The Deloitte City Mobility Index

Gauging global readiness for the future of mobility

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Where should cities go tomorrow?

A smart city is a data-driven city, one in which municipal leaders have an increasingly sophisticated understanding of conditions in the areas they oversee, including the urban transportation system. In the past, regulators used questionnaires and surveys to map user needs. Today, platform operators can rely on databases to provide a more accurate picture in a much shorter time frame at a lower cost. Now, leaders can leverage a vast array of data from the Internet of Things, artificial intelligence, and other digital technologies to develop and inform intelligent decisions about people, places, and products.

Unfortunately, when it comes to designing and implementing a long-term vision for future mobility, it is all too easy to ignore, misinterpret, or skew this data to fit a preexisting narrative.[1] We have seen this play out in dozens of conversations with transportation leaders all over the world. To build that vision, leaders need to gather the right data, ask the right questions, and focus on where cities should go *tomorrow*.

Given the essential enabling role transportation plays in a city's sustained economic prosperity,[2] we set out to create a new and better way for city officials to gauge the health of their mobility network and their readiness to embrace the future. The result is the Deloitte City Mobility Index (DCMI), a collection of conscious choices based on our vision of what smart urban mobility should look like. The DCMI is an in-depth exploration into the rapid changes occurring in the way people and goods move about, with intermodal journeys, active transportation options, such as sidewalks and bicycle lanes, and public transit playing prominent roles. The DCMI places economic prosperity at its core, takes a holistic view of the city's entire mobility landscape, and it is informed by our clear image of how the future of mobility could unfold in urban areas.

Here you will find an overview of how we constructed the DCMI and a discussion of some of our key findings. We invite you also to explore the accompanying in-depth city profiles and interactive feature, which we will be expanding over time.

Measuring urban mobility performance

To develop a picture of mobility across the globe, we went beyond what transportation looks like today to explore what mobility *could be* in a truly smart, liveable, economically vibrant city. Three key themes emerged from this research:

1. **Performance and resilience.** Urban mobility should be efficient. It's a given that the trains should literally run on time. But cities that scored highest in this category also minimize congestion and travel times, maintain roads and other infrastructure, and offer multiple, integrated modes of transportation.
2. **Vision and leadership.** Urban mobility requires innovation, coordination among stakeholders, and direction. Creating a high-performing, resilient, and inclusive mobility system is unlikely to happen by accident. This second theme analyses how deliberate and forward-thinking a city's leaders are regarding its future mobility needs.
3. **Service and inclusion.** Urban mobility should be accessible to all residents. Exemplary cities in this category offer widespread coverage and modest wait times for public transit, affordable options, and user-friendly ways to access a variety of transportation modes.

With these three themes as our lodestar, we dug into the component pieces of each.

What we learned: Select findings

"WHAT'S PAST IS PROLOGUE"[3]—BUT NOT DESTINY

Some of the cities we looked at are centuries old; they reflect countless choices made by political leaders, businesses, and residents over time. Naturally, those circumstances, both physical and political, shape today's mobility landscape, and affected their rankings in our index. Cities in which decision-making authority rests with multiple actors, like Paris and Washington DC, often struggle with articulating and acting upon a cohesive vision for the future.

That said, many of the cities we profiled have shown a remarkable ability to overcome their circumstances through new approaches. The mobility profile of Columbus, Ohio, for example, is typical of many mid-sized American cities: car-dominated, with limited public transit but also limited congestion due to its modest size. Faced with rapid growth and critical shortcomings, especially when it came to key health outcomes, city leaders crafted an ambitious strategy to remake Columbus's transportation system into a model for smart mobility.[4] Even weather need not be a hindrance. Walking and cycling are most prevalent in Paris, Berlin, and Amsterdam—all northern European cities. Helsinki is a top performer, too, where it frequently snows!

INTEGRATION IS KEY

Cities with high population densities such as London, Singapore, and Berlin scored highest on transportation performance. With more people funding systems that cover less ground, these cities get more bang for their bucks. Cities with large geographic areas, such as New York and Chicago, tend to do better within city limits but do not perform as well in their larger exo-urban areas.

One reason for this may be the lack of integration, coordination, and effective governance among transportation regulators and providers between the city and the suburbs, and between public and private entities. The city proper usually has one transit authority, surrounding areas have their own, and the level of cooperation between the various entities can vary widely. While this is improving in many of the cities surveyed, it still has a ways to go.

Our findings suggest that having multiple regulatory providers inhibits a smoothly functioning and integrated transportation system, but interagency coordination can be successful. In Toronto, for example, the Toronto Transit Commission handles public transportation within the city, while a multitude of smaller authorities (GO Transit, YRT/Viva, MiWay, and others) cover the surrounding municipalities. The various authorities operated largely independently—for years, passengers travelling between regions required multiple tickets and, apart from a few exceptions, travellers who crossed boundaries had to pay two fares. However, since city leaders created the Metrolinx and the region's "Big Move" plan in 2009, integration has proceeded in stages. When completed, this multiyear endeavor will fully integrate a number of transit systems across Ontario, allowing users to pay fares with a single card across the network.[5]

As cities grow and expand and housing costs rise, many young families have little choice but to move to the suburbs and commute into the city for work. Too often, it becomes clear that the only viable commuting option is driving; absent a single authority or close coordination among multiple authorities, public transportation can be too complex and time-consuming to utilize. But driving private cars adds to congestion, pollution, and parking challenges, not to mention the financial burden it places on families. In fact, some families find that the lower costs associated with a move outside of the city core are offset by car ownership costs or expensive travel passes. City governments would do well to work together with their surrounding regions to fix this issue, and to do so quickly.

There is also a direct tie between the presence of multiple regulatory authorities and service providers and having a lower ability or willingness to explore innovative solutions. In our index, the leading innovations include *smart parking and ticketing, integrated payments*, i*ntelligent transit systems,* and *electric vehicle infrastructure*. For any of these efforts to succeed, they often need to be offered across commuting corridors and inter-agency (regulatory body) coordination and cooperation are required. Data integration, governance, and security are also easier with more tightly linked governing bodies.

Finally, the data suggests that more than any other indicator, having low levels of integration is correlated with low readiness to face the future of mobility. Creating seamless urban transportation demands a unity of purpose and an ability to act in concert across different modes and jurisdictions.

THE CHALLENGES OF PRIVATE CARS

Our vision for smart urban mobility emphasizes active transportation and public transit. That necessarily means any city that relies heavily on private cars—as many US cities do—will fare poorly on several metrics in the index. We think that choice is reasonable. Our analysis—and many others'—reveals a number of deleterious consequences from overreliance on private autos, including congestion, pollution, and accidents.[6] If cities continue to grow—and the Organisation for Economic Co-operation and Development (OECD) predicts that 70 percent of the world's population will live in urban areas by 2050[7] —then public and private players need to find ways to move people and goods in ways that maximize use of space and minimize such social costs.

Private cars can work well in some circumstances and are an important piece of the mobility landscape, however. Geographically spread-out cities tend to favor car use, and North American and Australian cities are among the most geographically spread out of cities measured. Thus, they have a higher modal share of private cars and a lower share of active transportation. Their strategic plans also tend to focus more on road improvements and road-based transportation.

Still, cities that rely heavily on personal vehicles should think through ways to optimize their use. For example, by augmenting private ownership with carsharing and ridesharing, perhaps as part of a mobility-as-a-service solution, it may be possible to keep the cars-to-people ratio in check—or even drive it down. And cars are often the fallback option when the first mile/last mile problem is unsolved. Our research suggests that if getting to public transportation is a problem, people will get in their cars . . . and won't get out until they reach their destination. Creating convenient and affordable solutions for the beginning and end of a journey—think bicycle-sharing, dynamic shuttles, and ride-hailing, ideally integrated via a full-fledged mobility-as-a-service offering—can be an important step to reducing reliance on personally owned vehicles.

Paris has made significant strides in reducing the number of single occupancy vehicles. It introduced a pioneering bicycle-sharing plan in 2007, an electric carsharing plan in 2011, and closed off the left bank of the Seine to cars in 2013. As a result, traffic has dropped by more than 30 percent in the past 15 years.[8]

CULTURE'S ROLE IN TRANSPORTATION

Similar to the EU's designation for traditional foodstuffs of specific character, a city's mobility system will ultimately be shaped by its culture and "terroir" and have its own distinctive local flavor.

Geography plays a massive role in mobility, and this is something that leaders should consider when looking at other cities for inspiration. Spread-out cities tend not to rank highly for active transportation. This is no surprise: If you have to get from A to B, cycling across a large city is a less viable option. While it is relatively easy for cities like Amsterdam and Helsinki to do well in this regard, their recipes for success may be hard to replicate in a sprawling metropolis, such as Los Angeles.

The role of culture is also much more important to the development of a transportation system than we usually assume. Casual ridesharing is common in cities such as Washington DC (where it is known as "slugging") and New York, but less so in other US cities. Similarly, Amsterdam is quite famous for its cycling culture, but this seems not as common in other cities, even those with similar geographic and population profiles.

Then there is the issue of social attitudes toward public transportation, such as "bus stigma" and the importance of "car culture." Cities can spend billions to upgrade their transportation systems, but if the public perceives that taking a bus or train is a second-class option compared to driving in, passenger numbers will not increase. Such was the case for Denver (not included in our survey).[9] Car ownership is deeply ingrained in the American psyche, is reinforced by decades of advertising by automakers,[10] and is an increasingly important status symbol in China.[11] Overcoming those cultural barriers could be particularly challenging for transportation planners. They should consider ways either to work with prevailing beliefs, or to find ways to shape them gently.[12]

Remaking your mobility landscape

From our research, we found that mobility plays a central role in a city's economic prosperity. This is why the rewards for getting it right are potentially great. Looking for out-of-the-box solutions to solve their problems, leading future of mobility cities demonstrate that finding money is rarely a long-term solution. Their success tends to stem from integration and innovation rather than sheer investment.

For cities that have fared poorly across specific indicators, all is not lost. Given the speed of change and technological trends, any city has the opportunity to radically remake its mobility landscape over the next five to ten years. Cities that rank poorly today could leapfrog to become leaders in the future of mobility by deploying advanced solutions that solve some of transportation's perennial problems.

Leaders need to identify what the "right" kind of spending is—typically, those that integrate systems or introduce technological improvements. These will produce better returns over time. While adding more service or building more roads can be helpful, developing better-integrated strategies with greater involvement from the private sector often yields better results. In these scenarios, the government often takes on different roles, such as enabling data sharing, monitoring cybersecurity, incentivizing private-sector innovation and participation, and establishing the standards and rules by which mobility providers must abide.

DCMI METHODOLOGY

We chose more than 60 unique data parameters based on a review of existing literature, their correlations with economic growth, and our research team's analysis. Data was gathered from a variety of sources, including government statistical databases, third-party reports, private vendors, and nongovernmental organizations. We then brought in the qualitative judgments of a variety of experts on urban mobility or particular cities, both inside and outside Deloitte.

We assigned each metric a score between 1 and 5 based on the data parameters within it. Depending on the metric, score assignment involved converting a qualitative assessment into a number, indexing data to create a relative score, or both. We applied some data parameters and metrics to more than one theme.

To look specifically at a city's readiness for the future of mobility, we focused more closely on the parameters that dealt with "smart" or "digital" elements of transportation. In particular, the DCMI looks at *integrated and shared mobility, vision and strategy, innovation, regulatory readiness for the future of mobility*, and *ease of use*. The metric scores were then averaged. "Five" indicates being closest to full future of mobility readiness. (See figure 1.)

The data was collected for the years 2016 and 2017 (or earlier where newer data did not exist). Unless specified otherwise, this information is no more than five years old. In some instances, trend data was collected, but predominately the data was cross-sectional for the latest year.

In all, we examined more than 40 cities. (Profiles of 18 cities were published contemporaneously with this report. Additional cities will be added in the coming months.) Cities were selected to achieve geographic distribution, a variety of sizes (population and area), and various levels of economic development.

Of course, any effort to create a composite measure such as this is a product of choices and assumptions made along the way. Ours were guided by a view of how seamless urban mobility that is faster, cheaper, safer, and cleaner than today could look, and the important contribution such a system can make to prosperity and productivity. Places that had multiple modes of easily accessible transportation; that had placed an emphasis on walking, biking, and public transit relative to personally owned automobiles; and that had taken steps toward digitally enabling their mobility network received high marks. Different choices and assumptions, guided by a different vision, would necessarily yield different results. In addition, the DCMI currently presents a snapshot, not a trajectory. It does not capture how cities have trended over time, nor can it evaluate how past investments have affected mobility. As we update the data every year, a more robust picture will emerge.

Figure 1. Deloitte City Mobility Index themes, metrics, and select data

THEME	METRIC	EXAMPLE DATA
Performance and resilience	**Transportation demand vs. supply**	• Peak hours spent in congestion • Driving time to city center • Metro/subway average peak frequency • Metro track length (km), number of light rail stops, number of bus routes
	Resilience and reliability	• Metro/tram service disruptions (as percentage of total trips) • Congestion level
	Road safety	• Road quality • Walkability • Number of traffic-related fatalities and serious injuries relative to population
	Integration and shared mobility	• Existence of open data or APIs for transport data • Integrated ticketing option across transit modes • Bicycle-sharing system in the city • Mobility as a Service application
	Air quality	• PM2.5 and PM10 concentration
Vision and leadership	**Vision and strategy**	• Assessment of city innovation and future mobility strategy • Assessment of collaborations with the private sector and academia
	Investment	• Assessment of city innovation and future mobility strategy • Assessment of collaborations with the private sector and academia
	Innovation	• Electric vehicles as percent of total vehicles • Presence of mobility-focussed accelerators/venture capital/start-ups
	Regulatory readiness for FoM	• Assessment of city openness to ridesharing • Number of relevant regulatory bodies • Assessment of city support for autonomous vehicles
	Environmental sustainability	• Bicycle lanes (km/city area) • Existence of electric vehicles tax incentive • Percentage of cars sold annually that are low CO2 (battery or plug-in hybrid electric)
Service and inclusion	**Public transit coverage**	• Average waiting time for public transportation • Percentage of public transit trips requiring waits of 20 minutes or more • Assessment of overall system
	Affordability	• Modal split of trips multiplied by amount of minimum wage work required to pay for each mode
	Versatility	• Existence of underground rail and tram systems • Carsharing system in the city
	Customer satisfaction	• Customer satisfaction with public transit • Peak hours spent in congestion (per person, per year)
	Ease of use	• Integrated ticketing option across modes

ENDNOTES

1. City leaders are not alone in this. Corporate goal-setting is plagued by similar biases and challenges when it comes to assessing current performance and setting future goals. See Michael E. Raynor, Mumtaz Ahmed, Derek M. Pankratz, and Rob Del Vicario, "A theory of relativity: Setting priorities and goals for financial performance improvement," *Deloitte Review* 17, July 27, 2015.
2. Sir Rod Eddington, "The Eddington transport study," UK Department for Transport, December 2006.
3. William Shakespeare, *The Tempest*, Act II, Scene 1.
4. "Andrew J. Ginther, "Smart city: The city of Columbus," E&E News, accessed December 15, 2017.
5. Metrolinx, "The big move: Baseline monitoring report," September 2013.
6. See, for example, Graham Cookson and Bob Pishue, "INRIX Global Traffic Scorecard," *INRIX Research*, February 2017; Federico Karagulian et al., "Contributions to cities' ambient particulate matter (PM): A systematic review of local source contributions at global level," *Atmospheric Environment* 120 (2015): pp. 475–83; World Health Organization, "WHO global urban ambient air pollution database," 2016. OECD, *The Cost of Air Pollution: Health Impacts of Road Transport*, (Paris: OECD Publishing, 2014); Jonathan I. Levy, Jonathan J. Buonocore, and Katherine von Stackelberg, "Evaluation of the public health impacts of traffic congestion: A health risk assessment," *Environmental Health* 9, no. 1 (2010): p. 65; and Erik Hansson, et al., "Relationship between commuting and health outcomes in a cross-sectional population survey in southern Sweden," *BMC Public Health* 11, no. 1 (2011): p. 834.
7. OECD and CDRF, "Trends in urbanisation and urban policies in OECD countries: What lessons for China?," OECD, accessed December 15, 2017.
8. Adele Peters, "Inside Paris mayor Anne Hidalgo's ambitious plans to create the post-car city," *Fast Company*, April 4, 2017.
9. Andrew Small, "Denver radically expanded its transit. So why are more people driving cars?," CityLab, November 2, 2017.
10. Derek M. Pankratz, Sarah Kovar, Jordan Sanders, and Philipp Willigmann, "Framing the future of mobility: Using behavioral economics to accelerate consumer adoption," *Deloitte Review* 20, January 23, 2017.
11. Tania Branigan, "China and cars: A love story," *Guardian*, December 14, 2012.
12. Richard H. Thaler and Cass R. Sunstein, *Nudge* (London: Penguin Books, 2009). See also Deloitte Insights' collection on Behavioral Economics and Management.
13. The sources of data included:
    - **2thinknow data:** Data sources purchased from 2thinknow, a research company based in Australia that focuses on analysis of cities. Data points include metro/subway average peak frequency, taxi rate per km, traffic-related injuries and casualties, and others (14 data points in total).
    - **Government statistical databases:** Including census reports, economic statistics, and geographical information.
    - **City and state/province websites:** Including US Department of Transportation, city transport authority websites
    - **External reports and indexes:** Including Movmi Shared City Mobility Index, INRIX Global Traffic Scorecard, TomTom Traffic Index, Waze Driver Satisfaction Index, IESE Smart Cities Index, Arcadis Sustainability Index, Easy Park Smart Cities Index, Moovit average waiting time for public transportation survey.
    - **NGO reports:** These include the road quality rating provided by World Economic Forum, Particulate Matter (PM2.5 and PM10) reports by World Health Organization, European Alternative Fuels Observatory, OECD, CDP, and American Public Transportation Association.

- **Qualitative analysis:** Done mostly by the Deloitte USI team. For example, evaluation of Electric Vehicles and Autonomous Vehicles regulation, operation of ridesharing companies.

14. See Scott Corwin, Joe Vitale, Eamonn Kelly, and Elizabeth Cathles, *The future of mobility: How transportation technology and social trends are creating a new business ecosystem*, Deloitte University Press, September 24, 2015; and Scott Corwin, Nick Jameson, Derek M. Pankratz, and Philipp Willigmann, *The future of mobility: What's next?*, Deloitte University Press, September 14, 2016.

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