



Urban Mobility Readiness Index

HOW CITIES RANK ON MOBILITY
ECOSYSTEM DEVELOPMENT



**Nowhere
will mobility
innovation
be felt more
acutely than
in cities**



Executive Summary

The planet is getting more urban. By 2030, more than five billion people — about 60 percent of the world population — will live in cities. By then, the United Nations predicts that as many as 43 megacities will exist, each with 10 million or more residents and most in Asia and Africa. That will be up from 33 in 2018.

We're also becoming more mobile and connected. New technologies and business models are pushing aside the once indomitable privately owned automobile and other less efficient modes of transportation. Whether from drones, autonomous vehicles, hyperloops, the electrification of transportation, shared networks of cars, scooters, and bicycles, or the advent of 5G wireless, the world of mobility is changing almost daily.

Nowhere will that transformation be felt more acutely in the coming decades than in the world's major cities where increased urban density and congestion make the tasks of creating and maintaining urban transport systems ever more complex. That's why developing and improving urban mobility is

a top priority of cities around the globe. If a city can't move its people, goods, and data efficiently, it's hard to see how it thrives.

Today, in order to keep up, city leaders must think in terms of creating mobility ecosystems rather than building a subway here or bike lanes there. Ecosystems are holistic approaches to the challenge of urban mobility. With the latest technologies blurring the lines between infrastructure, vehicles, sensors, and mobility applications, these ecosystems — just like in biology — develop around the interaction of various networks and modes of transport. At their best, they operate seamlessly, constantly connected in real time. Ultimately, they become a competitive advantage for their cities.

Behind The Index

That's why the Oliver Wyman Forum created the *Urban Mobility Readiness Index: How Cities Rank on Mobility Ecosystem Development*. It is a tool to help cities evaluate their capacity — now and in the future — to exploit new forms

Leading cities tend to perform best in system efficiency and innovation

of mobility to gain an economic edge. To compete effectively for business and skilled labor, municipal leaders will need to provide policies, regulation, and infrastructure that allow these ecosystems to flourish, while also protecting residents against risks from mobility innovation.

The index serves as a predictive metric that gauges and compares various cities' capabilities to compete and distinguish themselves in mobility. In this first edition, 30 global cities from six regions were ranked. The first edition of the index identifies five cities, listed in descending order, as the best prepared overall for the New Mobility: the city of Singapore, Amsterdam, London, Shanghai, and New York.

The index uses five criteria to rank cities. They are:

System efficiency, which focuses on controllable metrics, such as public

transport operating hours, public transport affordability, public transport reliability, and traffic management;

Social impact, which focuses on volatile metrics, such as road safety, air quality, vehicle occupancy rates, car ownership rates, and traffic fluidity;

Innovation, which focuses on technology-related metrics, such as the concentration of skilled workers and startups, electric vehicle market share, and government investment in connected, autonomous vehicle technologies;

Market attractiveness, which focuses on market-driven metrics, such as international airport connectivity, multimodal app maturity, and mobility sharing competitiveness and penetration; and

Infrastructure, which focuses on static metrics that don't change quickly or easily, such as the density of public transit stations, the walkability of a city, and the strength of a city's multimodal networks.

The top five cities share a healthy combination of heritage infrastructure from past investments, sustained investment, rapid technology adoption, an engaged private sector, and forward-looking policies that aim for managed growth. The highest-ranked cities performed well across all categories rather than excelling in one or two, but generally, leading cities performed best in system efficiency and innovation metrics. The average score across all 30 cities was 51, 19.8 percentage points below index leader Singapore's score and 24.2 points above the lowest score.

The index analyzes existing public and private mobility networks; current regulation, policy, and infrastructure; a city's livability, and capacity to incorporate future technologies and efforts to support them. The rankings and commentary are designed to help officials, businesses, and others interested in urban economic development to identify best practices and strategies for cities in need of mobility upgrades.

Overall Rankings Of Cities

Cities are ranked on a scale of 1 to 100, based on how well they meet five core criteria

System Efficiency Social Impact Innovation Market Attractiveness Infrastructure



Source: Oliver Wyman Forum analysis

The Impact Of New Mobility

Around the globe today, cities operate at vastly different stages of development when it comes to mobility. In Los Angeles, 89 percent of travel involves a car; in Hong Kong, only seven percent does. In Amsterdam, 60 percent of people get around by cycling or walking; in Mexico City, 70 percent take mass transit. With urban mobility, one-size-fits-all solutions will never work.

What should be the pivotal factors in determining a city's success? The Urban Mobility Readiness Index reveals that a willingness to innovate and the consistent support of mobility systems over time are key. The index strives to be predictive, comparing urban areas not only on their current operational efficiencies, networks, and services, but also on their capacity to encourage and absorb emerging technologies. The index evaluates the trajectory of a city, not a snapshot of how that city is doing. Cities score high not just because their subways run on time, but because they have established a pattern of policymaking and investing in mass transit that ensures incorporation of innovations over time.

Another differentiating element is this index's focus on cities' exposure to cutting-edge technologies and how actively cities support the establishment of startups,

encourage experimentation by nearby universities, and partner with both to create an urban laboratory for new tech. That requires a regulatory environment that nurtures innovation while still policing its effects on residents.

Transformational Trends

But it's not just cities under pressure. Mobility itself is being transformed by revolutionary technologies and solutions that are changing how people, goods and data are moved. The Urban Mobility Readiness Index is being developed at a pivotal time as city officials and mobility businesses grapple with developing strategies to incorporate emerging technologies and solutions.

Three broad technological trends will be primarily responsible for reshaping urban mobility in every city — digitization, automation, and electrification. The sharing economy, a fourth trend, has led to new business models in which the mobility service provided is more important than its ownership.

All four are already changing the mobility choices people have in the biggest urban areas. They also are compounding problems. For instance, as ride-hailing increases, so do

congestion and the concurrent pollution. The rising adoption of electric vehicles is forcing urban areas to find the funds to invest in charging stations and may eventually prompt new investment in power generation capacity to support the new demand.

Going Electric

The electrification of transportation holds the promise of moving the planet away from fossil fuels. Every form of transport — from cars, trucks and rail to ships and airplanes — is moving in that direction and will need new infrastructure to support them. That will include private and public charging stations and more renewable energy sources to provide sustainably the additional power required.

For cities, electrification offers the prospect of reduced greenhouse gas emissions and less air pollution, less noise with the elimination of internal combustion engines, and enhanced livability. A few of the cities on the list are making the switch to electric quickly, especially in China, where the government has actively supported the transition. Of the 425,000 electric buses operating worldwide, 421,000 are in Chinese cities and urban areas, partially explaining why Chinese cities score so high on the index.

Cities are also feeling the need to digitize their mobility networks. The push to digitize stems from the development of multiple revolutionary technologies like artificial intelligence, machine learning, big data, predictive analytics, and the Internet of Things. They are changing the face of mobility by enabling such capabilities as real-time traffic control, predictive maintenance of vehicles, and seamless trip planning. Future applications are nearly limitless.

All Things Digital

Automation is already responsible for robo-taxis and driverless buses and trains in some

cities. Eventually, it will turn everything into self-driving vehicles — from cars and trucks, to passenger rail, to air taxis, to cargo ships, to maybe even airliners. In the interim, this technology trend is providing autonomous functionality that improves safety, efficiency, and reliability.

Digitization is also bringing the same technology-enabled convenience, efficiency, and accessibility to mobility that it brought to banking and shopping. Many of the new technologies will aid efforts to create seamless, multimodal mobility networks through apps, digital platforms, centralized databases, and artificial intelligence. Cities have seen a proliferation of platforms and apps, including mass transit apps, taxi-hailing apps, car-pooling platforms, and apps that give directions and help drivers avoid traffic. These apps and platforms coordinate urban commuting, last-mile deliveries, booking and ticketing, and real-time updates on transit, traffic, weather, and shipments.

Ride-hailing and car-sharing services are early examples of the seamlessness that these technologies can bring to transportation and also foreshadow the rise of a sharing economy business model that stresses shared assets over individual ownership. Here, mobility is defined by the service provided rather than the vehicle providing it. Mobility-as-a-Service (MaaS) is enabling mobility on demand, and cities have already seen increases in ride-hailing services as well as scooter- and bicycle-sharing programs.

More Than Transport

Understanding a city's mobility involves analyzing mass transit, traffic flows, road conditions, and operations at airports, rail stations, and harbors. But any study of mobility must expand far beyond those obvious systems to include the efficiency of a city's telecommunications, the sophistication and breadth of its networks for moving

money, and the safety and reliability of all the above.

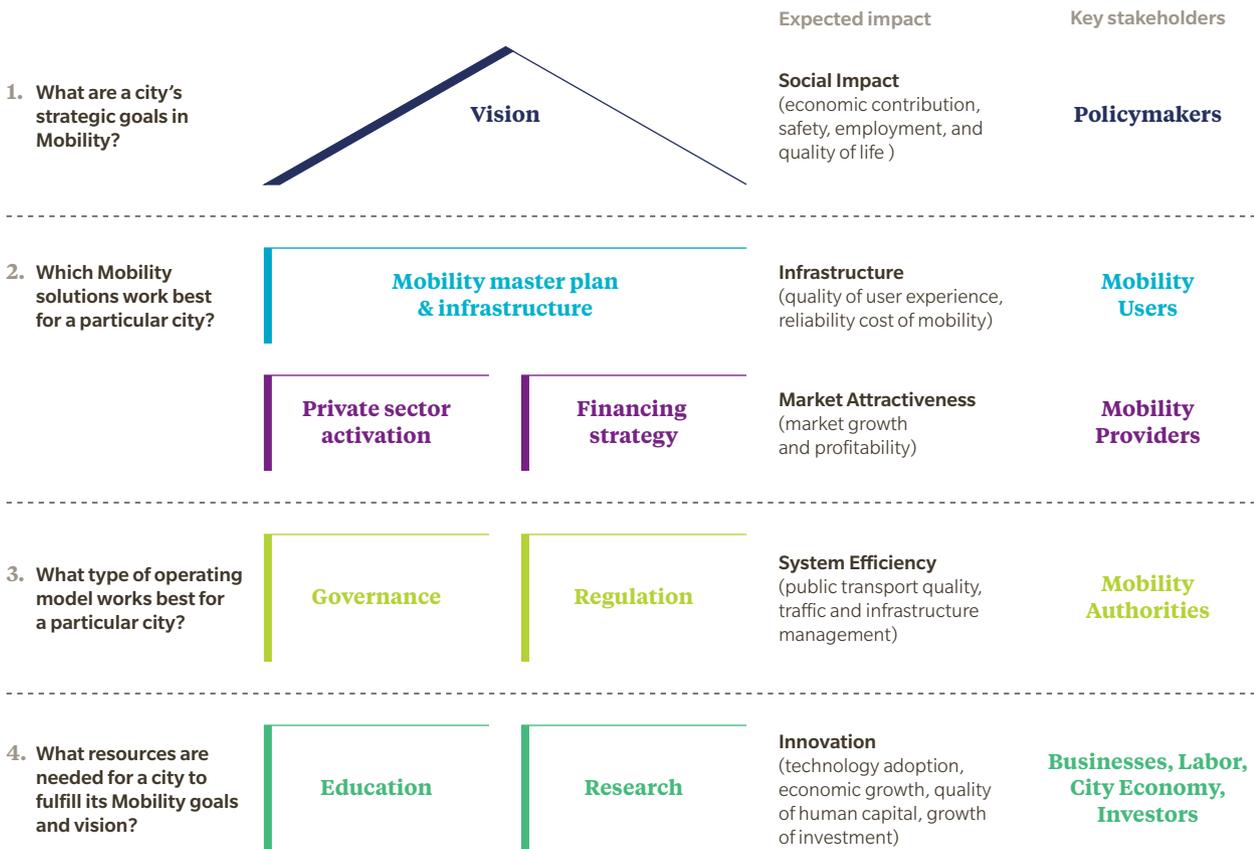
The cities destined to become tomorrow's mobility leaders will score high on the Urban Mobility Readiness Index based on how forward-thinking, user-centric, and data driven their approach is to mobility. In partnership with the private sector, they will focus on optimal transit solutions — not just legacy systems and not just new technologies. They will seek

frequent disruption in urban mobility and incorporate the latest ways of integrating mobility options.

When it comes to New Mobility, each city is unique — distinctive on the basis of such factors as climate, geospatial layouts, population densities, age of the municipality and its infrastructure, and governance. Urban leaders and planners must recognize what makes their city different and reflect those unique challenges in their mobility strategies.

The Future Mobility Ecosystem Playbook

Cities should address four strategic questions before building an ecosystem



Source: Oliver Wyman Forum analysis



Index

Methodology

For the inaugural 2019 edition of the *Urban Mobility Readiness Index*, the Oliver Wyman Forum selected a set of 30 global cities for in-depth analysis. These cities are geographically diverse, representing six regions — North America, Latin America, Europe, the Middle East, Asia-Pacific, and Africa. These cities — comprising sprawling metropolises like Beijing and more compact cities such as Helsinki and Amsterdam — were identified because of their distinct mobility challenges and the varied solutions they are pursuing. They tend to be leaders in understanding the importance of mobility, and they also represent economic epicenters for their regions, making their efforts to improve mobility vital to growth for the entire region. The initial batch also was chosen, to some extent, on the availability of data that would enable the Forum team to assess, compare, and track the evolution of their mobility capabilities over time in future versions of the index. The 2020 edition will include an additional 20 cities.

To build the index, we began by creating a vision of what cities should be striving for in mobility — the characteristics that businesses, consumers, and policymakers consider indispensable now and will still pursue a decade from now. The ultimate strategic goal of cities must be to build mobility ecosystems that reflect New Mobility technologies and priorities, such as seamless, electrification, and digitization. These ecosystems are made up

of real-time connected, multimodal networks that ultimately provide city residents and businesses door-to-door planning, reliability, and transparency when moving people or goods.

Based on internal discussions and conversations with leading professionals and experts in the mobility and transportation fields, the research team arrived at five key attributes of these New Mobility ecosystems:

Integrated. Mobility in the future will stress intermodal, one-stop service providers that provide seamless travel, commutes, and delivery experiences.

Accessible. Future mobility will focus on user-oriented approaches that are transparent, easy to use, affordable, convenient, efficient, and available to everyone.

Sustainable. Systems and solutions will not degrade the environment or health of city residents and can be supported economically by the local community.

Innovative. Cities should take advantage of the latest technologies, reinterpreting them to fit their needs.

Collaborative. Municipalities need to create coalitions with private-sector enterprises — both large legacy players and startups — so they can work together to shape the future.

It follows then that leading cities in the mobility revolution will likely expand their public transportation modes, availability, and linkages; embrace the sharing economy;

Ranking Criteria

The index uses five basic criteria to rank the cities — system efficiency, social impact, innovation, market attractiveness, and infrastructure. Below find the 35 components that fall under these five metrics — key performance indicators that identify which cities will excel in mobility

Expected impact	Type of metrics	Metrics
System Efficiency	Controllable Metrics Primarily influenced by market dynamics and the private sector	Transit Estimated Time Of Arrival Public Transport Operating Hours Public Transport Affordability ICT Preparedness Electric Charging Stations Availability Government Investment In Charging Stations Direct EV Incentivization Traffic Management Grade Noise Pollution Restraint Municipality Population Concentration
Social Impact	Volatile Metrics Often controversial for municipal governments to regulate	Road Safety Air Quality Transit Commute Speed Traffic Fluidity Public Transport Utilization Commuter Volume Car Ownership Moderation Vehicle Occupancy Rate Population Density International Airport Volumes
Innovation	Technology-Related Metrics Linked to emerging technologies	CAV Adoption Government Investment In CAV Technologies Autonomous Transit Vehicles In Use Concentration Of Human Capital & Innovation Electric Market Share In Sales
Market Attractiveness	Market-Driven Metrics Municipal governments have the greatest impact	Mobility Sharing Economy Competitiveness Mobility Sharing Economy Penetration Municipal Investment In Mobility Sharing Economy Multimodal App Maturity Fleet Management Activity International Airport Connectivity
Infrastructure	Static Assets Remain nearly consistent over time	Public Transport Station Density Walkability City Resilience Strength Of Multimodal Network

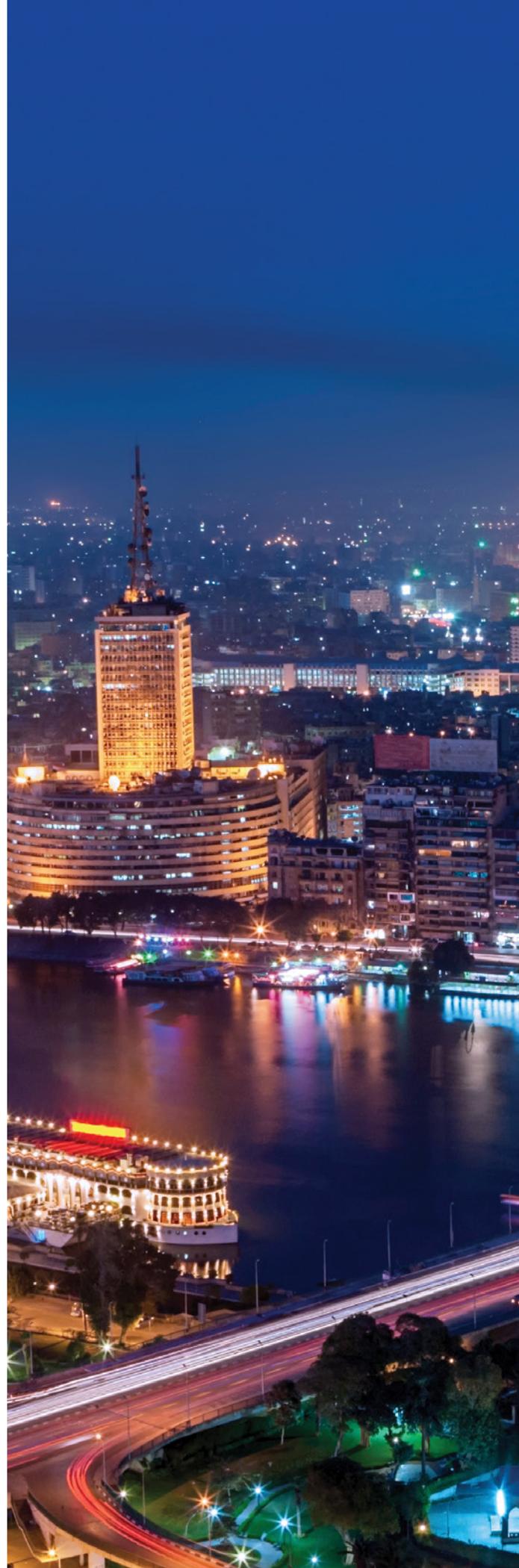
Source: Oliver Wyman Forum analysis

experiment with emerging technologies like autonomous vehicles (AVs); prioritize digitization and sustainability; and align municipal policies, regulations, and budgets accordingly.

Index Reliability

In the process of constructing the index, the key performance indicators that make up each category have been assigned a weight based on their relative importance to the ultimate task of building urban mobility ecosystems. The Forum index gives extra weight to factors that capture the ability of a city to become a future leader and ensure rankings reflect performance prospects rather than the competitive status quo.

Weights of the key performance indicators were determined based on discussions that our index team conducted with a wide range of experts including urban planners, traffic managers, transportation finance specialists, and mobility technology executives as well as data collected by Oliver Wyman and the Institute of Transportation Studies. As part of the construction and testing of the index, we conducted a principal component analysis on the data to determine alternate weights as well as a 10 million-sample statistical analysis of possible weight combinations. The extensive testing yielded results very similar to the weights chosen by our team, reinforcing our confidence in the index composition and metrics' weighting.



Efforts to improve mobility in these economic epicenters is vital for regions to grow



FIVE

Metrics to Rank Cities

The index breaks out rankings for each performance indicator as a way for cities to see areas where they need to focus moving forward to improve their standing. Quantitative data took priority wherever available. Yet, some indicators required qualitative judgments, for which the Oliver Wyman Forum enlisted the knowledge of leading experts in transportation and mobility-related industries. Qualitative judgments were then assigned a numerical value for the Index calculation. Any indicators with qualitative components are noted.



System Efficiency

Definition

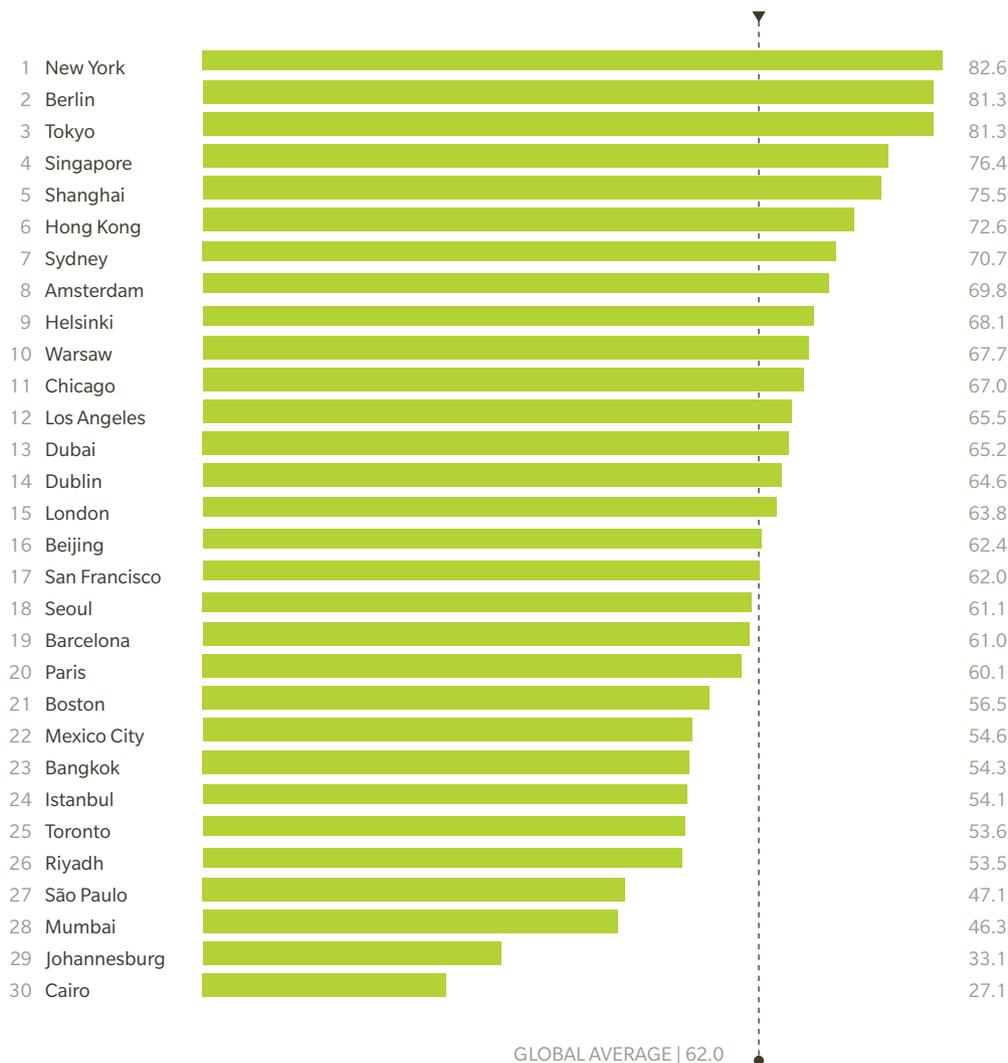
System efficiency metrics focus on controllable factors that are influenced by market dynamics and the public sector, such as public transport operating hours, public transport affordability, public transport reliability, and traffic management.

Example

New York ranked first because of its subway network, which boasts the most stations of any system worldwide and offers 24-hour service 365 days a year; its growing bicycle network and protected bicycle lanes; its dedicated Select Bus Service corridors; and its traffic management with connected vehicle technologies.

Ranking Results

Cities are ranked on a scale of 1 to 100



Source: Oliver Wyman Forum analysis

Social Impact

Definition

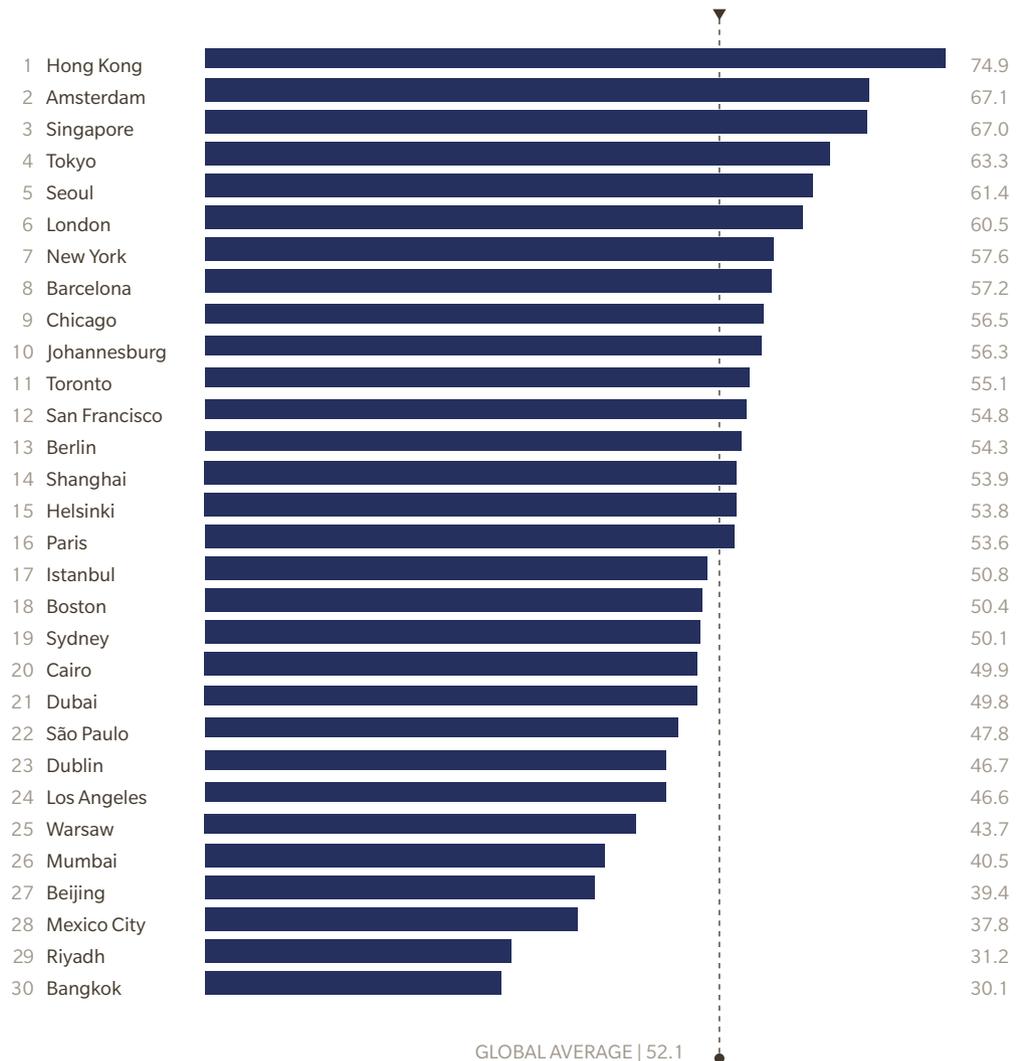
Social impact metrics are based on volatile variable measures that often prove controversial for municipal governments to regulate, such as commuting time, traffic fluidity, public transit utilization, commuter density, car ownership, vehicle occupancy, population density, road safety, air quality, and international airport volumes.

Example

Hong Kong excelled because of its high mass transit utilization, representing 88 percent of Hong Kong's transport; the city initiative that led to a 32 percent drop in traffic fatalities between 2007 and 2017; and city efforts that led to a 50 percent drop in roadside levels of nitrogen dioxide.

Ranking Results

Cities are ranked on a scale of 1 to 100



Source: Oliver Wyman Forum analysis

Innovation

Definition

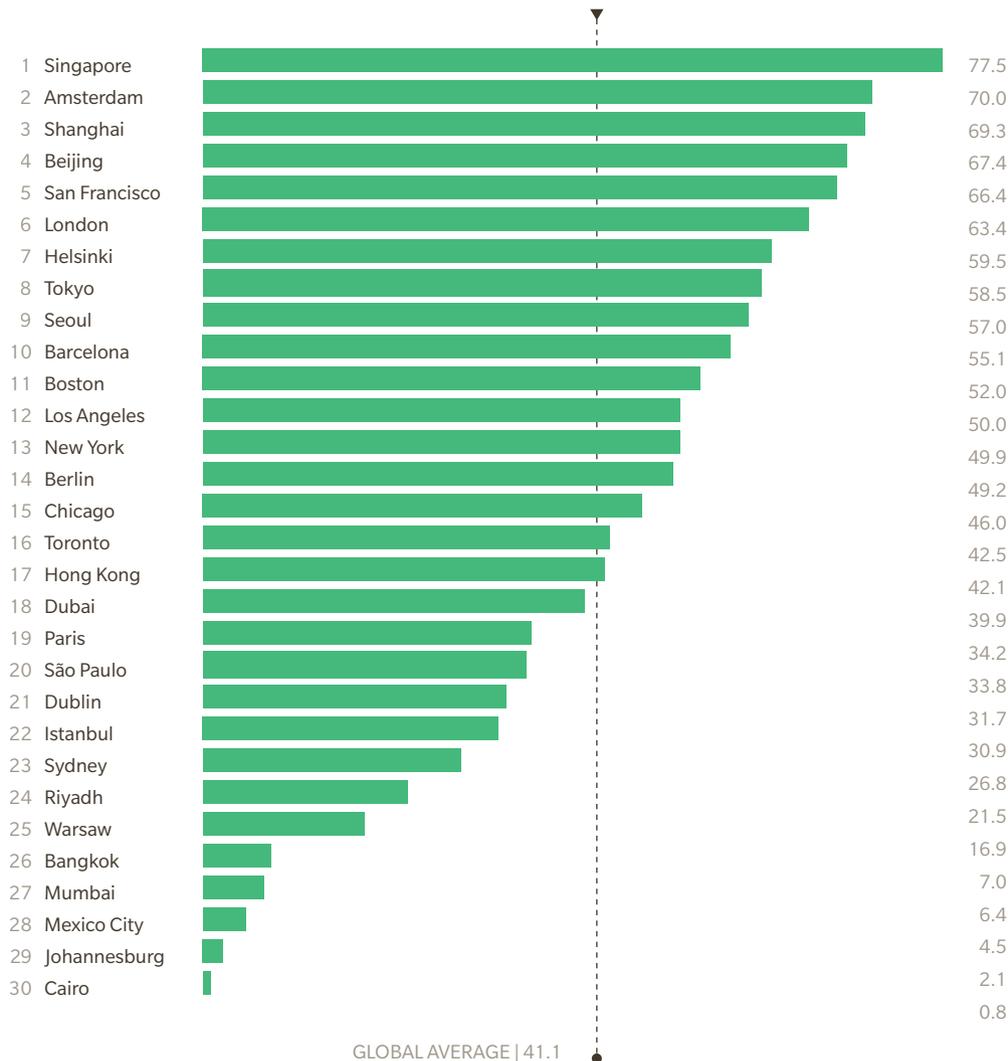
Innovation is a technology-related metric linked to emerging technologies, such as connected autonomous vehicles, electrification, and advanced connectivity. It considers the city government's investment and commitment to these technologies, and the city's abilities to attract and keep high-tech labor and startups.

Example

Singapore tops the list because of its development of world-class facilities for autonomous vehicle testing; facilitating collaboration among government, industry, and academia to research New Mobility technologies and business models; outstanding smart traffic management; and its nurturing environment for mobility startups.

Ranking Results

Cities are ranked on a scale of 1 to 100



Source: Oliver Wyman Forum analysis

Market Attractiveness

Definition

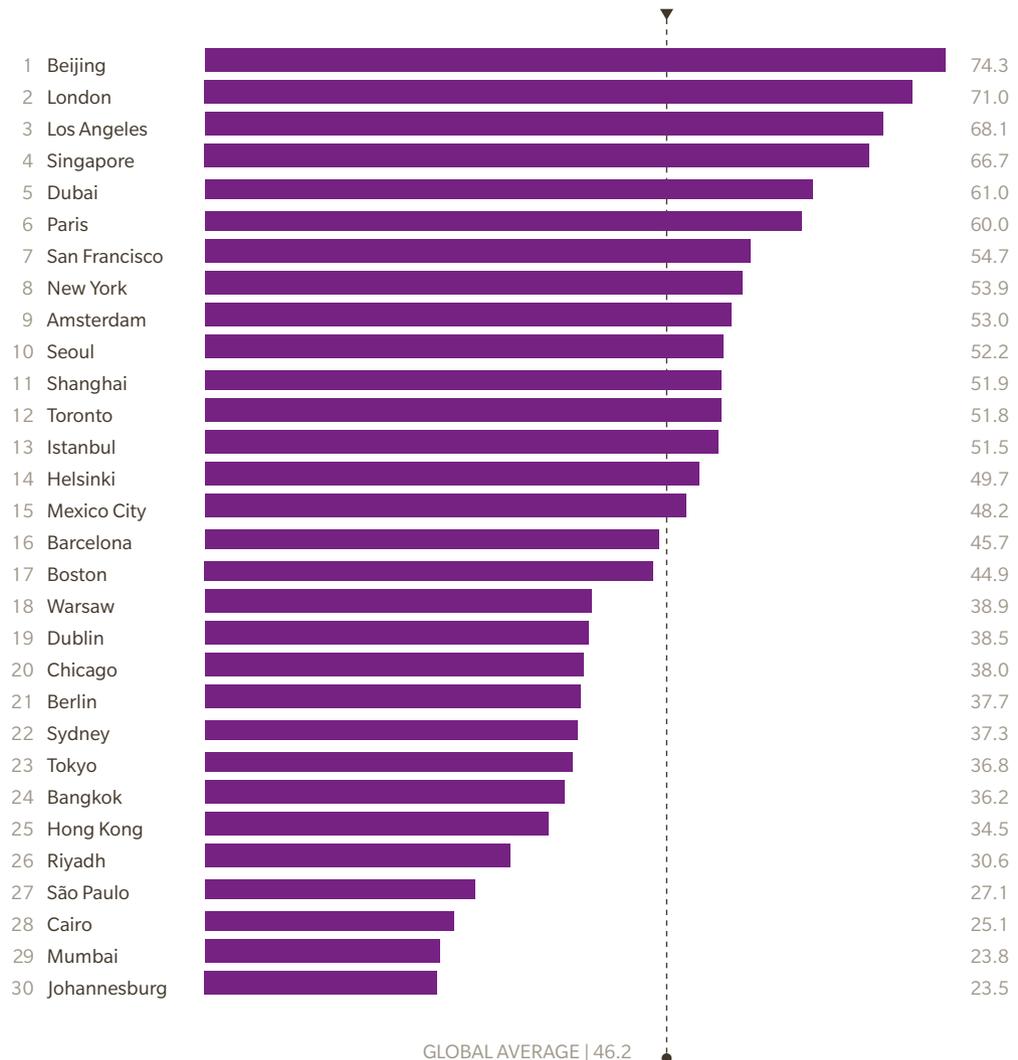
Market attractiveness is based on market-driven metrics over which municipal governments can exert influence, such as the competitiveness and penetration of sharing-economy business models in mobility, multimodal app maturity and availability, fleet management, internet connectivity, and the scope of international airport connections.

Example

Beijing ranks first because of sizable government investments in public transportation infrastructures; investment in innovation in new energy and connected vehicles; the city's significant measures to advance its logistics industry; efforts to expand ride-hailing and vehicle-sharing through well-funded startups; and the largest scheduled airline capacity and highest number of seats on flights worldwide at its airport.

Ranking Results

Cities are ranked on a scale of 1 to 100



Source: Oliver Wyman Forum analysis

Infrastructure

Definition

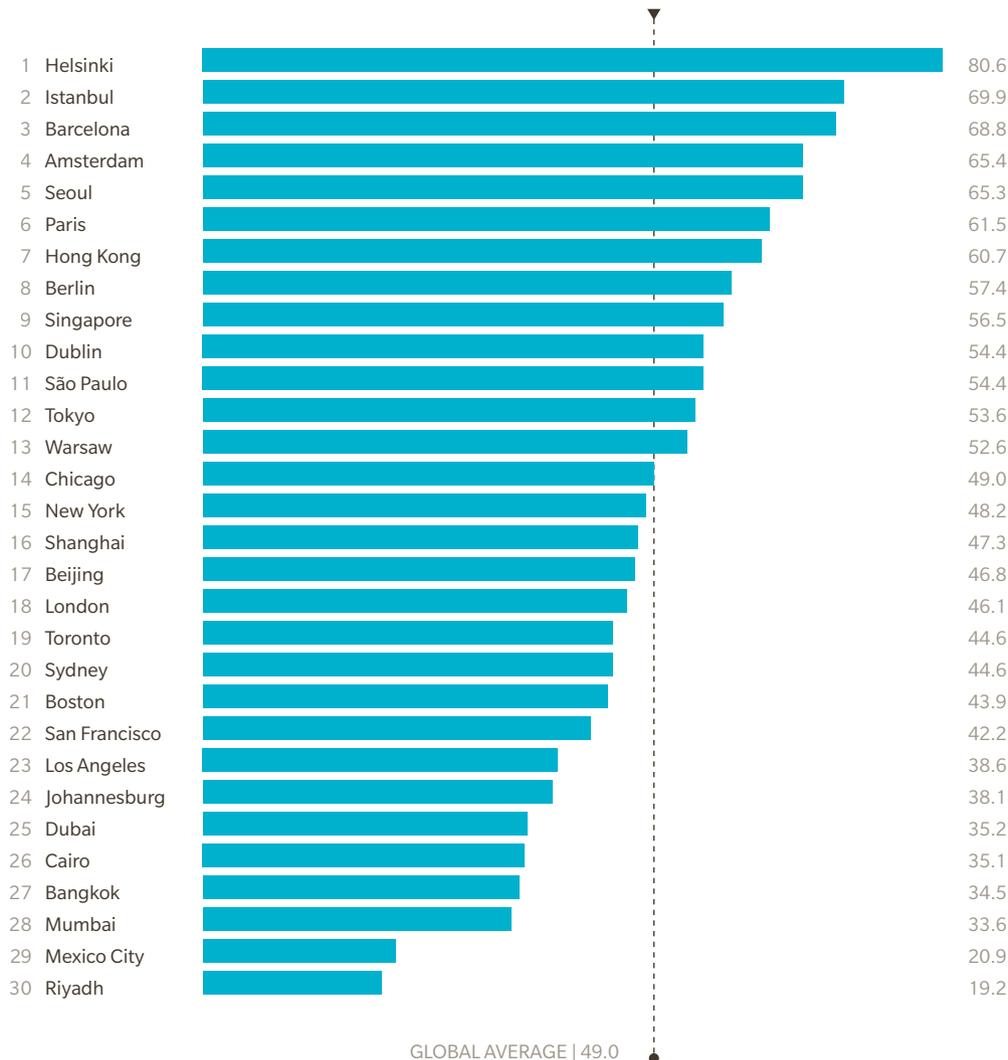
Infrastructure metrics focus on static measures that are likely to remain near constant over time or are at least difficult to change, such as the density of public transit stations, the walkability of a city, and the strength of a city's multimodal networks.

Example

Helsinki claimed the top spot because of its walkability, accounting for 21 percent of total modal share; the performance of its grid road system and public transport network, especially during rush hours; and Whim, a journey planner app that integrates all transportation modes in the city.

Ranking Results

Cities are ranked on a scale of 1 to 100



Source: Oliver Wyman Forum analysis

Leaders And Laggards

The index identifies the maturity levels of mobility efforts in various cities. Leading cities have invested consistently over the years in their infrastructure and adopted an aggressive approach in integrating cutting-edge technology with progressive transportation policies. These cities are the leaders in New Mobility advancements, such as integrated mobility platforms, innovative digital mobility services, and autonomous driving. They often embrace new technology quickly and reap the advantages of early technology adoption in mobility. In addition, these cities have developed the necessary local capacity to address future mobility challenges, increasing their readiness to succeed in the future.

Developing cities tend to take a less aggressive approach in disrupting the status quo and advancing urban mobility services. They often approach new technologies with caution and are less proactive when experimenting with new policies. As a result, they find themselves playing catch-up with the leaders. Compared with leading cities, the distribution of developing cities on the mobility curve is flatter.

Lagging cities tend to fall toward the bottom of all five metrics rankings, suffering from chronic infrastructure inefficiencies coupled with limited investment by the private and public sector in mobility. Their tendency to lack major universities and research centers results in limited innovation and advancement to support the development of local mobility

services. Governing bodies in these cities also often lack the political will to realize a brighter future for mobility, which can lead to substantial delays in mobility projects and limit direct investments in mobility solutions. The mobility ecosystems in these cities will not develop at a comparable pace with those in cities with money and resources and that score higher in rankings.

The Leader Of The Pack

Singapore, the index's number one city, scores well above average and even well above Amsterdam, the number two city — with a score 39 percent above the index average. Disparities that big between cities do not tend to develop the bottom half of the index. Singapore is first in innovation and in the top five for three out of the remaining four categories.

What makes Singapore so special? For one thing, Singapore has been a pioneer on the policy front, reducing congestion through road-use charges and even limited bans on automobiles. It has demonstrated a strong political will to push mobility beyond the status quo, a heavy reliance on technology, and close working alliances with academia and business. In fact, Singapore has become a tech hub rivaling Silicon Valley, with leading universities, proliferating startups, and an active National Research Foundation.

The city-state of Singapore is known for its Smart Nation initiatives, aimed at

improving life and its comparative advantage in business through technology. One of the six initiatives is focused on the transport sector. And the work has substantially helped Singapore advance its mobility aspirations, allowing it to essentially transform itself into a living laboratory for urban mobility solutions. Numerous urban mobility startups have set up shop there, and the city has supported extensive experimentation in autonomous vehicle technology and smart traffic management.

Levers To Moving Up

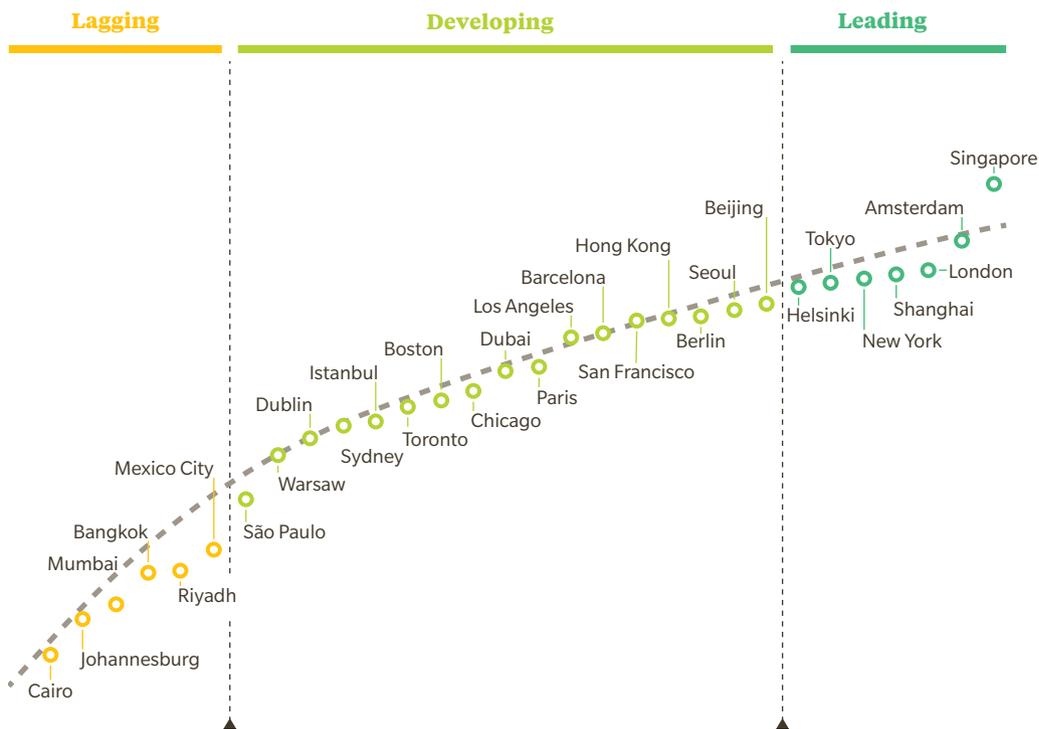
First and foremost, investment is key to progress, and overall capital availability may differentiate tomorrow’s mobility leaders.

This explains the strong showing of the more developed economies, but also suggests that cities like Riyadh and Dubai, where investment resources exist, may have the ability to improve their performance in the coming years if they spend their funds wisely.

What this also suggests is that mobility could exacerbate global economic inequality around the world. Cities with slow-growing economies tend not to have the money to invest in infrastructure or to attract the startups and businesses leading the mobility revolution, which could put those cities even further behind when competing for new business. We already see this inequity playing out in the current index rankings.

But there are aspects that have nothing to do with money. The political landscape of

Cities Ranked By Level Of Maturity



Source: Oliver Wyman Forum analysis

Cities must
recognize risks
when adopting the
latest innovations





a city can serve as either an accelerator or a barrier. Proactive governments tend to help cities make progress, which is certainly behind Singapore's success. In terms of index scoring, Shanghai (number four), Beijing (number eight), and Hong Kong (number 11) have also been beneficiaries of China's aggressive incentives to encourage electric car ownership and mobility research.

As cities become increasingly congested, they also must overcome social norms that stigmatize public transportation while elevating car ownership. Although technology is their friend, they also must better anticipate negative impacts from incorporating the latest innovations, such as business closures and loss of employment. Ride-hailing service, for instance, has experienced considerable backlash because of its relatively unregulated introduction in most cities.

The Future Of The Index

The Oliver Wyman Forum anticipates significant movement in rankings over the coming years as cities increasingly recognize the importance of mobility and as new technologies become more available. The index itself is also likely to evolve, including an effort in the coming year to enhance its predictive capabilities. It will also reflect the availability of new data sources, and the list of cities will expand substantially. Finally, the rapid pace of change in mobility and the potential for more new technologies will probably compel the addition of new indicators to reflect the latest developments in the field. Themes already on the radar for possible inclusion are three-dimensional travel, regulatory developments, and hydrogen-powered vehicles.

About the Authors

ALEXANDRE M. BAYEN holds the Liao-Cho Innovation Endowed Chair at the University of California, Berkeley in the Electrical Engineering and Computer Sciences department and is the director of the university's Institute of Transportation Studies. He conducts research in machine learning and control and optimization, with applications to transportation systems, water networks, and healthcare systems.

MATTHIEU DE CLERCQ, a Dubai-based partner with Oliver Wyman, is a senior strategy and economic development expert who provides insights and recommendations to governments, state-owned enterprises, and private sector companies. He has extensive experience in the Middle East, Africa, and Asia where he supports large-scale urban development and infrastructure projects and advises on sectorial development, investment strategies, future technologies, localization, and foreign direct investment.

GUILLAUME THIBAUT, a Paris-based partner with Oliver Wyman, is a transportation expert with a special focus on the analysis and deployment of disruptive digital business models in mobility and defense-related industries, as well as professional services. In recent years, he has spent considerable time advising on the development of the global drone market and urban air transport.

EMILIO ELASMAR, a Dubai-based Oliver Wyman engagement manager, contributed substantial research and analysis to the formulation of the Urban Mobility Readiness Index and this report.

About the Oliver Wyman Forum

The Oliver Wyman Forum is committed to bringing together business, public policy, and social enterprise leaders to help solve the world's toughest problems. The Oliver Wyman Forum strives to discover and develop innovative solutions by conducting research, convening leading thinkers, analyzing options, and inspiring action on three fronts: Reframing Industry, Business in Society, and Global Economic and Political Change. Together with our growing and diverse community of experts in business, public policy, social enterprises, and academia, we think we can make a difference. For more information, visit www.oliverwymanforum.com

For an analysis of the rankings for each city, please visit:
<https://owy.mn/2Qkl59d>



About Berkeley ITS

The Institute of Transportation Studies at the University of California, Berkeley was created in 1947 by the State of California to support research efforts related to future mobility. It is an organized research unit on campus, comprising seven research centers, a startup accelerator program, a technology transfer program, a library, and testing facilities for automated vehicles. It employs over 200 faculty, researchers and technical staff, focused around verticals of mobility, which include digitalization, automation, electrification, the shared economy, policy, planning, and finance.



