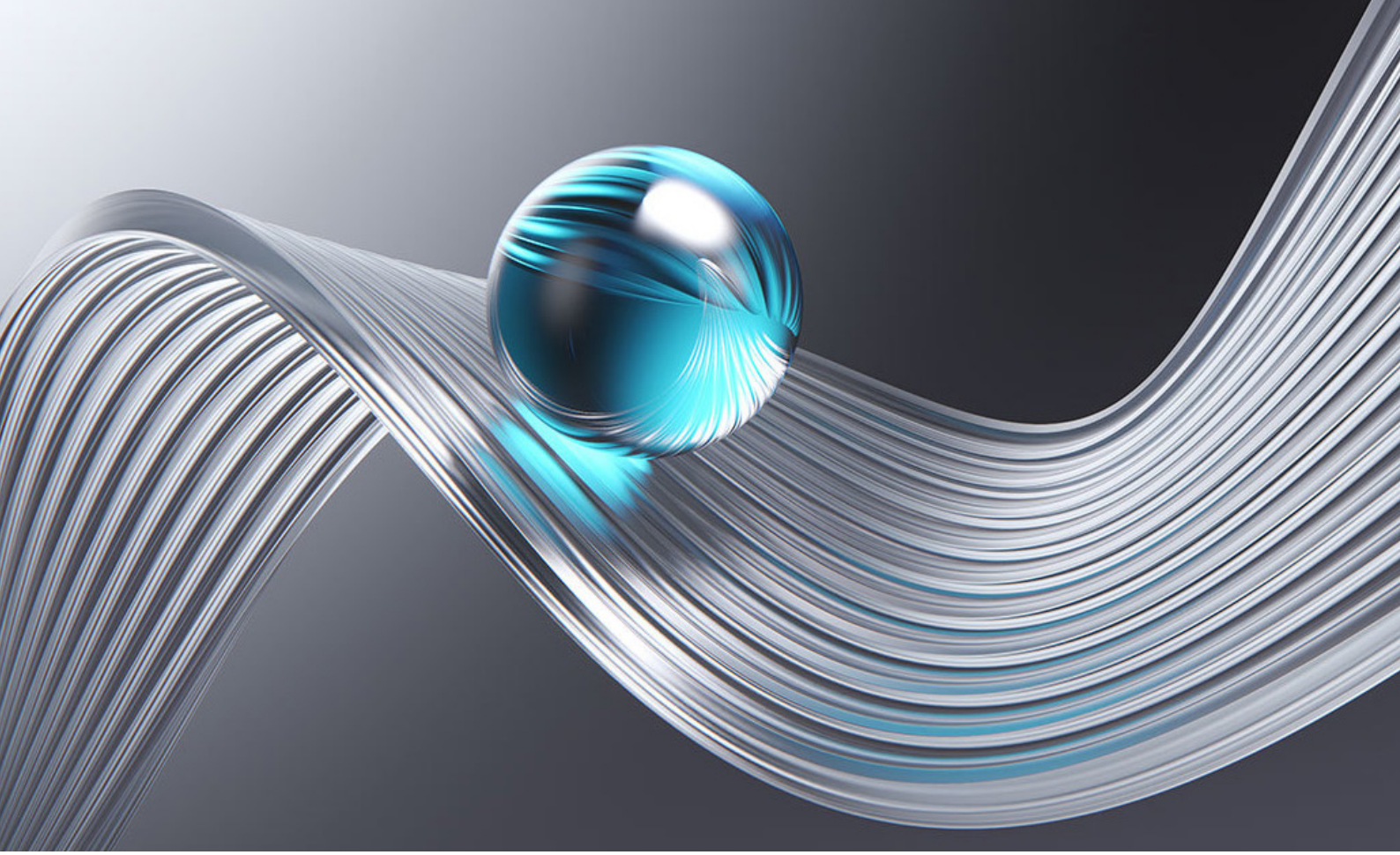

Setting course for a future of seamless mobility

Urban traffic is getting worse. Here's how public- and private-sector leaders can forge a strategy toward seamless mobility.

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The age of modern transit began in 1863, when the first underground railway began rolling in central London. The line was short and smoky, and nothing like it had ever been seen before. But it worked, and cities around the world began to follow London's lead. Over time, city authorities came to see providing transportation as one of their core responsibilities, and governments often owned and ran transit systems themselves.

The future, however, could be very different. Under what we call "seamless mobility," travelers mix and match different kinds of transit, ranging from trains and bikes to robo-taxis and autonomous shuttles. Rail would remain the backbone of the urban transit system, delivering about 40 percent of urban passenger-kilometers. But there will be more people in shared modes of transportation; over time, all of these will be electrified, and many will be autonomous.

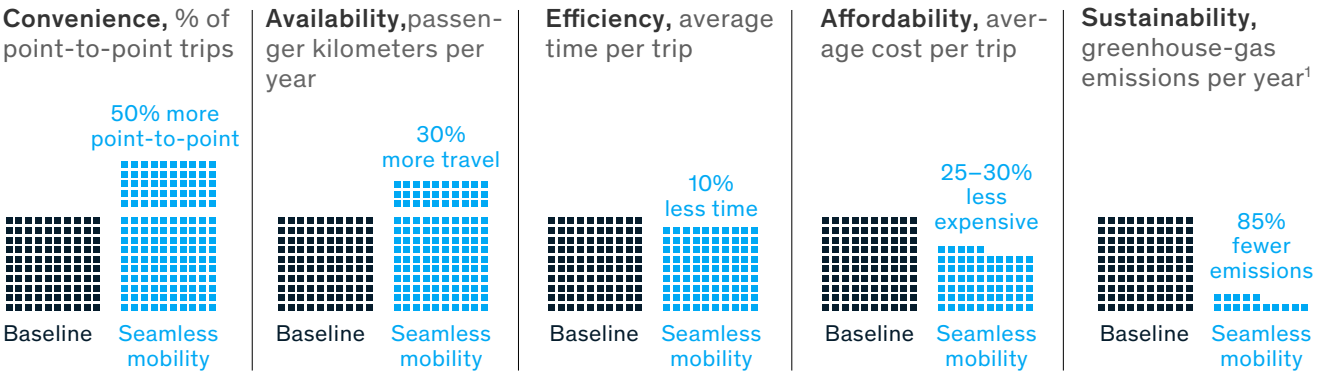
We have identified five indicators to evaluate mobility systems: availability, affordability, efficiency, convenience, and sustainability. By integrating four trends—autonomy, connectivity, sharing, and electrification—seamless mobility improves all of them. Specifically, we believe it could accommodate up to 30 percent more passenger-kilometers (availability) while still reducing average time per trip by 10 percent (efficiency). In addition, it could cost 25 to 35 percent less per trip (affordability), increase the number of point-to-point trips by 50 percent (convenience), and, if AVs are electric, reduce greenhouse gas (GHG) emissions by up to 85 percent (sustainability).

To get there, it is critical to maintain a high-quality physical infrastructure those Victorian engineers would have been familiar with. But seamless mobility will also require new kinds of physical assets, such as storage and maintenance facilities for shared autonomous fleets, fast-charging infrastructure for electric vehicles (EVs), and dedicated lanes for autonomous vehicles (AVs) equipped with vehicle-to-infrastructure

Exhibit 1

Seamless mobility has the potential to improve all system indicators.

System indicators, change over baseline



[1]Assuming that all electric vehicles and autonomous vehicles are powered by no-emissions sources.

communications and IT systems. All of this comprises a significant new area of opportunity for infrastructure companies to design, build, and operate, and for new forms of public–private partnerships.

Under seamless mobility, these kinds of hard assets will not only need to be well-built; they will also need to be smart and connected. And that brings us to new kinds of infrastructure, much of it in the form of bytes and clicks, such as traffic-flow management, real-time public-transit information, vehicle routing, maps, and vehicle tracking.

Some of this, of course, is already in common use. For example, the application of smartphones, GPS, and the Internet of Things (IoT) to infrastructure and vehicles has enabled newer forms of travel, such as car sharing and e-hailing. It has also made traditional modes more efficient, by making trains run more smoothly and routing buses more efficiently. In some US cities, portions of the bus fleets travel along flexible networks, based on rider orders placed through an app, rather than fixed schedules. All this is just the start of the journey, though. To consider what kinds of infrastructure may be needed in the future, thinking about it in terms of supply and demand can be useful.

Optimizing supply: Improving capacity utilization

It's time-consuming and expensive to build new bricks-and-mortar infrastructure. More important, in many places it will not be necessary if existing assets are used more productively. Here are some tools that cities can deploy to do the latter.

Paving the way for AVs: Priorities range from ensuring that roads have clear signage and are in good repair to devising consistent data standards and communication protocols. The latter can actually boost road capacity because allowing autonomous vehicles to communicate with each other enables them to drive closer together, meaning more vehicles can travel safely on the same roads.

Automating, and tech-enabling, trains: Autonomous operations and advanced signaling reduce the space between train coaches, making it possible to achieve higher speeds and carry more people. Dozens of autonomous trains already exist, for both metro lines and for site-specific systems such as airports. When Paris automated its oldest metro line, the average speed rose 20 percent. Condition-based and predictive maintenance, which involves collecting performance data and using statistics to identify and fix problems before they cause breakdowns, can keep trains rolling more frequently and reduce maintenance costs by up to 15 percent.[1]

Deploying intelligent traffic systems: These systems minimize wait times and maximize movement through, for example, lights that sense traffic and communicate with each other, as well as dynamic lane allocation, which shifts lanes to the direction with more traffic. Such systems have reduced commuting time in Buenos Aires by as much as 20 percent, in San Jose and Houston by 15 percent, and in Mumbai by 12 percent.

Optimizing demand: from private to shared modes of travel

To progress toward seamless mobility, it's important to encourage people to shift to shared transportation and to move some traffic to off-peak hours. That is what we mean by optimizing demand. If people move away from driving themselves and onto rail, bus, or autonomous shuttles, existing infrastructure can carry more passengers without increasing congestion, and maybe reducing it. That, however, will require new kinds of infrastructure. Examples of demand optimization infrastructure includes:

Creating dedicated lanes for shared vehicles: Shared mobility solutions, such as car-sharing, e-hailing, and bike-sharing, are all growing, and

the potential is enormous. The emergence of shared, autonomous EVs that are less expensive than owning a private car could transform urban mobility.[2] If all the autonomous shuttles and buses that enter circulation travel in their own lanes, they will be a faster, more attractive travel option. Cities such as Bogota and Brussels have already found this to be the case with traditional buses.

Scaling e-scooters and shared bicycles: Bike-sharing has also grown rapidly in the past decade. In the United States, the number of bike-share trips increased from 2.3 million in 2010 to more than 35 million in 2017.[3] While these modes are still in their infancy, early anecdotes suggest that when e-scooters and shared bikes are linked to transit lines, this makes rail more attractive.

Changing commercial deliveries: Goods transport accounts for almost 20 percent of urban congestion. The construction and use of urban consolidation centers (UCCs) is one option to thin it. These are locations where deliveries are brought and then sent on to cities. That means fewer truck trips, on more efficient routes. Load pooling is another. Commercial vehicles with spare capacity are matched, via an online platform, with customers who need the space. An algorithm optimizes delivery routes and shippers use their fleet more intensively, reducing related mileage by 25 percent.[4]

The future of mobility comprises a significant new area of opportunity for infrastructure companies. They can only benefit, however, if they work closely with governments—and if all parties keep in mind that to deliver the goal of seamless mobility, the development and use of infrastructure will need to be seamless, too.

[1] *The rail sector's changing maintenance game*, February 2018, McKinsey.com; Shafiq Dharani, Tom Isherwood, Diego Mattone, and Paolo Moretti, "Telematics: Poised for strong global growth," April 2018, McKinsey.com.

[2] Aditya Dhar, Dev Patel, Rahul Raina, and Paolo Sandrone, "What US consumers think of shared mobility," November 2017, McKinsey.com.

[3] "Bike share in the U.S.: 2017," National Association of City Transportation Officials, 2017, nacto.org.

[4] An integrated perspective on the future of mobility, part 2: Urban commercial transport, McKinsey, September 2017

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