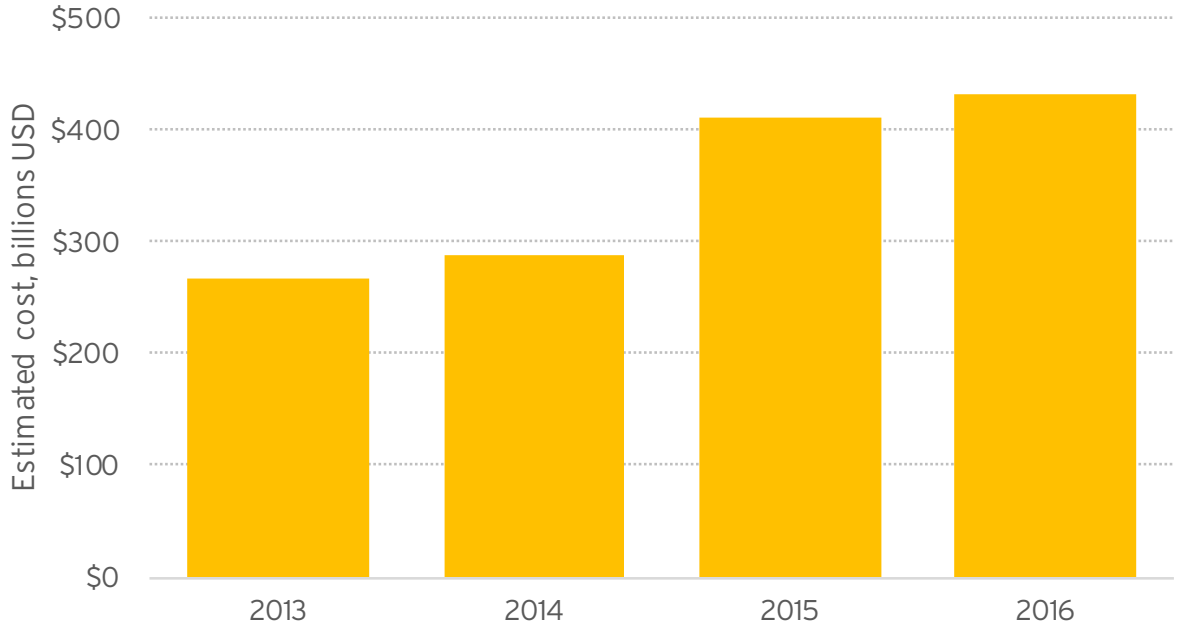
Fatalities resulting from motor vehicle crashes by victim type, 2015



Source: NHTSA Fatality Analysis Reporting System
Note: According to 2015 ACS data, bicycles and pedestrians account for 0.6% and 2.8% of commuters, respectively.

FIGURE 3

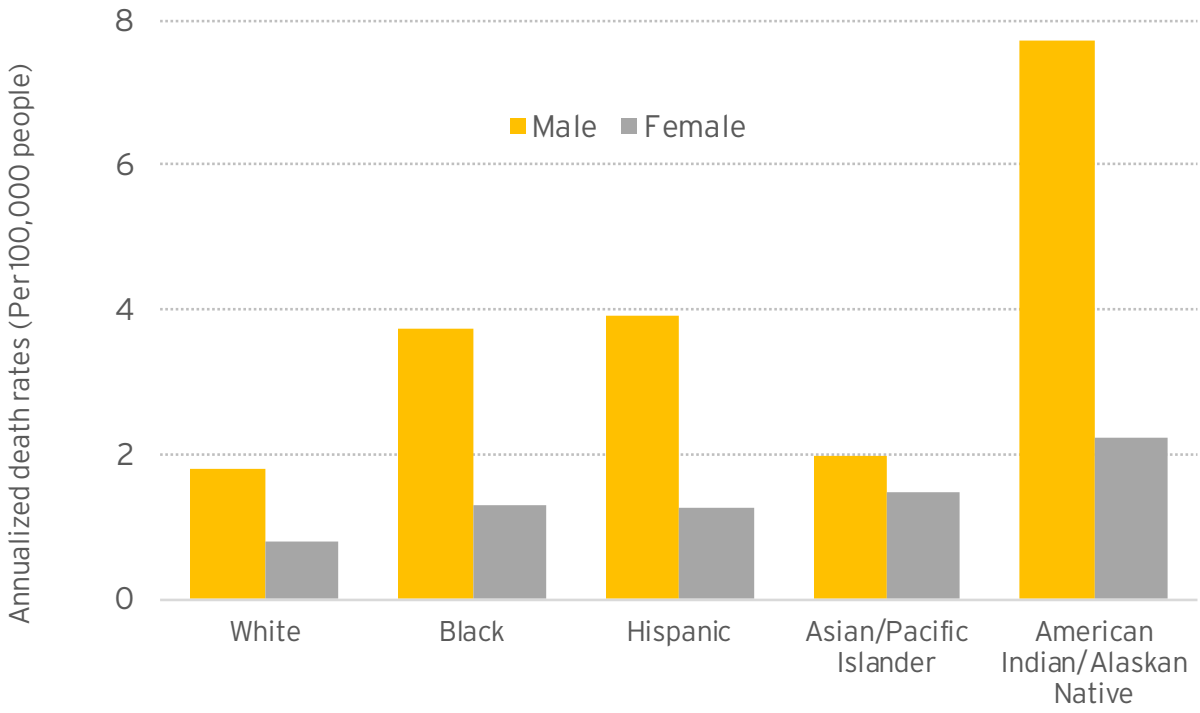
Estimated cost of motor vehicle deaths, injuries, and property damage, 2013-2016



Source: NSC Motor Vehicle Fatality Estimates
Note: Costs include wage and productivity losses, medical expenses, administrative expenses, employer costs, and property damage.

FIGURE 4

U.S. motor vehicle traffic-related pedestrian death rates by race, 2001-2010



Source: Centers for Disease Control and Prevention Morbidity and Mortality Weekly Report, Vol. 62 No. 15

vulnerable road users, such as cyclists and pedestrians, as revealed in Figure 2.[9] The rising popularity of walking and biking, especially in certain metropolitan areas, reinforces the unmet need for safer street designs that work for all users regardless of their transportation mode. New technology advances, especially smartphones, contribute to more distracted driving.[10]

The sudden uptick in road safety incidents, including crashes and near-misses, has real consequences for the economy and society, as Figure 3 shows. In 2010 alone, motor vehicle crashes caused economic losses of $242 billion due to lost workplace and household productivity, legal costs, medical bills, property damages, congestion costs, and environmental harm. Related societal costs, including a loss in quality-of-life, rose to $836 billion.[11] To appreciate the scale of the costs, auto insurance companies processed around $130 million in claims every business day in 2015.[12] Road safety incidents also disproportionally impact specific populations and exacerbate existing socioeconomic inequities. For instance, prior research has found higher motor vehicle mortality for people of color,[13][14] those with lower socio-economic position, and those with lower levels of education.[15]

In response to these growing safety concerns, ambitious public efforts are underway to understand how and why safety incidents occur, especially at local and state levels. In Kansas City, MO, the city installed sensors to tally car, bike and pedestrian traffic as well as population flows as part of its Smart City Initiative.[16] At the same time, the Missouri Department of Transportation (DOT) has targeted more than 30 road safety projects in St. Charles and Franklin County over the next year.[17] In Virginia, the Department of Motor Vehicle's new Crash Locations Map allows users to spatially explore motor vehicle crash data around the state, highlighting problematic streets to be redesigned for better user safety.[18]

Moving forward, these leaders will need to update the data inputs that guide the management of physical networks. The digital revolution has the potential to transform how cities and other localities manage the built environment and address longstanding road safety concerns through innovative approaches to data.[19] Real-time micro-level data can point to where the greatest safety lie as travelers make decisions in interaction with the surrounding infrastructure. If provided in a standardized format, cities can utilize this information proactively to understand and redesign unsafe intersections or corridors before incidents occur.

There is thus an urgent need for local governments to use all the tools at their disposal to realize their safety goals. This will require harnessing data and analytical insights from previously unavailable or underexplored sources. For instance, while smartphones' capacity to distract drivers threatens safe driving, mobile telecommunications data offers an innovative way to understand how cars interact with one another and the built environment. The volume and currency of smartphone-generated data is more frequent and spatially accurate than static crash data. However, collecting and analyzing data requires extensive inputs—and many local governments may not have the staff knowledge, budgets, or processing power to leverage this emerging resource. Even with adequate agency capacity, this data is often exclusively in the private realm and its usage carries considerable concerns around privacy of citizens and competitive advantage for companies.

The emergence of new data, in turn, is leading to new opportunities for collaboration, including public-private partnerships. A range of telecommunications, logistics, automotive, and insurance firms as well as application-enables transportation services such as ride hailing already collect, clean, and analyze a wealth of transportation-related data that can assist local leaders in their efforts to advance road safety.[20] More importantly, private firms benefit from

greater road safety much like the public does, from more efficient package deliveries to lower insurance claims to a healthier workforce. A variety of groups, including Together for Safer Roads, Advocates for Highway and Auto Safety, and the National Coalition for Safer Roads, show how the private sector can help provide data collection and analysis, share industry-specific knowledge, and deploy innovative technologies to improve road safety outcomes.

Today, people's mobility options are growing faster than in the past 100 years, including ride-hailing services, bike share, and forthcoming automated vehicles. It is therefore an ideal time to rethink approaches to transportation data and policies related to this expanded suite of mobility options.[21] To deliver safer streets for all, public and private leaders must design new data infrastructure, forge new arrangements to drive implementation, and implement new infrastructure policies that serve travelers more effectively.

In May 2017, the Brookings Metropolitan Policy Program hosted a day-long workshop bringing city leaders, civic innovators and private experts together to determine (a) the types of shared data, expertise, and technology that can improve public sector capacity around city road safety, and (b) the avenues through which formal collaboration could be established. The goal was to build consensus around core needs and potential solutions. This brief summarizes the results of the discussion with this assembly of experts.

The upcoming Section 2 seeks to identify existing gaps in safety data and systems, while Section 3 points to new data inputs that are gaining traction. Section 4 then highlights some key barriers to addressing these gaps and integrating new data through public-private data sharing, and Section 5 offers solutions to implement change.

02 Current gaps in road safety data

A key theme that emerged during the workshop was the need for public- and private-sector peers to identify gaps in measuring transportation safety. Official government data often considers road safety in terms of a narrow set of indicators, such as fatalities and injuries, and limited number of metrics, such as emergency calls, hospital trips, and deaths per day. However, these measures are not comprehensive, nor are they standardized from place to place.

Addressing road safety requires a broader and more consistent set of metrics, ideally measured at multiple points in time and based on a wide assessment of different risks. As cities look to support safer built environments, leadership inside city agencies must address institutional barriers related to data collection, management, and sharing. City policies must address the following challenges in order to build such a comprehensive understanding:

1. Lack of coordination among data collectors: When a road safety incident occurs, myriad sources in metropolitan areas collect useful data: law enforcement, first responders, hospitals, emergency service records, insurance companies, judiciaries, public works departments and so on. Yet, there are no legal requirements for these sources to share information with each other. Coordination of these sources would enable local governments to create a centralized traffic safety database featuring: useful crash data, 911 transcripts, licensure data, prosecution data, infrastructure data like lighting, road widths and slopes, public health records, and information on relevant road closures and events.

2. Non-standardized data structure and collection practices: With such a broad range of data sources listed above, data standards are an important tool to support shared analysis. However, workshop participants regularly mentioned a lack of standards across many relevant data categories, be it in the public or private sector. Similarly discussed were the lack of consistent data collection practices, which can lead to invalid or simply incomparable data. For instance, in a specific workshop participant city, the GPS location of road crashes were found to be in parking lots where police officers were stationed before getting to actual crash sites. Updated training via the police department can remedy this problem, but it creates challenges for historical citywide safety analysis. The private sector too collects the same types of data in different formats—for example, telematics data from ridesharing companies is completely different from analytics companies such as ZenDrive and Streetlight.

3. Shortage of leading data: Most safety data in the public sector use lagging indicators, or measures that come after events occur. This includes crash data or insurance claims. Real-time information can help generate leading indicators, enabling traffic managers to route traffic away from troubled locations, or directly test the effectiveness of new interventions. But, there is a distinct lack of real-time data streams today, making these issues hard to address. Yet another problem is that data are not always geocoded at the source, which hinders immediate spatial integration and analysis through visual representations like heat maps. In many cities and metropolitan areas, static crash data is still laboriously geocoded manually after the fact.[22]

4. Missing data: Figure 5 highlights multiple points in the safety information pathway where data loss occurs. Missing data can be one of two types: (a) where there are gaps in existing datasets; and (b) where entire datasets simply do not exist.

A good example of the first type is the 'near miss' or a 'close call' that has the potential to cause, but does not actually result in human injury, environmental or equipment damage, or an interruption to normal operation.[23] While there is a higher level of subjectivity involved in their identification, they can serve as predictors of safety incidents.[24] Similarly, instances in which persons seek medical care long after the actual crash can lead to gaps and inaccuracies in the data trail. In both cases, city leaders often miss opportunities to collect valuable, integrated data.

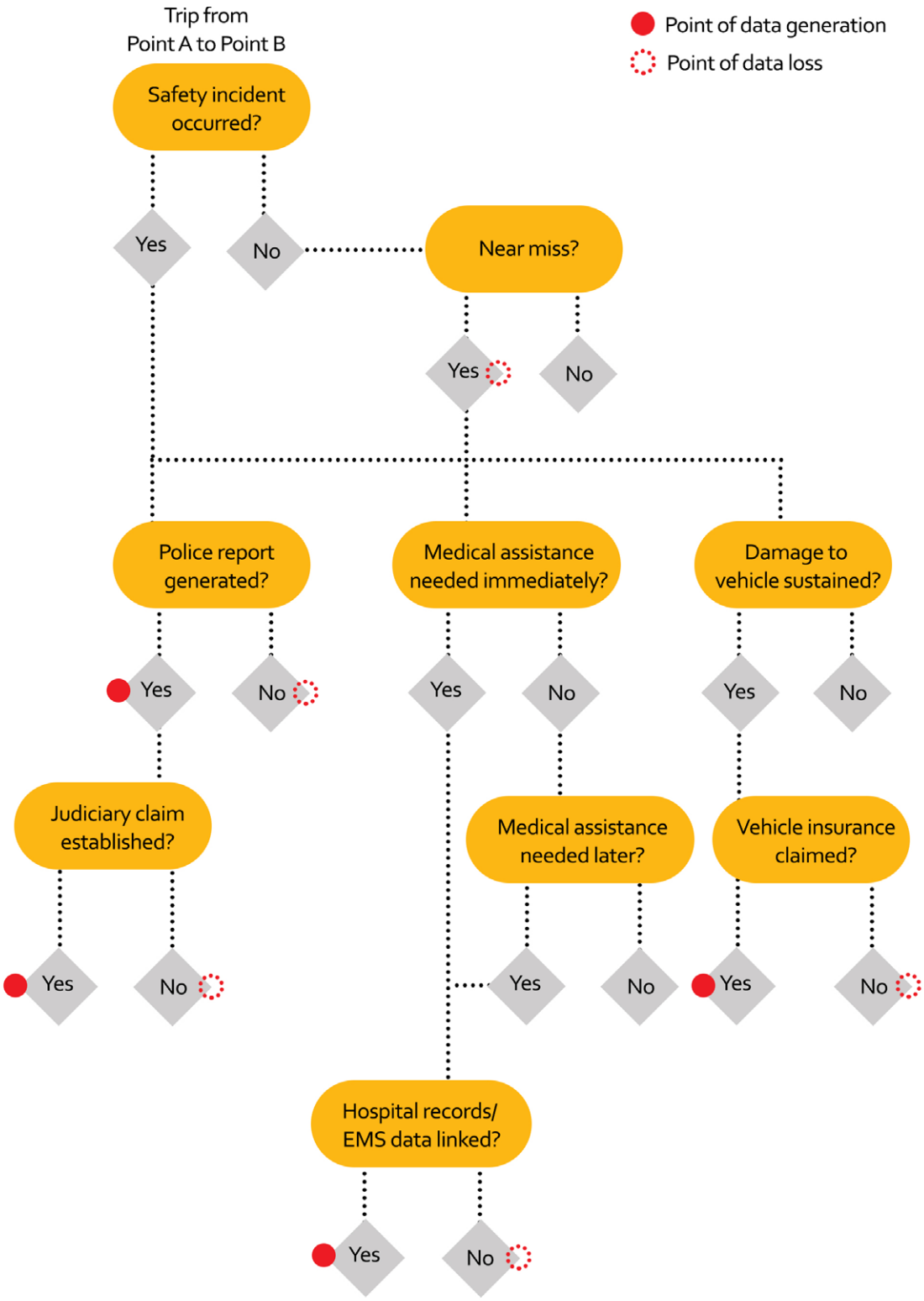
The second type of missing data involves datasets that are yet to become part of the mainstream data collection process. Researchers and planners predominantly rely on automobile traffic data, but there are few similar datasets for bicyclists and pedestrians. The fact that these other users are often the most vulnerable to safety incidents further compounds the problem.

These data-related challenges represent the difficulties government staff face while designing and managing safe streets in the digital age. Simply put, they often face outdated systems that do not yet have modern data capabilities.

However, these public leaders are not alone in their effort to make safer streets. The private sector has the potential to address the third and fourth gaps around available data. Likewise, private companies and civic organizations—including community foundations and community-based nonprofit's—can serve as expert advisors to designing new internal systems for data sharing and multiagency coordination. The hard part will be integrating existing public data with these newer streams of private data to inform governmental processes, share information with those that require it, and find common ground to achieve tangible public health solutions.

FIGURE 5

Points of data generation and loss after road safety incidents occur



Source: Brookings analysis of Environmental Protection Agency data

03 Emerging safety data inputs

Another prominent topic from the workshop involved the need to consider new types of data inputs to better track road safety. While emerging transportation technologies, such as automated vehicles and ride sharing networks, capture the public's attention, other lesser-known advances present new opportunities to improve road safety. One of the spillovers of the economy's rapid digitization is the seeming ubiquity of sensors, including satellite-based tracking, video monitoring, and other real-time methods to monitor the built environment. Public agencies, private companies, and even households all own devices that create these data streams. As listed below, modern efforts to assess and improve road safety can now choose from an incredible array of sensor-related data inputs:

- **GPS and navigation data:** Mobile applications equipped with accurate GPS functionality, camera recording capability, and web accessibility enable law enforcement officers to report road crashes with more accurate location data than traditional written reports.[25] GPS systems offer velocity and acceleration readings to monitor traffic, though wider penetration of mobile phones and sensors will improve reliability of data.[26] Other data sources that support tangible safety outcomes include forward collision warnings, personalized warnings of approaching crash sites, and mobile location-based information about speed limits and intersections.[27]

- **Event data recorders (EDRs):** Also known as "black boxes," 90 percent of new cars are

equipped with devices that record statistics on speed, acceleration, braking, and occupancy in the seconds before, during, and after a crash.[28] The National Highway Traffic Safety Administration (NHTSA) has proposed making the devices mandatory on all new cars. Though some drivers have privacy concerns and access to EDR data is often hard to obtain, the data can provide valuable feedback on potential highway improvements and aid local law enforcement.[29]

- **CCTV cameras:** Inexpensive, consumer-grade video cameras, which have become increasingly ubiquitous in cities, offer a wealth of information to improve road safety. Researchers have found that these devices can record around a quarter of road crashes in some areas. As more devices are installed, their efficacy in determining the causation of crashes will improve.[30] Rapid advances in analytical software can enable motion-captured data to be automatically converted into tabular data based on prior specifications.

- **Cellular data:** The impressive market penetration of smartphones offers a wealth of potential data for both public and private entities. Traffic analytics companies such as Inrix and AirSage collects billions of cellular data points from mobile devices to identify trends in transportation and travel patterns.[31] For example, during the London Olympics, Transport for London (TfL) used such techniques to analyze the flow and density of people across the city in order to make transit improvements.[32]

- **Naturalistic data:** Onboard video cameras and sensors are frequently employed to gather intelligence on crash causation. Complementary to vehicle-based data streams from EDRs, naturalistic data is particularly useful in showing how driver-related factors such as error, distraction, and fatigue have become more prominent in recent years.[33]

- **Infrared counts:** Automated technologies can count pedestrians and cyclists at lower labor costs compared to manual methods. But, equipment costs are often high and specialized training may be required for operation.[34] Infrared counters, when used in conjunction with GPS data, can estimate non-motorized traffic and injury risk at intersections, taking into account the level of infrastructure to support walking and biking.[35]

- **Crowd-sourced data:** Some local governments are expanding data collection efforts by engaging citizens in the process. Smartphone applications, in particular, enable users to document blighted properties, report illegal trash dumping, and share traffic crashes and other street-related challenges.[36]

- **Digitized medical records:** Perhaps surprisingly, the current health care system in the U.S. is still transitioning from paper to electronic medical records.[37] The Department of Health and Human Services recently provided seed funding to a California pilot system to make personal health records available digitally during natural disasters,[38] but the same concept could be applied to road crashes to make it easier for first responders to understand whether injured persons have pre-existing conditions or allergies to medication.[39] This sort of change could dramatically improve health care provided to individuals involved in serious crashes.

The combination of in-vehicle instruments, fixed data sensors, and computing and data storage systems often come together under the banner of "smart city" or "smart state" programs. Ohio is installing high-speed fiber optic cable and sensors along a 35-mile stretch of Route 33, called the Smart Mobility Corridor, to collect data on traffic counts, weather, surface conditions, and opportunities to improve incident management.[40] The Ray C. Anderson Memorial Highway in Georgia includes a tire pressure sensor at a rest stop near the Alabama state line to help drivers quickly test and prevent a leading cause of crashes.[41] New LED streetlights in San Diego are equipped with sensors that gather information on sound, light, and environmental conditions such as open parking spaces and gunshots.[42]

Such "smart" programs can help local governments more systematically and efficiently manage the coming data deluge and to connect all those inputs to safety objectives.[43] Designing and managing such programs also requires integration with private sector partners, ranging from sensor and other machinery manufacturers to data management companies. Yet designing such systems is not a straightforward process, and numerous barriers confront local governments and their private sector peers looking to improve data-centric approaches to safety.

04 Challenges to data sharing

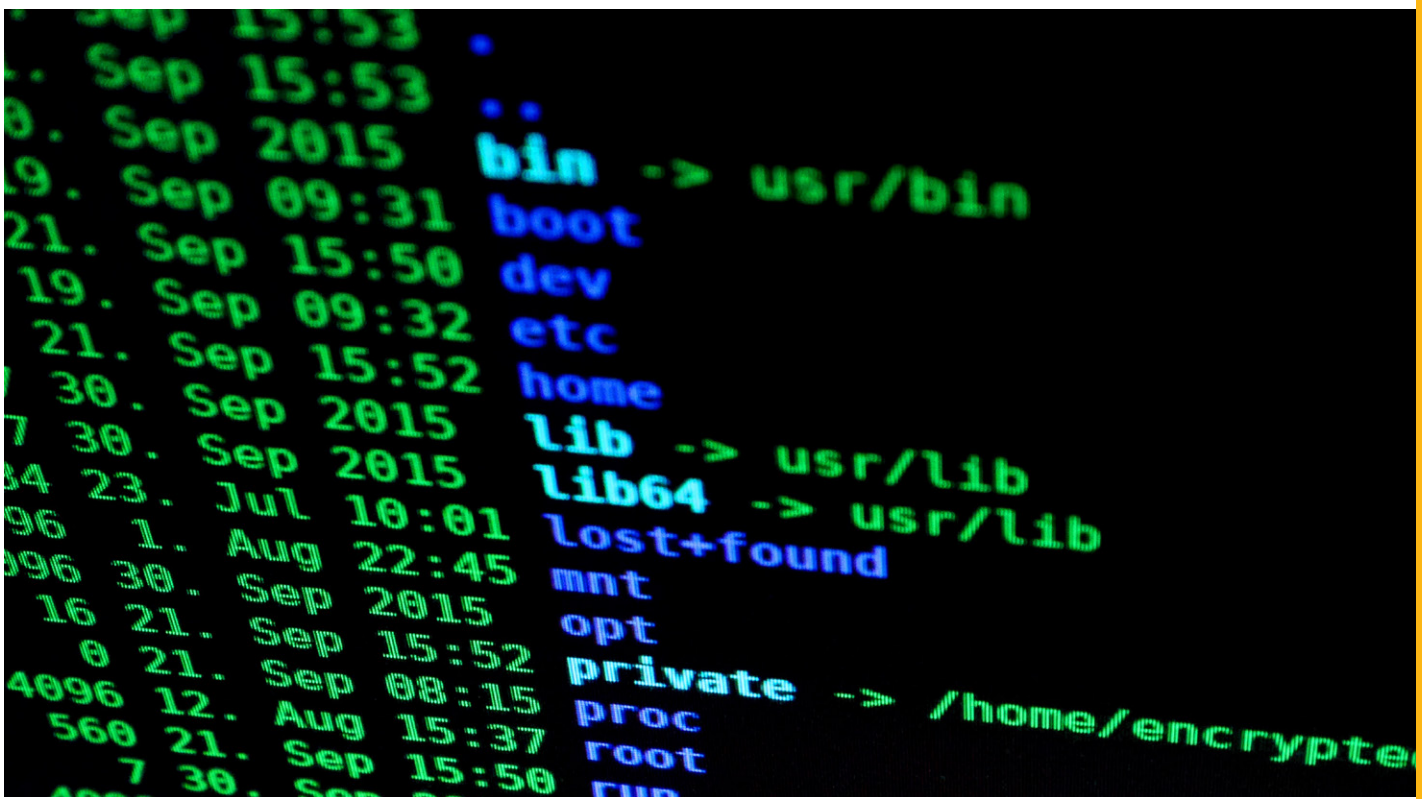
While new data sources offer real promise in improving safety outcomes, major challenges can hinder their integration. In many cases, those barriers relate to the fact that the private sector and private households are the initial generator (and sometimes owner) of new data inputs. In others, it involves a necessary culture change within government to update related data infrastructure and internal management policies. Overall, workshop participants emphasized that addressing these challenges is vital to building a collaborative, digital approach to road safety improvements.

Limited intra- and inter-agency sharing of existing data

Based on their experiences, workshop attendees consistently referenced a culture of data isolation. Access to road safety data was extremely limited even within government agencies due to security and liability concerns. Data was often not shared within the same city-level transportation agency[44], and typically only certain operational safety officials and perhaps select planners could view related data. In addition to intra-agency sharing concerns, attendees repeatedly raised inter-agency collaboration and knowledge-sharing as a key concern.

Outdated external procurement practices[45]

To augment public datasets, agencies often rely on privately generated data. However, conventional procurement practices do not easily apply to newer subscription-based models of data procurement. Cities must often rely on workarounds, such as adding contractual clauses for data acquisition



alongside larger procurements that may have only tangential relationships to the safety goal. This older procurement model is outdated, and is set to become unsustainable in the longer run. Yet as long as local governments struggle to simply get private data into their central databases, it will be impossible to take advantage of private data's capabilities.

Privacy and competitive advantage concerns

Even with better procurement practices, privacy and data validation concerns abound. On the private sector side, customers' privacy concerns and the retention of competitive advantage can pose real barriers to data sharing, no matter how noble the cause. The mobility footprints of individuals are unique, making it a real challenge to truly anonymize personally identifiable information without aggregating the data to an extent that it offers no detailed insights. At the same time, retaining their competitive advantage means that giving up their "secret sauce" may not be in the companies' best interest.

Data calibration, validation, and trust concerns

On the public-sector side, not being able to calibrate and validate the data sources can lead to a lack of trust in the data that is shared/acquired from the private sector. Moreover, many cities continue to wrestle with whether they should freely give away their data, especially if these measures are eventually monetized by the private sector.[46] Yet the private sector faces its own trust concerns, including the privacy issues mentioned above but also whether the public sector can secure the data from competing companies. Questions of ownership—who truly owns the data and controls its distribution and use—is particularly thorny and devoid of clear policy direction.

Balancing issue reporting with agency budgets and liability

Recently, more cities have begun to rely more on citizens themselves as a way to identify infrastructure issues that might otherwise go unreported or pose dangers for traffic. For instance, the City of Boston launched the 311-phone application to help citizens report non-emergency issues, like potholes and graffiti.[47] While this offers an inexpensive way to identify grievances, cities are struggling to balance issue reporting with issue resolution, while facing realistic constraints of agency liability and limited budgets. The lack of resources to respond to all reported concerns often results in city staff not being able to respond to all reported concerns The response becomes "first-come, first-serve" as opposed to targeted efforts to maximize the public good.[48]

Security vulnerability of new sensor infrastructure

Many local governments now use urban sensors and Internet of Things (IoT) technology to monitor the basic functioning of streets, air, water, soil, and more. Chicago's Array of Things[49] project tracks elements of the environment, infrastructure and urban activity with a network of sensors installed citywide. Atlanta's six-lane North Avenue "Smart Corridor"[50] includes streetlamps with attached environmental sensors that see, smell, and hear. However, these installations automatically create a new class of critical infrastructure that is vulnerable to cybersecurity threats due to their network connection. There is now new regulation in recognition of this potential urban security challenge.[51] Public officials must operate adequate security systems to both protect the sensitive data the sensors collect and to ensure the physical operation continues uninterrupted.

Inconsistent U.S. safety culture

With so many Americans dependent on driving to get to a variety of destinations, workshop participants consistently cited a prioritization of driver safety needs over the needs of other road users. Without a clear precedent for shared ownership of the road, road safety conversations often deeply discount the concerns of pedestrians, cyclists, and transit users.[52] In order to re-orient U.S. priorities to promote a more

inclusive safety culture, it could be instructive to examine the efforts of other countries. For instance, by prioritizing the safety of cyclists over automobile speed, the Netherlands facilitated a significant modal shift to bicycle use. Between 1980 and 2005, distance travelled by both cars and bicycles increased, yet fatalities for both drivers and cyclists were more than halved,[53] challenging the idea that greater bicycle use increases traffic danger. Local governments in the U.S. are recognizing this need for change. Local government leaders must create the right incentives, whether through gamification, redesigned streets, or changes in legal liability, to revolutionize the way in which all users view road safety.

Physical aspects of roadway design

Safety culture also translates into policies governing infrastructure design. Without systems designed to prioritize the safety of all users over other objectives—including vehicle speed—it is impossible to expect new data to create greater safety outcomes.[54] Currently, the U.S. operates a one-size-fits-all approach with the same guidelines across all rural, suburban, and city contexts.[55] At the same time, much of local roadway design uses older engineering rules, which might not be applicable to every context. The Vision Zero concept provides an excellent example of an alternative way of thinking about road safety. Rather than influencing user behavior, it targets potential hazards through improved road design that offers guides for user behavior. This extends to all aspects of roadway design, including road widths, pavement surfaces, allocation of road space, signals and signage, as well as lighting.[56]

Finally, workshop participants stressed the need to consider new collaborations to take advantage of emerging data and overcome the challenges detailed above. The barriers facing data innovation in the road safety space are immense—so much so that it would be difficult for local governments to tackle them alone. At the same time, private firms with deep wells of data and information management expertise face their own challenges related to unsafe streets, most notably negative impacts on their bottom lines. The question is how to use shared interest around safer roads to design new collaborative approaches.

Atlanta's Smart, Safe Corridor

Atlanta's North Avenue is one of the busiest, most important economic corridors in the city. Yet between 2014 and 2016—a period when motor vehicle fatalities in Georgia rose 33 percent—North Avenue's crash rate was two to three times higher than that of similar corridors. Troublingly, the corridor's signal system was over two decades old.[57]

Atlanta's leadership recognized the need to upgrade North Avenue's safety record, and decided to do so using a mix of cutting-edge data and a collaborative approach. First, Atlanta secured significant investment capital. The city acquired funding for the project via the $250 million 2015 Renew Atlanta low-interest bond program[58] and the 2016 passage of the T-SPLOST and MARTA sales tax hike[59] to attract $100 million in private partnership investment to undertake a revolutionary approach to reducing the City's infrastructure backlog and modernizing traffic management and road design. Second, city leaders ensured

that the safety-specific efforts of the North Avenue program integrated with citywide ambitions to initiate "smart city" programming, especially concerning the use of sensors to monitor daily activity.

Today, the same crash-prone North Avenue corridor is equipped with smart street lights with sensors and cameras for mobility and public safety applications.[60] Video footage holds the promise of conducting analytics on near-misses to determine potential crash hotspots and locate downed trees that pose safety hazards. Bicycle and pedestrian detection technology and sensors at key intersections along the route collect predictive data on areas most likely to cause crashes.

Collaboration among multiple actors and groups across the city helped make these efforts possible. Data collected from sensors feeds into a democratized data analytics tool showing sources of traffic danger. When city officials assessed the data, they found many rear-end and right-angle crashes, and that large events exacerbated the prevalence of crashes—findings that will enable planners to redesign intersections and better manage traffic on those occasions.[61] The city also collaborated with Georgia Tech on the corridor for knowledge-sharing and to create a living lab for students.[62] In the future, city officials hope to see the democratization of further data sources, such as crash prevention data from individual vehicles.[63] Just as importantly, lessons from North Avenue can lead to new "smart city" programs and safety improvements elsewhere in the city.

05 Designing collaborative solutions

Local governments and private sector peers have a unique opportunity to align policies, integrate data, and experiment with novel approaches to get the most out of emerging data. Essentially, both sides can benefit from streamlined, affordable, and secure data sharing. The longer-term sustainability of these efforts will depend on four major factors, solutions for which are still actively being developed: 1) structured data and knowledge collaboration among all players; 2) data procurement practices; 3) infrastructure performance and measurement security; 4) continued engagement with more systemic changes: safety culture and engineering design.

Structured data and knowledge collaboration among all players

Each key actor has a role to play in boosting data-centric collaboration. Local governments must improve coordination between different agencies in their own jurisdictions, among public sector peers in other cities, and in partnership with the private sector to design solutions. However, there are major constraints each side must consider. Government agencies will need to respect and protect the privacy of customers of private industry, as well as provide incentives to protect competitive advantage. Private industry must grant government the ability to calibrate and validate private data sources.Some nascent steps are already underway, but they will need to scale-up and standardize in order to advance additional data sharing. For instance, the National Highway Traffic Safety Administration developed

Crash Outcome Data Evaluation System (CODES) to link road crash records with information on health outcomes collected at the crash site, by emergency medical services en route, and in the hospital. It provided tangible conclusions about best practices to prevent injuries and fatalities and logical future policy decisions.[64] The city of Boston has created 'Analyze Boston', a website that centralizes all datasets covering the region and includes geospatial data on the environment, public safety, transportation, facilities, public health, and other factors.[65] GIS data has proved extraordinarily useful in representing location data on crashes and road characteristics, and conducting statistical analysis to determine risk.[66]

Public-private partnerships around data are certainly not the only form of collaboration. More cities are experimenting with academic partnerships, in which municipalities can still enjoy external analytics expertise but do so within their budget constraints. While these might not be sustainable solutions in the longer term and can only serve as a stop-gap arrangement for emerging concerns around privacy and the Freedom of Information Act, they can be mutually beneficial. Examples include hackathons or Open Data partnerships/ portals.

Data procurement practices

Cities must not be afraid to experiment with new ways of procuring data, exchanging their own data when mutually beneficial, and re-defining their strategic priorities. As a first step, the public sector will need to update budgeting processes to accommodate subscription-based models.[67] Alternatives to the payment-after-delivery model, as well as new means to demonstrate proof-of-concept to shelter private start-ups from financial risk, will be key. Many governments request product trials before signing contracts—as the Massachusetts Bay Transportation Authority (MBTA) did with NextBus[68]—but not all companies can afford to work on these longer timelines. Agencies will also need to grow and train their workforce to have the expertise to request the right kind of data (including metadata and historical data) and capabilities to analyze it when appropriate. Chief Information Officers centralized within municipal government or stationed within multiple agencies may foster greater interagency procurement reforms.

There is a clear need to ensure other city leaders learn about replicable instances of successful data procurement and implementation. Officials involved in those successful case studies should provide appropriate guidance to other cities to facilitate public-private data sharing. To incentivize private sector participation, local governments should jointly determine the ideal base case of the minimum viable amount of data needed to support decision-making. In line with the National Association of City Transportation Officials' base case creation guidelines via the NACTO Data Sharing Principles,[69] all cities must acquire the same data to level the playing field and reduce the need to customize data sets for each city. International efforts have useful lessons to offer as well, such as the Safer City Streets Methodology for developing a road safety database and network.[70]

Infrastructure performance measurement and security

Continued monitoring by city departments on how data-focused improvements are performing is a crucial, iterative step to perfecting the data environment and optimizing safety. Municipalities could take concrete steps to develop a usable set of metrics to measure progress (or the opposite) and to determine the tangible results of actions. Most importantly for the safety/data nexus, more certainty around performance measures will lead to a more robust market around data acquisition and sharing.

Cities today are beginning to recognize the need for upfront commitments to longer-term and higher levels of spending on operations

and maintenance.[71] Data security is now an essential component of that operations and maintenance work. As sensors become a more integral component of the built environment, local governments will not be trusted with data collection or private sector data integration if they cannot protect both user privacy and outside influence on equipment functionality. Further steps include greater engagement with governmental agencies dedicated to cybersecurity and counterintelligence, as a way to pre-empt potential threats.

Continued engagement with more systemic changes: Safety Culture and Engineering Design

Newer and more detailed datasets certainly hold great potential to enable local governments to make targeted interventions around safety. However, prior to jumping on the data bandwagon, cities will need to be very cognizant of the limitations of data. Better data does not guarantee more inclusive and impactful decision-making—successful community engagement and buy-in from citizen participants will have to go hand-in-hand. Clearly laying out incentives and relaying the benefits of the process to residents and businesses are essential. Privacy concerns make most parties wary of what ends data is being applied to. Clear and consistent communication with the broader public can go a long way in allaying these valid concerns. Similarly, data can only report on what has and is likely to happen on city streets. It is incumbent that city departments and their peers at the state level amend engineering design to protect all travelers, minimize crashes and discourage unsafe travel habits.

06 Conclusion

America's road safety record is unacceptable. As one of the nation's leading causes of death and a significant source of economic loss, automobile crashes inflict harm throughout the country. The threat to drivers, bicycle riders, and pedestrians makes this a national area of distress. The only answer is to design safer roads, regardless of how many Americans drive in the future.

The emergence of new data inputs, analytical software, and highly-trained staff creates new opportunities to deliver safer roads in the digital age. Maximizing returns from data, software, and people will require cities and other governments to collaborate with private and civic sector experts. The public sector simply cannot go it alone.

However, such collaborations currently face significant challenges to getting off the ground. Procurement policies must be modernized. Budgets must be expanded. Internal and external data sharing must be improved. New data infrastructure must be cybersecure. Privacy concerns must be addressed. Pilots must be designed to have a pathway to scale. And roadway design standards must be updated to reflect community values. Across each of these needs, there are responsibilities for the public, private, and civic sectors. A culture of collaboration, trust, patience, and risk tolerance is fundamental to delivering positive results.

Fortunately, change is underway. A combination of internal city experimentation and new collaborations between the public and private sector show that improved data management and exchange can lead to new policies, projects, and improved outcomes. This ongoing process will take time and dedication, but through iterative learning and amendment, public-private data and knowledge sharing holds the potential to make our transportation systems safer for all.

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