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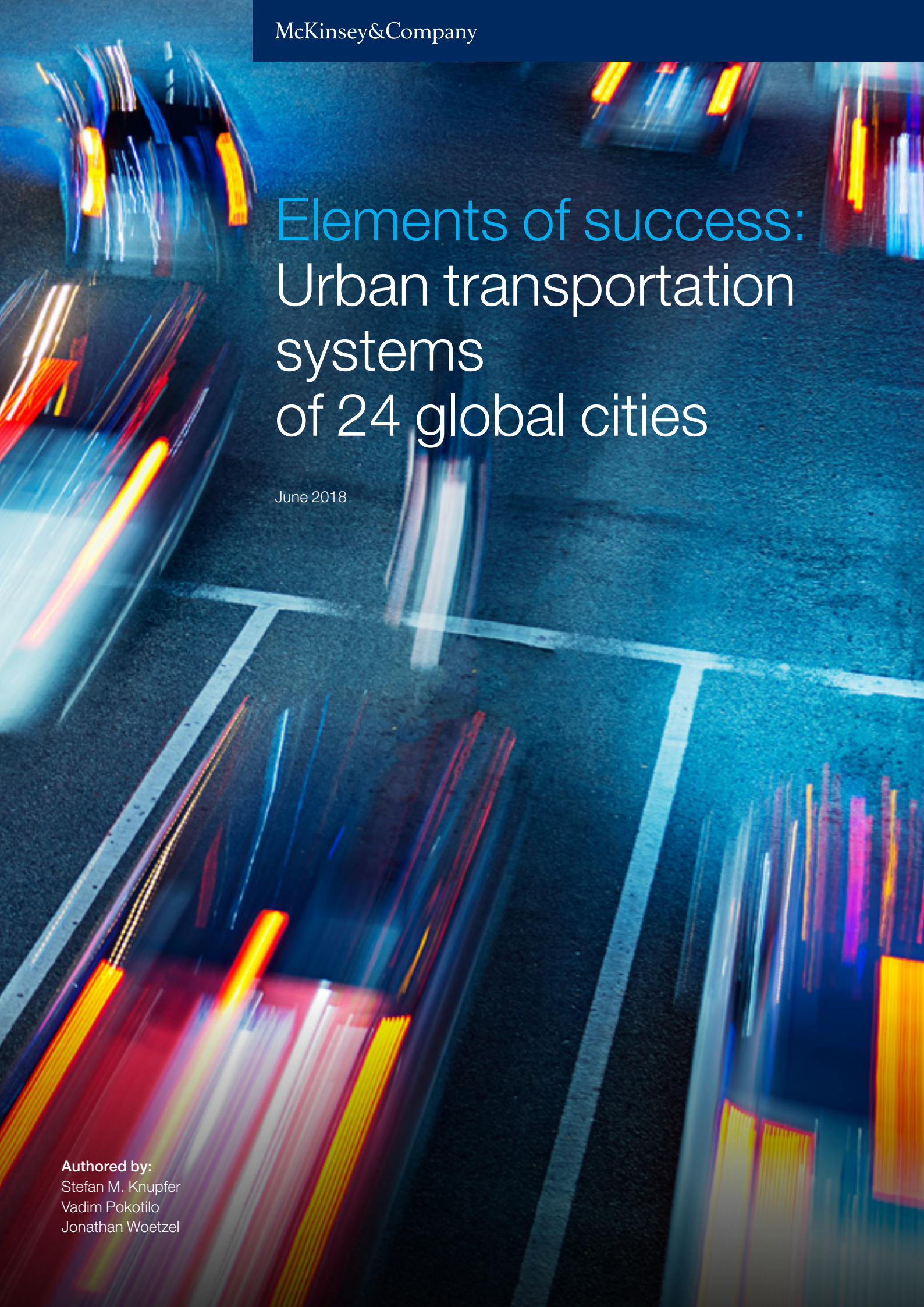

Elements of success: Urban transportation systems of 24 global cities

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Authored by:
Stefan M. Knupfer
Vadim Pokotilo
Jonathan Woetzel

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Foreword

Cities matter. They are the engine of the global economy and are already home to more than half the world's population. So many factors affect the experience of people living in them—housing, pollution, demographics… the list is long.

Mobility is just one such factor, but it's one of the more critical components of urban health. How a city's residents get to their places of employment, whether they get there safely, comfortably, and affordably, all figure into the overall economic wellbeing of a metropolis.

This report seeks to identify the most important aspects of mobility that make transit systems work, or not, and to compare them across 24 global cities as a means of helping leaders learn what they need to know to improve the health of their cities.

The methodology behind this research is unique in its approach, in that it analyzes 95 different indicators, surveys residents, and taps into the expertise of dozens of experts to present an authoritative picture of urban mobility.

We offer this report as a contribution to the context, insights, and solutions that cities need to forge a future that best serves their residents.

Stefan M. Knupfer, Senior Partner

Leader, McKinsey's Sustainability and Resource Productivity Practice

Vadim Pokotilo, Partner

Leader, McKinsey's Urban Transportation Service Line

Jonathan Woetzel, MGI Director and Senior Partner

Leader, McKinsey Cities Special Initiative

Preface

This report provides a comprehensive view of transportation systems in 24 major cities around the world and compares these cities on five metrics—availability of transportation, affordability, efficiency, convenience, and sustainability—that directly affect the lives of billions of people. This data is then synthesized to identify the world's top ten cities by how well they serve the mobility needs of their residents.

To accomplish this, the report relies on a combination of extensive quantitative analyses, the opinions of experts, and the perceptions of urban residents. The philosophy behind this approach is that the specifics of how city transportation systems function is important, as is the satisfaction their users have with them.

This information is broken down into four parts: a description of the methodology used to compare transportation systems; the benchmarking results; the details of the most important aspects of mobility; and profiles of the top ten performers. Further, the report details global trends in transportation systems.

The resulting report reflects a deep understanding of where the problems are, what is working, and what people are thinking. Our hope is that these insights can help city mayors, transport authorities, and carriers define priorities and improve their decision making.

Methodology of benchmarking

The lives and experiences of people are at the heart of urban life—and of this report, which assesses the transportation systems of 24 cities in terms of their impact on city residents.

To do so, we collected a comprehensive set of indicators that cover all modes of transport (personal, public, shared, bicycling, and walking) before, during, and after a journey. We used 80 indicators directly and another 15 to calculate and cross-check our results. We also surveyed 400 residents in each city to get a sense of how satisfied they were with the mobility options available to them.

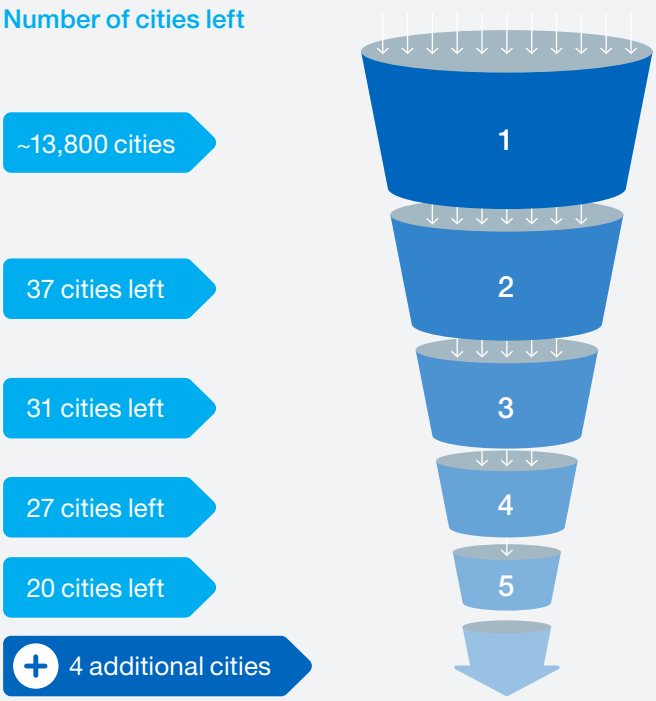
Then we went a step further. Our idea was to rank the cities on the metrics of availability, affordability, efficiency, convenience, and sustainability—and finally on overall quality. To do so, we asked more than 30 transportation experts—representatives from public- and private-sector transportation organizations from around the world, and advisers to these organizations—to weight our list of indicators and corresponding aspects according to importance and impact on quality of life.

Three groups of indicators we used for benchmarking

City selection

No two cities are alike, of course. But some are more similar than others. In order to create a reasonably comparable sample, we narrowed down the world's cities based on size, level of economic development, transportation system characteristics, and availability of data. On that basis, we selected 20 cities. We added four more—Berlin, Hong Kong, Shanghai, and Singapore—whose transportation systems are considered outstanding by external institutions.*

The city selection process: selected cities are located in 19 countries on five continents



Filters applied

Size of the city

- Population of urban agglomeration: At least 5 million people
- Significance: Among the top three cities in the country

Level of economic development

- At least $10,000 GRP per capita

Mobility specifics

- Motorization: More than 150 cars per thousand people

Data availability

- Quality of data: More than 50% of data is available from international sources**

Expert assessment

- Leading positions in at least two of the analyzed urban mobility rankings given a population of more than 3 million people

* Mobility rankings by external institutions included: TomTom Traffic Index; The Future of Urban Mobility 2.0 by Arthur D. Little and UITP; Sustainable Cities Mobility Index by Arcadis; and the Urban Mobility Index Report by Qualcomm and CEBR.

** Guarantees comparability of the indicators among cities.

The user experience and urban mobility

Our goal was to assess comprehensively how urban transportation systems affect the quality of urban life. We identified five factors—availability, affordability, efficiency, convenience, and sustainability—that shape the traveler's experience before, during, and after each trip.

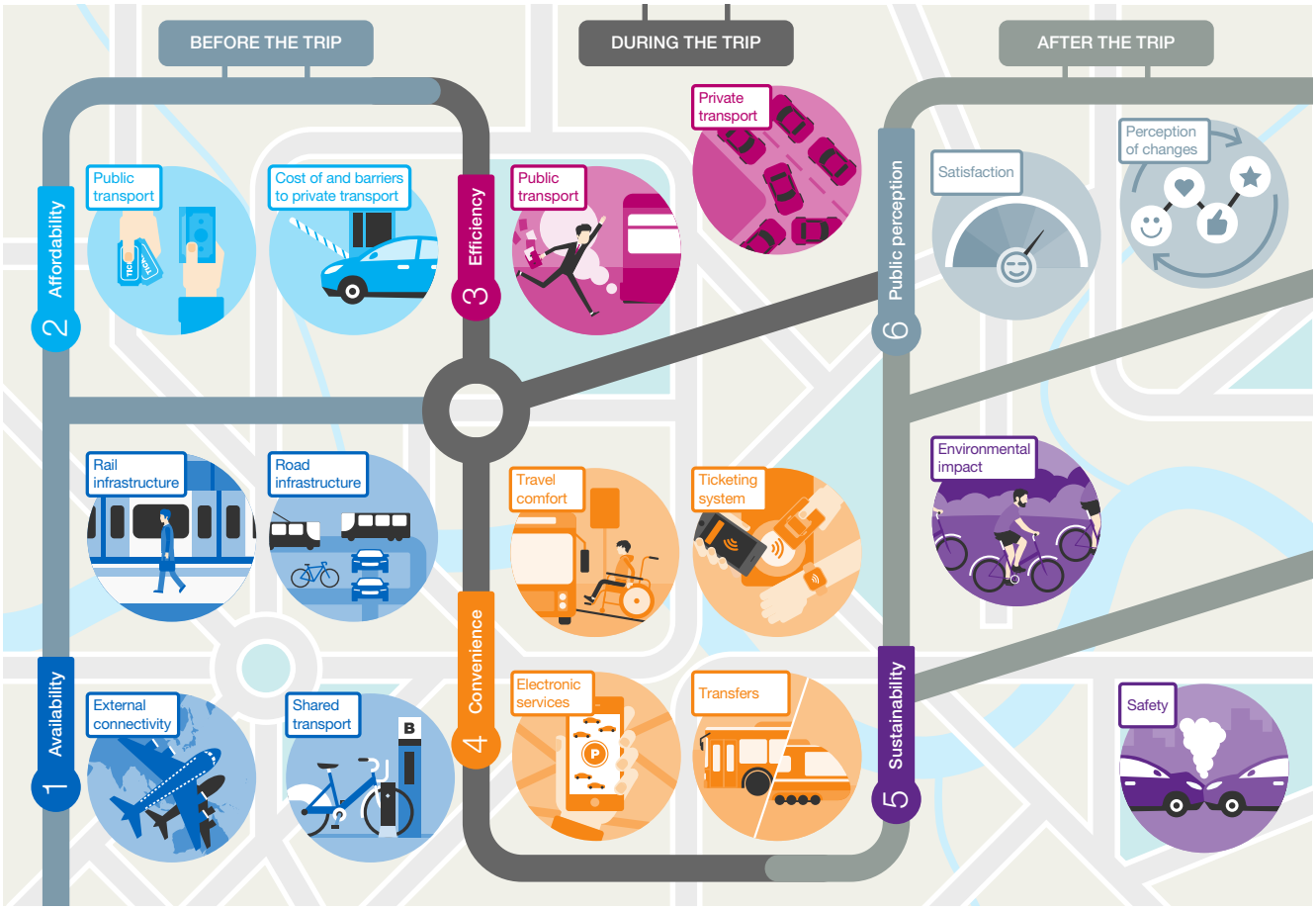
Before: How many travel options within and outside of the city are available? And how affordable is transportation for residents?

During: We assessed efficiency, defined as speed and predictability of commuting time, and convenience of different transportation system elements.

After: We analyzed sustainability of the transportation system in terms of safety and environmental impact.

These were the broad values considered; for each, we looked at specific contributing data. For example, in terms of convenience, we broke the subject down into overall travel comfort, ticketing system, electronic services, and ease of transfers from one mode to another.

Finally, for a better understanding of these factors, we asked residents to evaluate both their overall level of satisfaction, and their sense of whether the system they used was changing for the better.



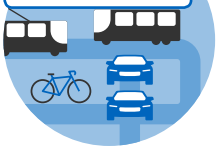
Indicators: Before the trip

1. Availability

Rail infrastructure

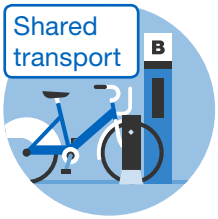
- Percentage of population living within one kilometer of a metro station/suburban rail station
- Percentage of jobs within one kilometer of a metro station/ suburban rail station

Road infrastructure



- Road infrastructure quality
- Pedestrian connectivity (length of route from Point A to Point B compared to straight distance, for the sample of routes in each city)
- Bicycle lanes as a percentage of the total length of the road network (excluding highways)

Shared transport



- Number of rental bicycles per million people
- Number of vehicles in car-sharing services per million people

External connectivity

- Number of destinations served by regular flights from city airports

2. Affordability

Public transport

- Cost of monthly public transport ticket, as percentage of average income
- Number of subsidized passenger categories
- Cost of a one-kilometer taxi ride, as percentage of average income

Cost of and barriers to private transport

- Cost of two hours of paid parking, as percentage of average income
- Taxes or license fees on purchase of a car
- Congestion charges for private vehicles
- Urban toll roads
- Restrictions on use of private vehicles

Indicators: During the trip

3. Efficiency

- Average effective speed during morning rush hour*
- Average above-ground transport waiting time
- Dedicated bus lanes, as percentage of the road network (excluding highways)

- Congestion: rush hour travel time compared to free flow travel time
- Average speed during morning rush hour
- Commuting time predictability index

4. Convenience

- Average age of buses and metro carriages
- Bus and metro operating hours per week
- Percentage of buses and metro stations that are wheelchair-accessible

- Availability of travel chip card for several types of public transport
- Possibility of remote top-up
- Availability of mobile ticketing
- Possibility to buy ticket/chip card using a bank card
- Possibility to use contactless cards and mobile applications directly at pay gates
- Possibility to pay for non-transport services using chip card

- Penetration of the most popular official transport app, percent
- Average rating of official transport apps
- Wi-Fi availability in metro carriages, at metro stations, in buses, and at bus stops
- Availability of real-time online information about public transport
- Online information about parking; ability to pay for parking online

- Average distance, in meters, from metro station to the three nearest bus stops
- Average transfer time between public transport modes
- Availability of citywide wayfinding system

* Effective speed is defined as straight distance/commuting time (taking into account the real length of the route can differ depending on the network).

Indicators: After the trip

5. Sustainability

- Number of road casualties, per million people
- Number of public transport casualties, per million people
- Safety enforcement index

- Diesel and gasoline fuel standards
- Average age of vehicles on the road
- Electric vehicles, as percentage of car sales
- Weekly hours worked by private vehicles, per square kilometer of city area

6. Public perception

- Percentage of respondents who are satisfied with specific aspects of their current service

- Percentage of respondents who are satisfied with recent changes (past three to five years)

Geospatial analytics

To conduct a robust analysis and ensure a level of independence from external resources, we developed a unified, objective methodology based on geospatial data. We performed an independent modeling and calculation of important indicators for "availability" and "efficiency" rankings. This helped us to improve our data collection, and also to get a better feel for each of the 24 cities. Moreover, it gives us a credible baseline for future updates and analysis.

To start, we defined city areas using unified methodology to make results comparable. Official city borders don't always describe real-world situations accurately. In some cases, they are smaller than the actual physical city (for example, Paris), while in others the borders are larger than the urban area (for example, Istanbul). Thus, we divided the analyzed cities into three groups:

- Locations where the official city limits describe real population distribution comparatively well (Beijing, Berlin, Buenos Aires, Chicago, Johannesburg, London, New York, Seoul, Singapore, Toronto). For this group we use official city limits.
- Locations where the official city limits are larger than the core concentration of residents (Bangkok, Hong Kong, Istanbul, Madrid, Mexico City, Moscow, São Paulo, Shanghai, St. Petersburg, Sydney). For this group we started with official boundaries, but removed districts with low population density that we do not consider to be part of the city.
- Locations where the official city limits are smaller than the core concentration of residents (Los Angeles, Milan, Paris). For this group we used administrative boundaries of metropolitan areas, covering cities and their nearest suburbs.*

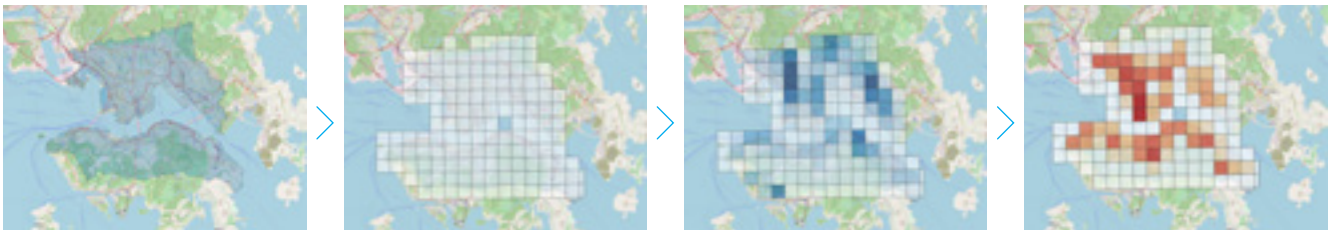
The only exception is Tokyo, where we used a smaller delineation than official boundaries, to distinguish the city from the urban agglomeration.

Then we divided the city maps into one-kilometer squares. For each square, we determined the population density, based on NASA data and municipal population statistics. Distribution of jobs was defined based on the cartographic information regarding offices, organizations, shopping centers, and other data points. The result was a matrix for each city that showed its distribution of work and residential areas (Exhibit E1).

28K km²

Urban areas were scanned and analyzed in detail

Exhibit E1. Density of population and jobs at the city map



1. City boundaries
Identifying limits of urban area

2. The matrix
Dividing the city area into 1 km² squares

3. Population density
Assigning the share of population to each square

4. Jobs density
Assigning the share of work places to each square

* Here and throughout the report all references to Los Angeles, Milan and Paris are to Los Angeles—Long Beach—Santa Ana Urbanized Area, Province of Milan, and Metropolis of Greater Paris respectively.

Efficiency

We calculated efficiency by looking at morning rush-hour traffic. Locations and home-to-work routes were derived from the matrix. Then we built a graph showing the 1,000 routes with the highest traffic streams, and created an origin-destination (OD) matrix proxy for each city (Exhibit E2).

For each of these 1,000 routes we calculated the key transit metrics—distance, average trip duration, and speed of the ride in the morning rush hour. We then defined average values for each city. After weighting the metrics with the route's probability, we calculated final indicators that reflected the efficiency of the transportation network: road congestion and average effective speed on public transport.

Furthermore, we calculated a unique indicator that represents predictability of commuting time by car. That is important to residents because they want to be able to plan their commute time accurately. To compute predictability, we calculated commuting time for several weeks for each city and defined the standard deviation to average commuting time.

Exhibit E2. Process of identifying the major flows of private and public transport in rush hours

1. Graph modeling

1,000 most popular routes in the city (darker roads have more traffic)

2. Heatmap of non-public transport routes

1,000 most popular routes imposed on the road infrastructure (darker roads represent greater traffic flows)

3. Heatmap of public transport routes

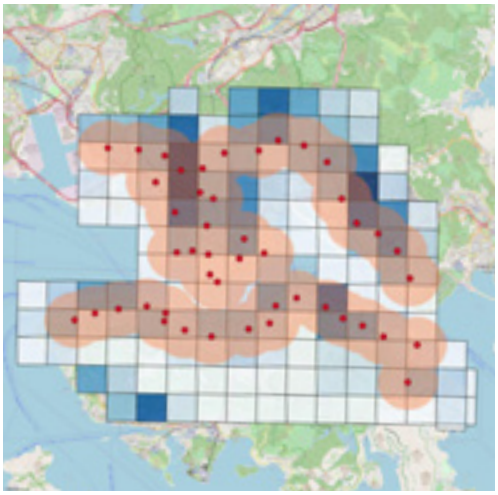
1,000 most popular routes imposed on the public transport infrastructure (darker roads represent greater transit flows)

Availability

For each city, we considered two additional indicators to be defined with geospatial analysis.

First, we looked at public-transit availability. Using the job-population distribution matrix, we were able to calculate what percentage of office and residential properties were located within walking distance of metro and suburban rail stations. Exhibit E3 shows two urban areas, with 75 percent and 36 percent of the population living within one kilometer of metro stations.

Exhibit E3



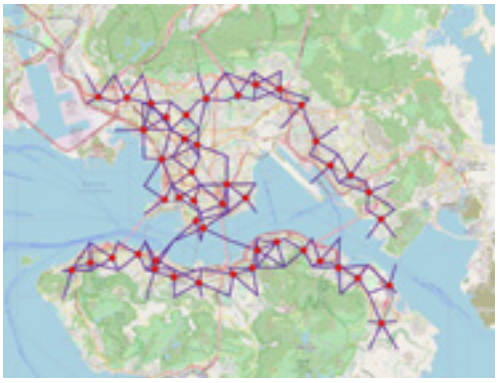
75% population coverage

36% population coverage

Finally, we created a graph of walking routes for each city. That enabled us to calculate the resulting coefficient of pedestrian infrastructure connectivity—that is, the additional distance required to get between two points compared to the straight line. Exhibit E4 shows two routes, with coefficients of 160 percent and 30 percent; the lower the coefficient, the better.

Exhibit E4

Pedestrian graph modeling



Calculation of routes

Examples

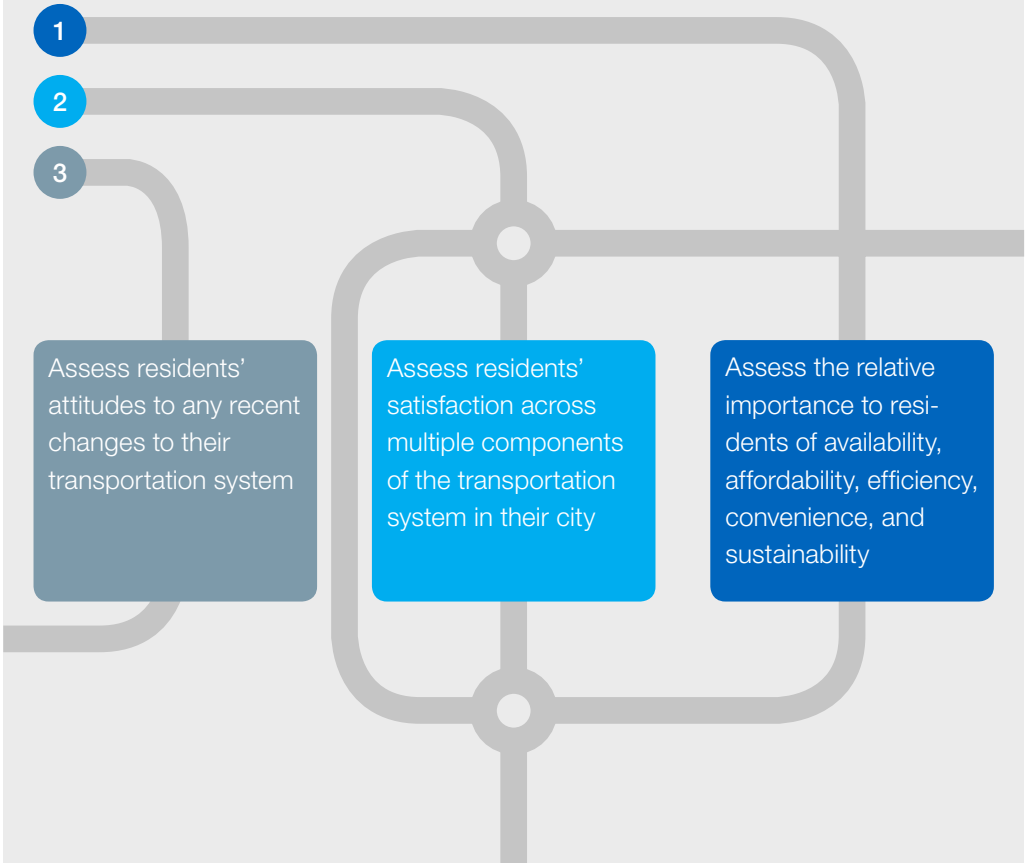
160%
overrun

30%
overrun

Survey of city residents

In addition to this quantitative information, we wanted to develop qualitative insights as well. We therefore surveyed residents in all 24 cities, asking them about how satisfied they were with their transportation system right now, and with the changes they have seen in the past three to five years.

Our survey had three key objectives



10K
respondents

1M
responses

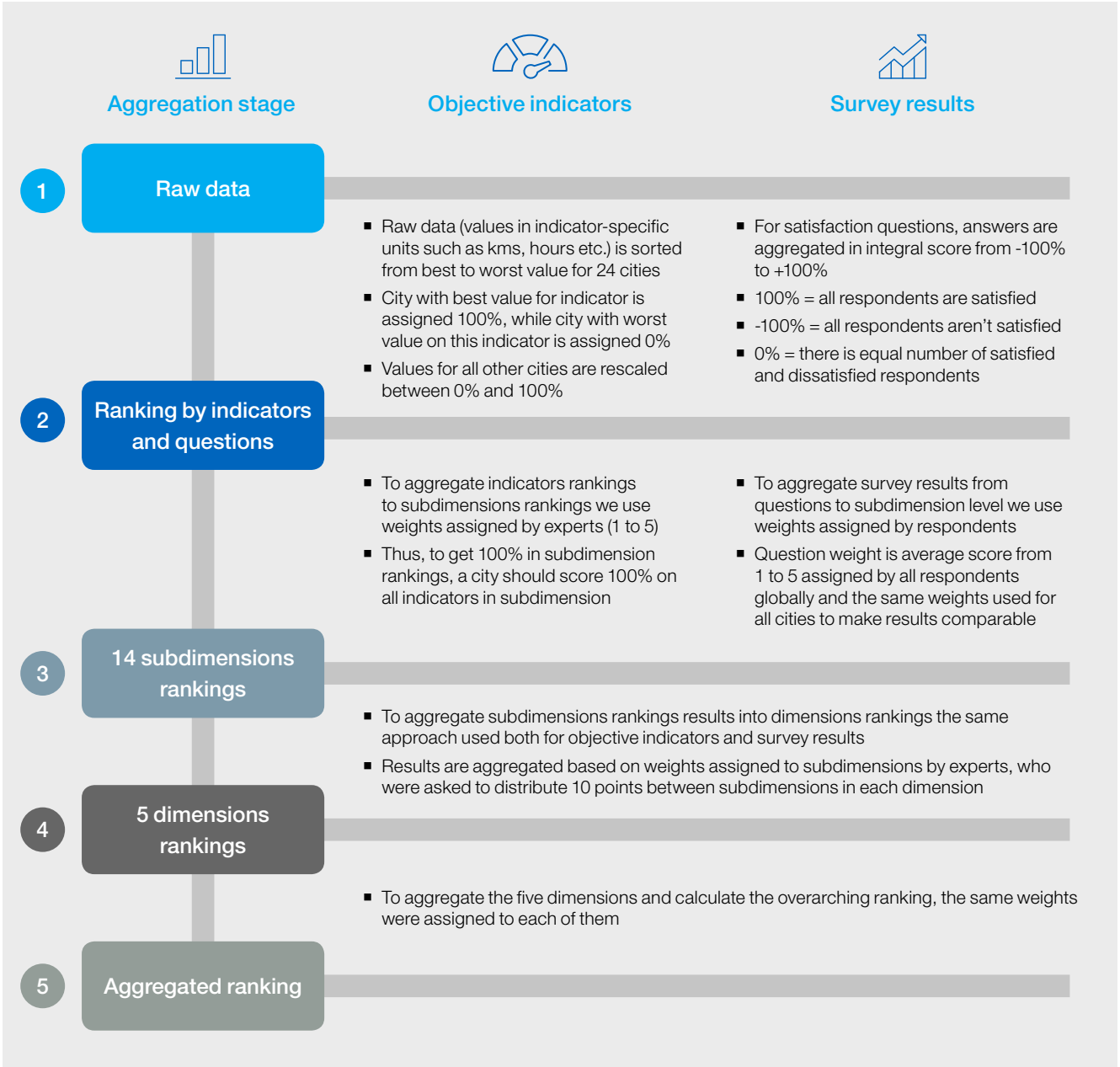
The survey was done online, and conducted by a single contractor following the same methodology; 400 people in each of the 24 cities participated. To design the sample, we matched respondents to the age-gender ratio of residents of each city.

Rankings calculation

It's hard to compare cities on more than 50 indicators at once—that's why we aggregated them into meaningful groups described previously (availability, affordability, efficiency, convenience, and sustainability).

Aggregation is performed in three stages. First, raw data (indicators, values and survey results) are translated to unified comparable values. During the second stage several indicators or questions are aggregated into subdimensions based on weights from the experts and resident surveys. Finally the rankings by objective indicators and by respondents' satisfaction were aggregated into five dimensions based on weights assigned by experts.

We devised this system with the goal of obtaining the most independent and objective information possible. To that end, for the residents survey we assigned weights derived as average scores given by approximately 9,600 respondents from 24 cities around the world. For the experts survey, we asked more than 30 internal and external urban transportation experts to estimate the importance of different indicators and subdimensions.

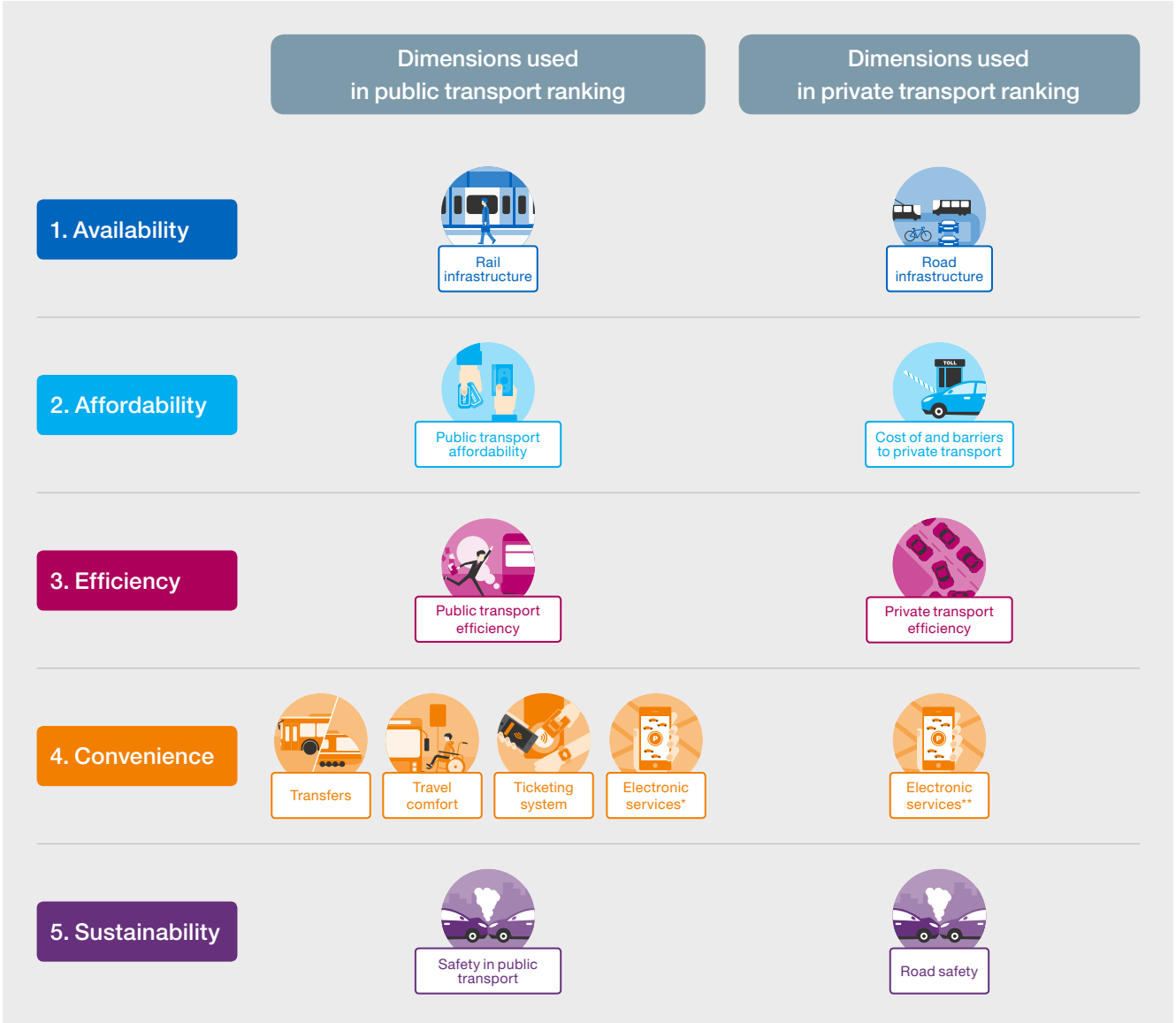


Approach to rankings by transport mode

Given that many regulators and the general population still think about transport systems mainly through the lenses of public and private transport, we've also developed separate public and private transport rankings in addition to the comprehensive overall one. These rankings combine different subdimensions and indicators from the overall ranking based on natural attribution, to give a clearer sense of how transportation system look like from passengers' and drivers' points of view.

Both rankings by transport mode consist of relevant subdimensions: availability, affordability, efficiency, convenience, and safety, where the convenience subdimension for private transport consists of relevant electronic services such as parking and fines payment online. Similar to the main ranking, the five subdimensions in each ranking by transport mode are weighted equally, while indicators within subdimensions have weights assigned based on the experts survey.

Residents' perceptions were assessed based on questions related to private and public transport, with weights assigned based on the experts survey.



* Electronic services related to public transport (e.g., Wi-Fi availability in metro carriages, at metro stations, in buses, and at bus stops).

** Electronic services related to private transport (e.g., online information about parking; ability to pay for parking online).

Core findings and observations

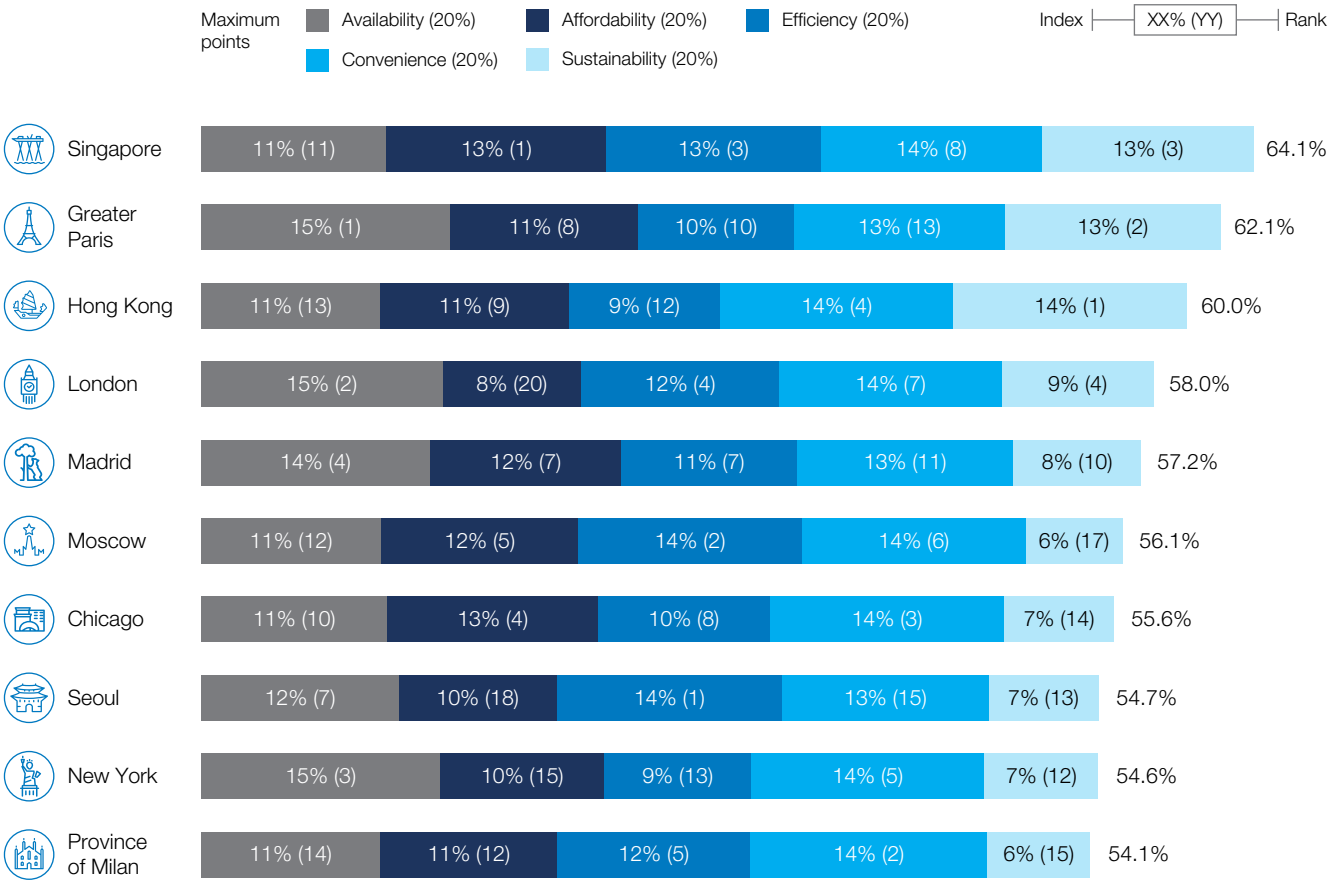
Ranking by objective indicators

Since we believe that all five of the dimensions we analyzed are equally crucial for shaping the passenger experience, the same weights were assigned to each of them in overall ranking.

Interestingly, there is no absolute winner that scored maximum points or took first place in all dimensions. Each of the leaders has its own strengths and weaknesses, and the most balanced cities with several distinctive achievements rose to the top.

Even the leading cities in terms of cumulative results score no more than 65 percent from a 100 percent maximum, which implies that every city has its own areas for improvement. If we were to derive the formula for an ideal transport system, it would be as available as in Paris, as affordable as in Singapore (where public transport is very affordable despite high barriers for car usage), as efficient as in Seoul, as convenient as in Toronto, and as safe and sustainable as in Hong Kong.

Top ten cities: Overarching urban mobility ranking



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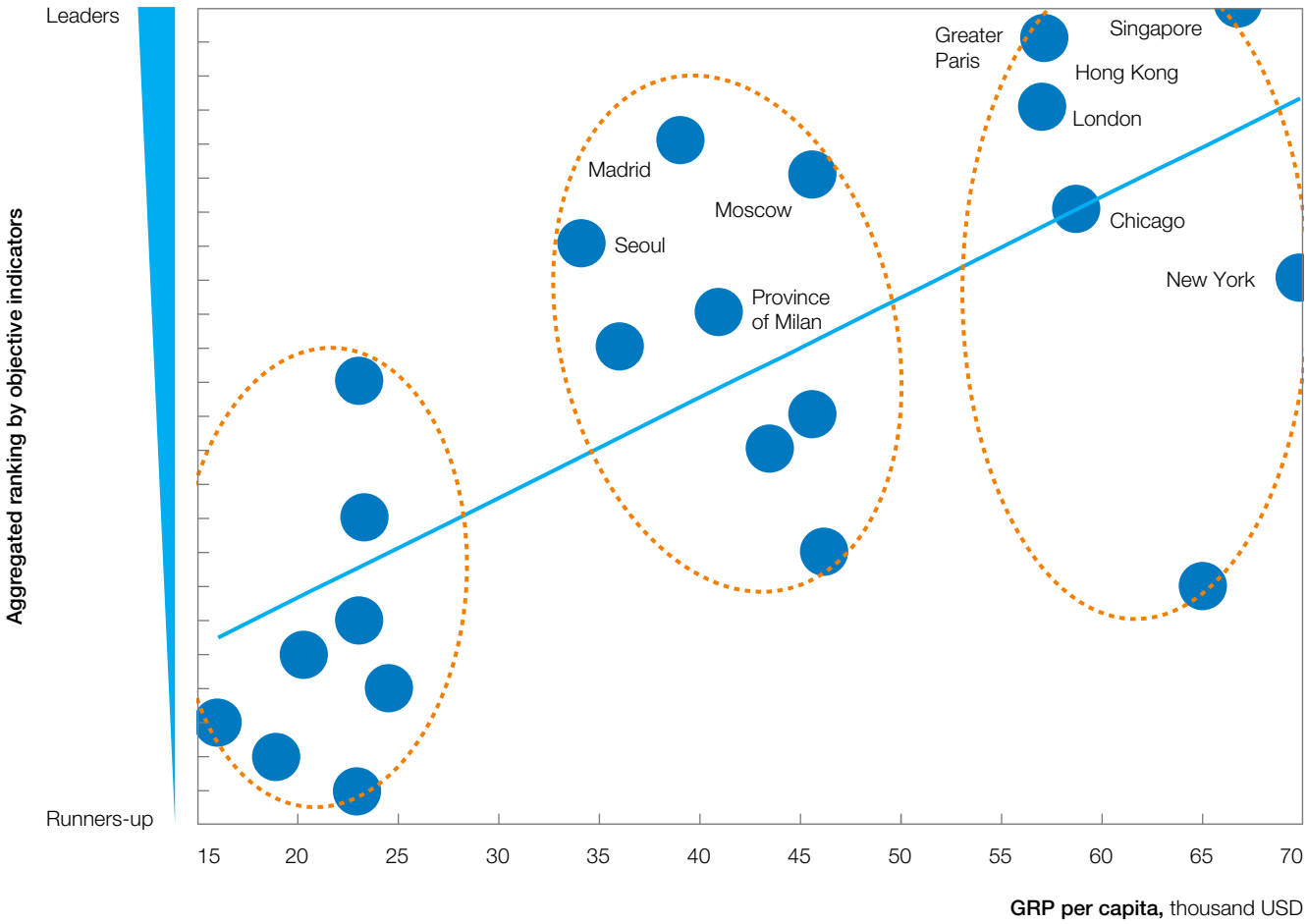
The relationship between transport systems' development and cities' welfare

Creation of best-in-class transport systems requires significant investments: development and maintenance of roads and rail infrastructure, renewal of the public transport fleet, investments in intelligent transportation systems (ITS), and digitization, to name a few. Does this mean that only rich cities can provide a great transport experience for their residents? To some extent yes, but not necessarily.

We plotted results of our ranking versus GRP per capita measured at purchasing power parity. As expected there is a clear trend: in general, richer cities have more opportunity to build impressive transport systems, thanks to their vast resources. However, there is a more compelling insight: wealth neither definitively limits development of transport systems, nor guarantees its success. In all three groups of cities with comparative levels of wealth the same pattern exists: though cities have similar resources, results are quite different—the delta in rankings in the group of cities with relatively similar wealth levels can reach as many as ten positions.

Though a city's wealth and history define the options for transport system development, its authorities' focus on and commitment to development and implementation of a clear transport strategy can significantly influence the outcome.

Ranking results versus cities' welfare



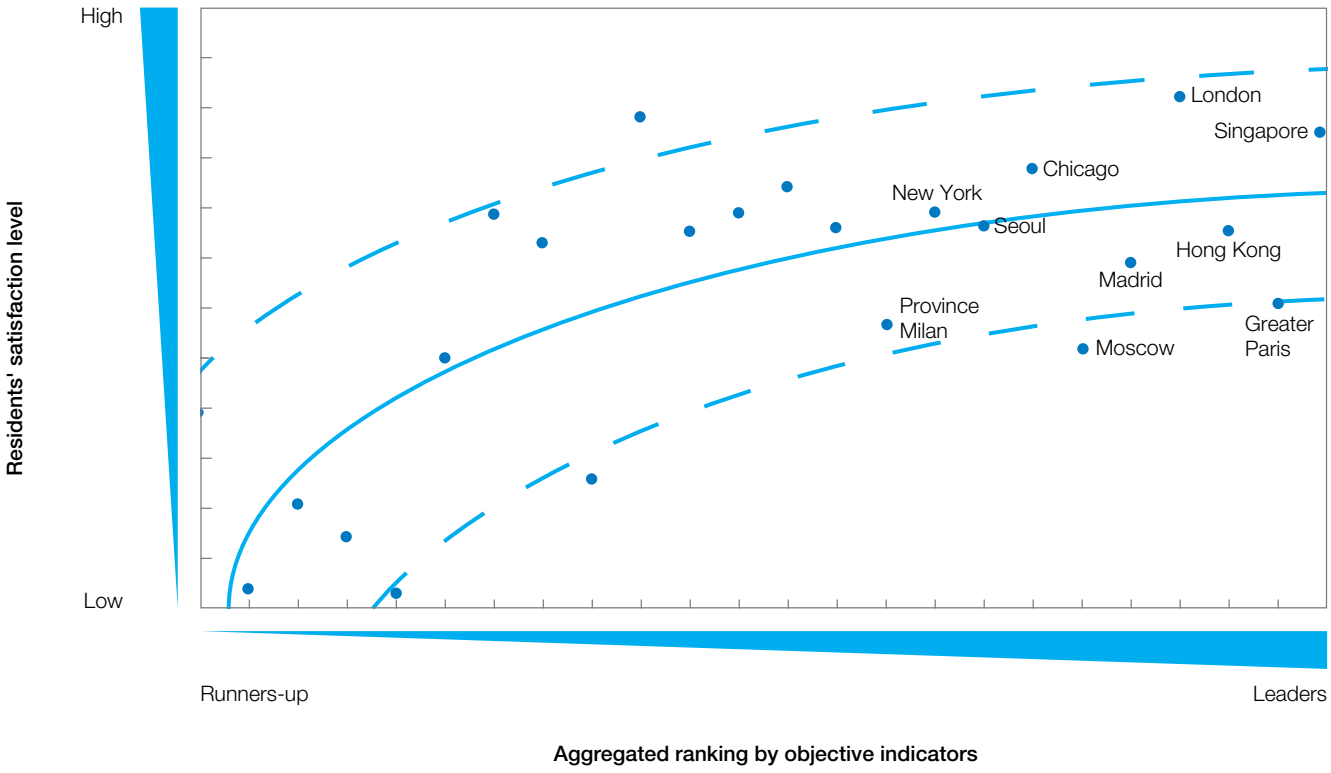
The relationship between residents' perceptions and reality

Residents' opinions are often a powerful influence on city authorities. Transportation is frequently an emotional issue for residents. When there are problems, they cite it as being among their biggest pain points, and when improvements are made or proposed, residents can become strong proponents who really appreciate the changes.

Overall, residents' perceptions reflect the factual development of transport systems comparatively well—in general, city authorities can expect higher satisfaction in response to positive changes. However, the trend is not linear. In cities with a lower initial base (the bottom third of cities, by objective indicators) one could expect significant long-term growth of satisfaction in response to positive developments. However, when transport systems reach a minimum of development, satisfaction growth slows down as it becomes more difficult to impress people.

Another observation is that residents don't always assess transportation fairly—in some cities perceptions are notably lower or higher than expected, as measured by objective indicators. While there are a handful of possible explanations, we believe that active and comprehensive yet targeted communication could improve residents' perceptions and eliminate gaps versus objective assessments. To ensure residents' satisfaction is based on fair perceptions, cities need data-driven communication-funnel management that includes awareness, evaluation, consideration, trial, and loyalty tailored to specific resident segments and respective communication channels. Proper communication and tailored promotion of the changes, including active residents' involvement, improves both the perception of change and satisfaction levels in general.

Public perception vs. reality



General patterns in residents' perceptions

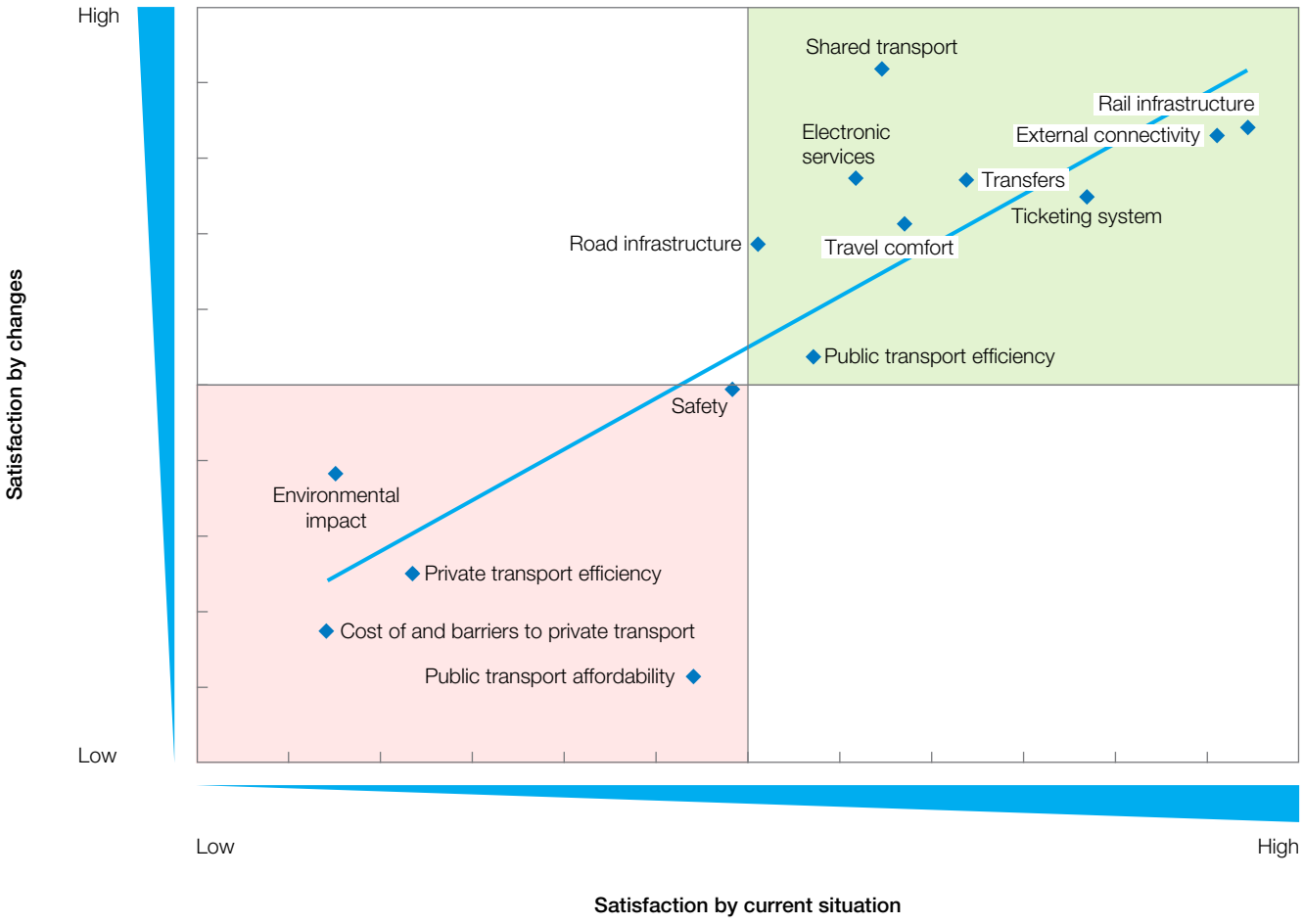
It appears that though there are local differences, universal global patterns exist: residents view some aspects more favorably than others in most of the cities worldwide. What's even more important is that there is strong correlation between their perception of the current situation and their perception of changes over recent years.

Residents are usually optimistic about issues that developed quickly in recent years, for various reasons. For example, many cities surveyed continue to develop rail infrastructure, and enhance travel comfort and intermodality as part of their transport strategies. Other positive changes such as in electronic services, ticketing systems, and shared transportation are driven by rapid technology development.

Then, there are three topics where residents are neutral on average: road infrastructure, public transport efficiency, and safety. The reason for this is that on these topics there is a wide difference between opinions of residents in different cities.

Finally, key pain points are symptomatic for large cities: private transport efficiency (too many cars on a limited number of roads), both private and public transport affordability (limitations on car ownership to ease congestion, and ticket price increases to invest in availability and convenience) and ecological sustainability (traditionally painful for large cities).

Average satisfaction by current situation and by changes among 24 cities



What aspects are the most important in urban transport systems?

Top five most important things for residents

1. Road safety
2. Safety in public transport

Safety

3. Road congestion level

Private transport efficiency

4. Predictability of the travel time on public transport

Public transport efficiency

5. Air pollution and traffic noise

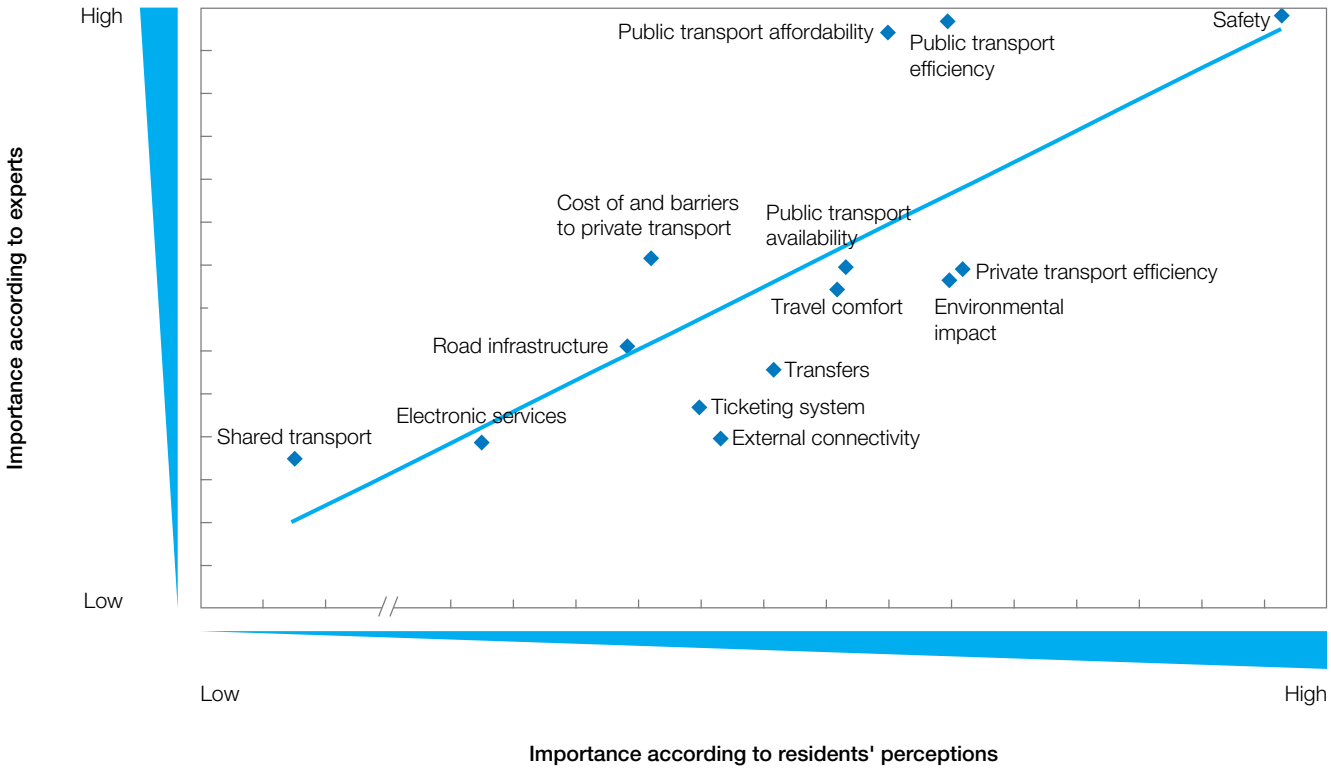
Environmental impact

The development of urban transport systems is a topic that is full of contradictory opinions from the many stakeholders involved. Which of the competing imperatives is more important—to keep private transport affordable or make it more efficient? How to make public transport available and convenient, but affordable? Are issues such as electronic services and shared transport more important than traditional spheres of authorities' attention, such as road infrastructure?

In our study we collected opinions on the importance of different aspects of transport systems from two sources: experts and a survey of residents. Interestingly, there is a high correlation between the two—the common opinion of large groups of people is in line with experts' thoughts. The only notable difference is that the experts put more weight on public transport affordability and efficiency as critical aspects for a large city's whole transport system.

Safety leads by a wide margin as the most important aspect of transport systems, according to both experts and residents. The second most important topic is transport efficiency (here residents perceive the importance of public and private transport efficiency equally, while experts think that public transport efficiency is almost two times more important). Finally residents and experts think that public transport affordability, availability, convenience, and ecological sustainability are critical to a well-functioning system.

Importance of urban mobility aspects



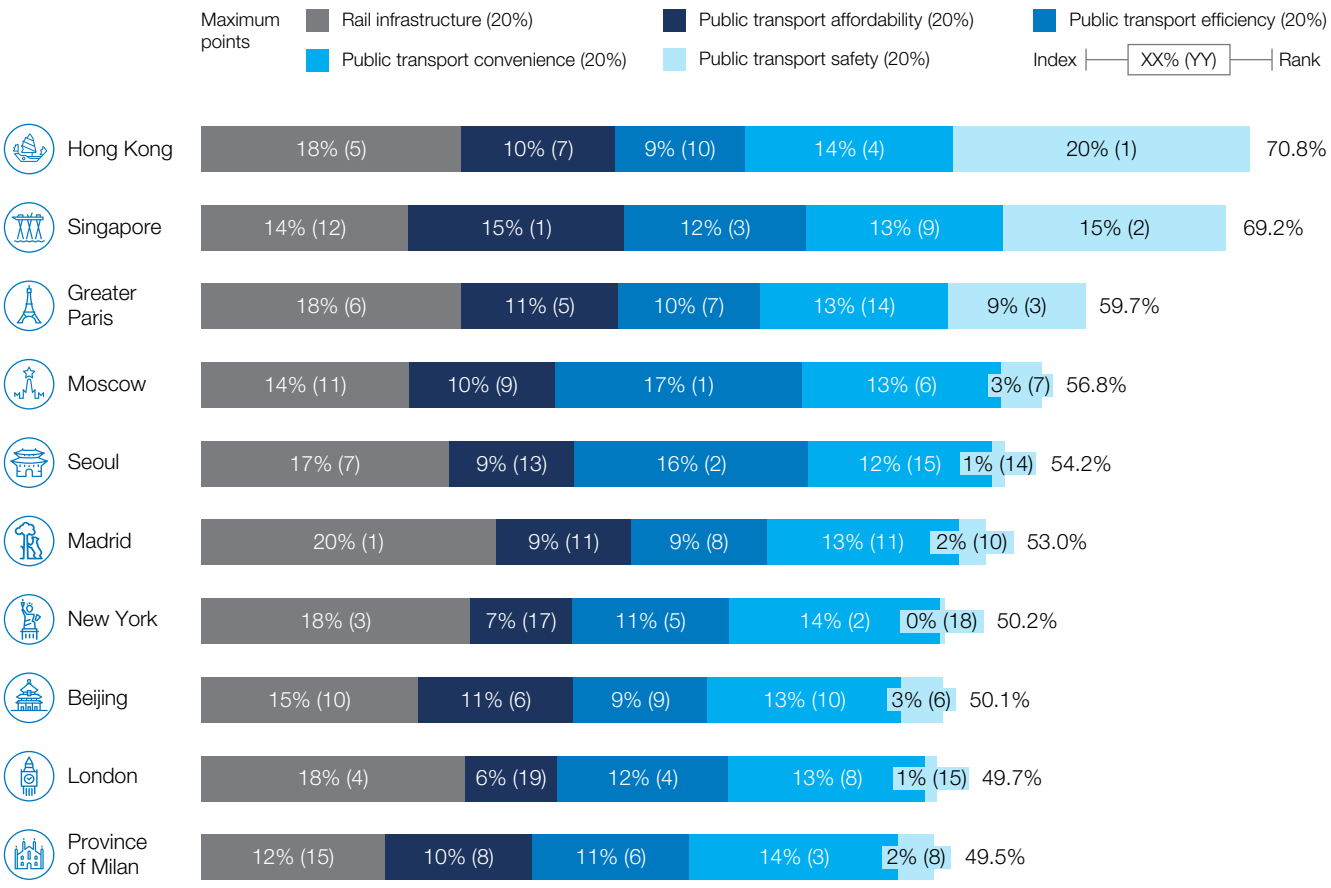
Public transport ranking

The majority of overall ranking leaders are also present among top ten cities in terms of public transport effectiveness. Ongoing urbanization and the growth of large cities increase pressure on cities' transport systems. In this situation, the increase in the use of public transport becomes a key lever to cope with increasing load. To achieve this goal, cities' public transport should provide good coverage, be efficient, convenient, safe and, ideally, affordable at least as compared to private cars.

Almost all leaders in our public transport ranking have leading positions in rail infrastructure coverage and public transit efficiency. Beyond that, the leaders' strengths become quite diverse, with high deviation in public transport safety: Singapore, Hong Kong, and Paris have much lower rates of public transit fatalities per one million people as compared to other cities. Two other diverse dimensions among the leaders are convenience and affordability, which uncover current challenges on cities' agendas.

The fundamental dilemma "how to get high-quality service at low cost?" is relevant for public transit as well: how to create dense, efficient and comfortable public transit and keep it affordable without heavy subsidies? Singapore represents a notable example in achieving high results across all dimensions, including affordability. Moscow and Beijing are two other examples of balanced cities in the public transport provision that are among the top ten in the other five subdimensions.

Top ten cities: Public transport ranking



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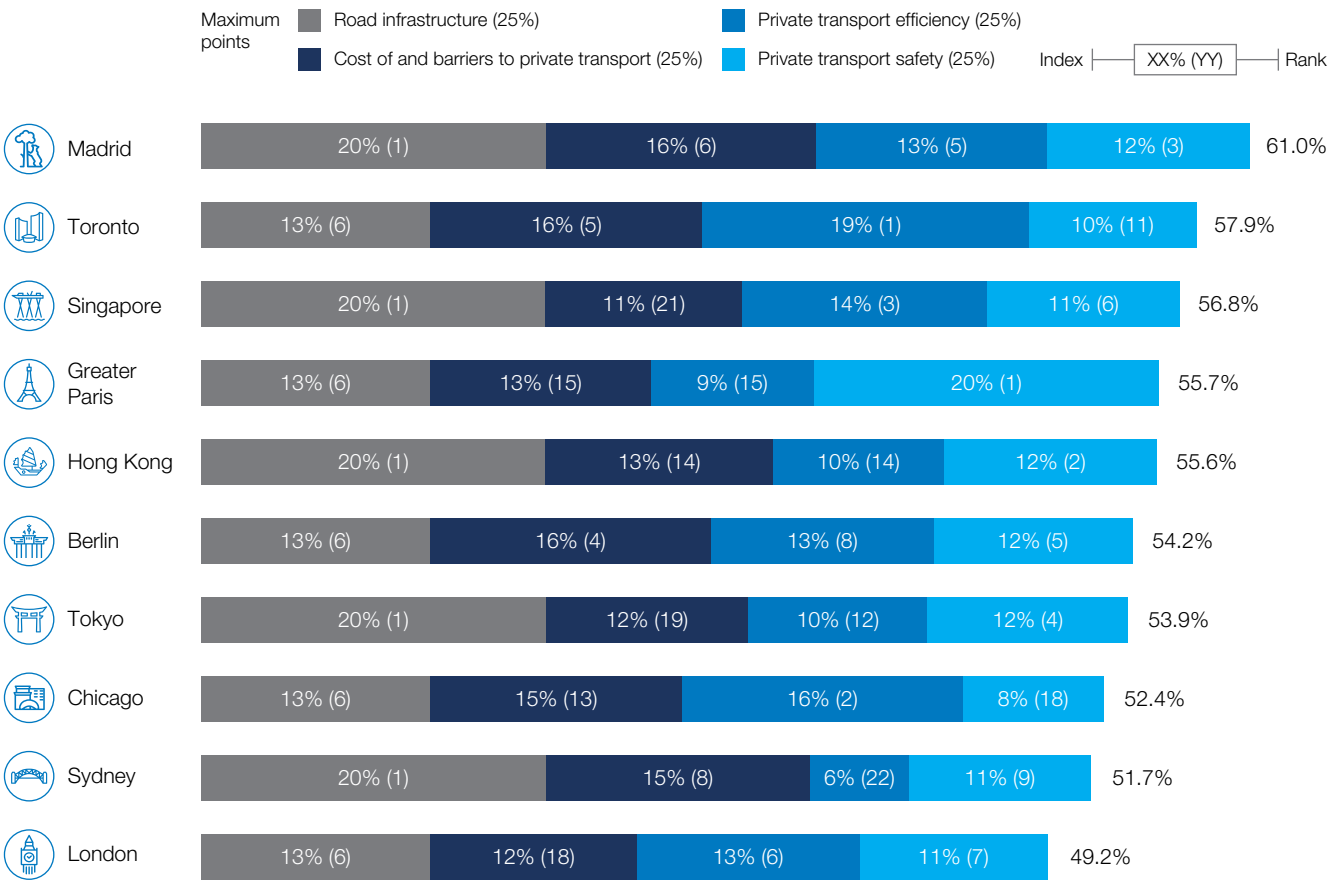
Private transport ranking

Despite a focus on growth of public transport use, private transport remains significant and in some cities is the leading form of transportation. Moreover, motorization continues to grow in many cities, and private cars are the most visible part of the transportation system for residents. This is one of the reasons why our survey shows that topics related to private transport (congestion, affordability, safety, and impact on environment) are the most important and painful ones for residents.

We evaluated cities' private transport on infrastructure quality and availability, car usage barriers, efficiency, and safety. Unlike in public transport, the cities with higher private transport rankings have much more diverse profiles. For example, Madrid, Hong Kong, Berlin, and Tokyo have similar positions across all the components. At the same time there are cities with extreme achievements in a couple of spheres, and acceptable performance in others. For example, Paris provides distinctive safety and road infrastructure, and Toronto has strong road infrastructure, efficiency, and safety.

The most pressing dilemma for cities in private transportation is balancing affordability and efficiency once road capacity is reached and its expansion potential becomes limited. The introduction of barriers is often considered to be the key lever for easing congestion, but residents, who are quite negative on congestion, are even more so on increasing car usage barriers.

Top ten cities: Private transport ranking



Figures may not sum due to rounding

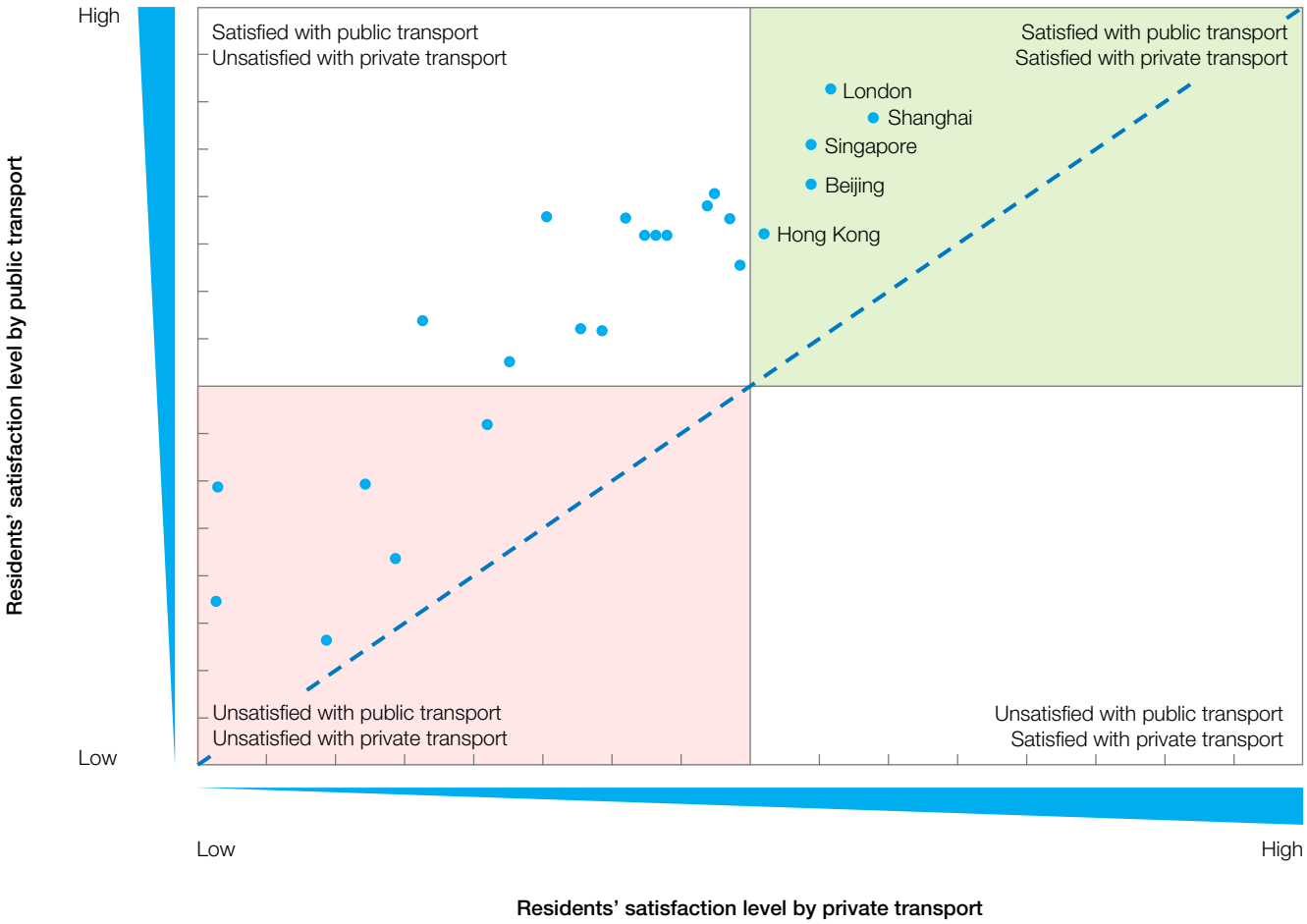
Resident satisfaction by transport modes

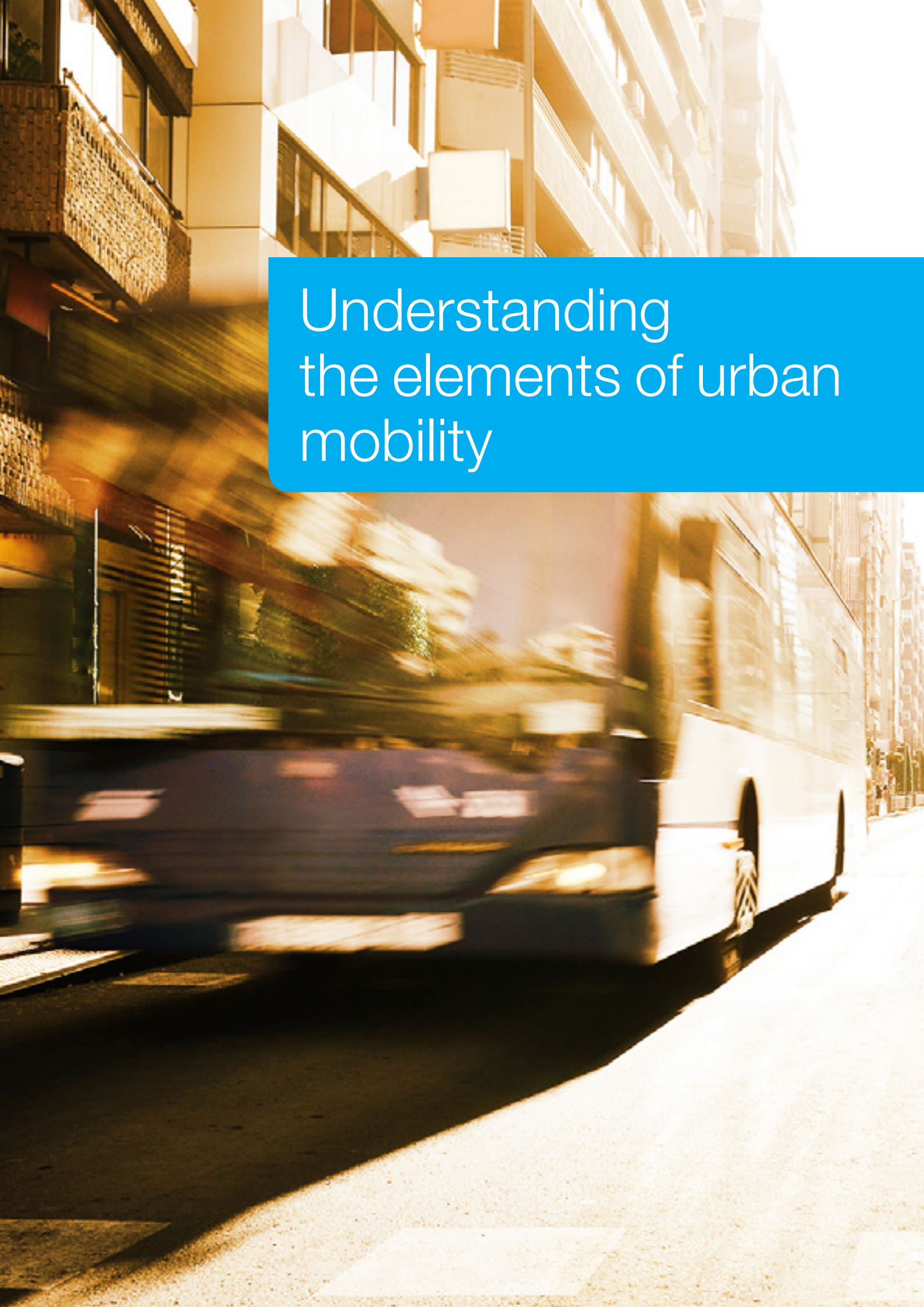
Both for public and private transport the pattern of objective results versus survey results is similar to the integrated ranking. What's more interesting is a comparison of satisfaction by transport modes.

Though satisfaction by public and private transport is highly correlated, in all cities analyzed residents are satisfied with public transport more than with private (all cities are higher than diagonal on the graph). Private transport remains the main pain point in a majority of cities—only in five of 24 cities are there more satisfied respondents than unsatisfied ones. Compare this to the 18 of 24 cities where there are more residents satisfied with public transport than not.

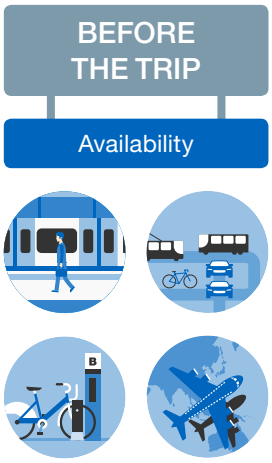
All five leading cities where people are satisfied with public and private transport impose significant barriers on car ownership, which makes private transport more efficient. In parallel, these cities are committed to developing public and shared transport, and pedestrian and cycling infrastructure. High satisfaction by these developments usually surpasses dissatisfaction by barriers imposed on private transport.

Residents' perception of public and private transport





Understanding the elements of urban mobility

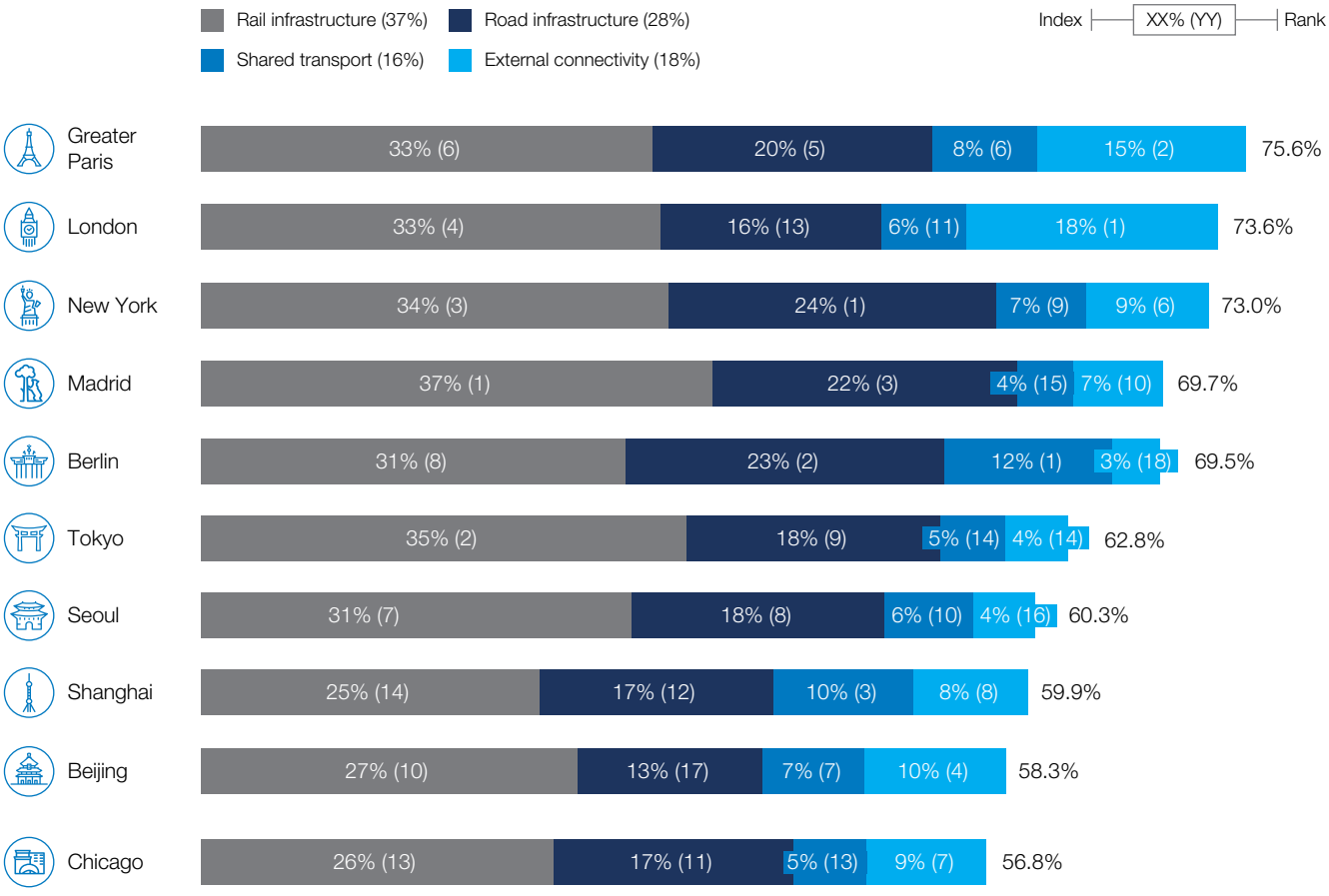


Availability

The availability index represents the set of indicators measuring the variety of transit options available to residents. The overall availability index is split into four subdimensions: Rail infrastructure, Road infrastructure, Shared transport, and External connectivity. The weights were assigned based on surveys of urban mobility experts with two metrics getting higher weights: rail transport and road infrastructure getting in total 65 percent weight.

The leaders in this section, such as New York and Madrid, are characterized by dense subway systems and road infrastructure. Typically this represents the result of strategic historical master planning. Asian megalopolises have typically higher density and are characterized by higher availability of rail infrastructure, while European cities have medium densities and have relatively higher availability of road infrastructure. There are also several cities whose rating is to a larger extent driven by the two other subdimensions, shared transport and external connectivity. For instance, Paris and London are characterized by very strong external connectivity and relatively high levels of shared transport development.

Top ten cities: Availability



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BEFORE THE TRIP

Availability

Rail infrastructure

We assessed rail infrastructure as the availability of metro and suburban rail networks given that these two systems typically are the foundation of a large city's transport system. Next, following Transit-Oriented Development (TOD)* principles, we considered not just the density of metro stations in a city, but also effectiveness of their locations, as this determines how well the network covers the needs of its residents. Therefore, we measured availability of public transport infrastructure as the share of population and jobs located within a one-kilometer radius of metro and suburban rail stations.

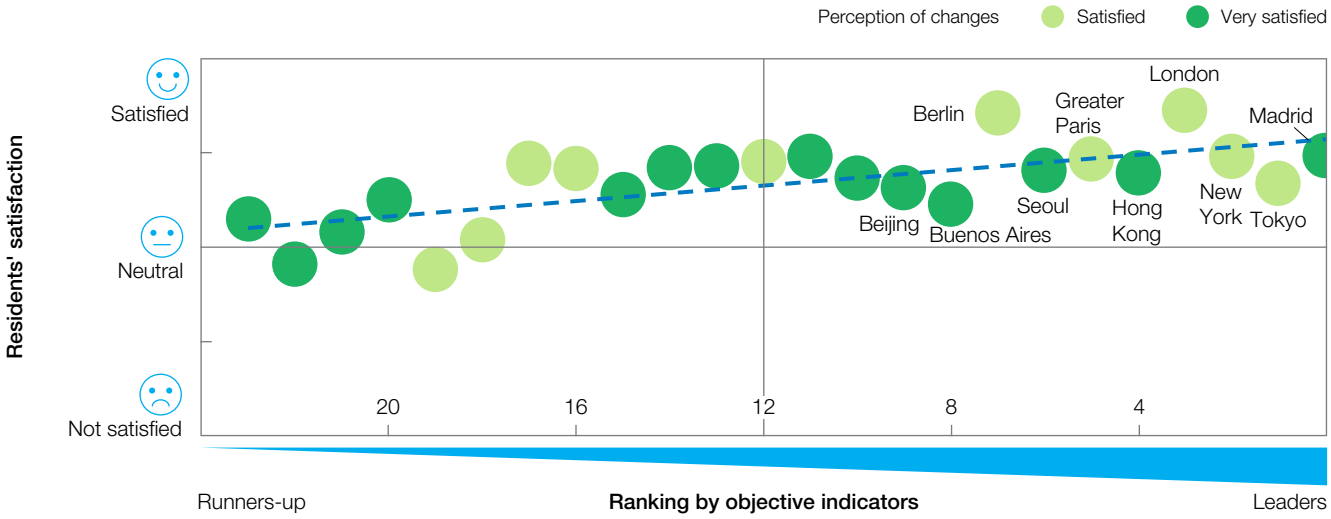
The leaders in terms of rail infrastructure are Madrid, Tokyo, and New York, as they provide the highest rail coverage—80 percent of jobs and population are within one kilometer of a metro or suburban rail station there.

Residents globally are satisfied with rail infrastructure in their cities at the moment and appreciate its development—in all cities analyzed, more people are satisfied with the changes than not. Public transport development is one of priorities in many large cities and, consequently, the cities continue to invest in enhancing their public transport networks, especially rail service. For instance, some cities extend their metro with historically unprecedent speed—over the last 20 years Hong Kong has quadrupled its metro length and plans to further extend the reach of its railway network by 25 percent. Meanwhile Paris will add more than 200 kilometers of new track and 72 new stations between now and 2030.[1]

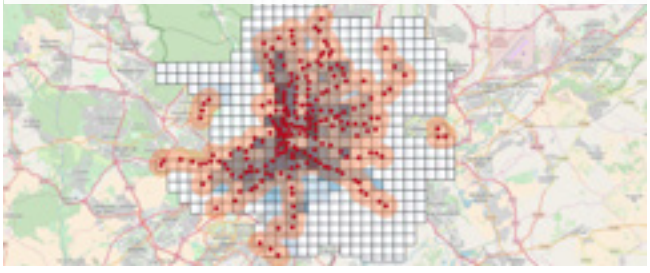
Parameters

- Percentage of population living within one kilometer of a metro/suburban rail station
- Percentage of jobs within one kilometer of a metro/ suburban rail station

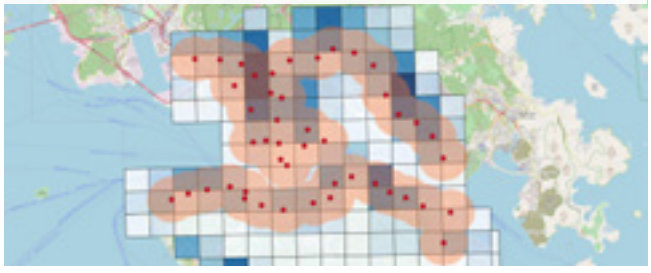
Perception vs. reality: Availability of rail infrastructure



The Madrid metro provides 89% population coverage—most of the densely-populated areas are located less than 1 km from metro stations



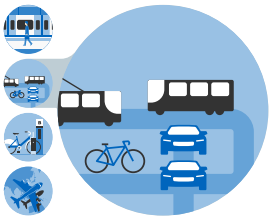
The Hong Kong metro provides 75% population coverage—some densely populated areas in the north are farther than 1 km from metro stations



* Transit-oriented development seeks to create of pedestrian-oriented, mixed-use communities centered around high-quality train systems.

BEFORE THE TRIP

Availability



Parameters

- Road infrastructure quality index
- Pedestrian connectivity (i.e., length of route from Point A to Point B compared to straight distance for the sample of routes in each city)
- Bicycle lanes as percentage of the total length of the road network (excluding highways)

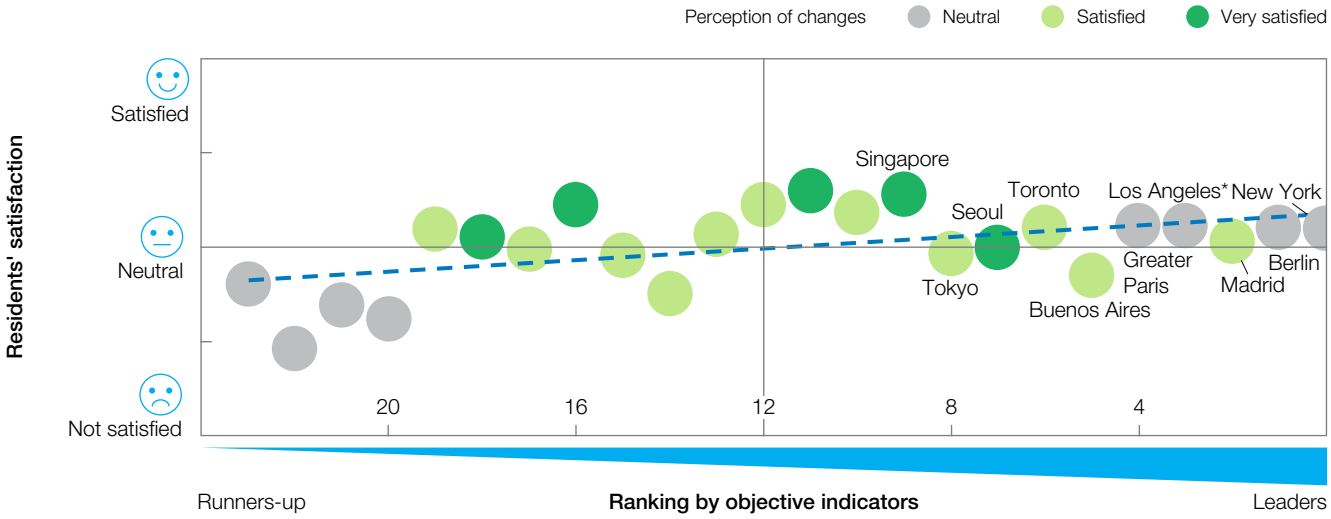
Road infrastructure

Next to the rail infrastructure that forms the foundation of a transport system, road infrastructure represents the circulatory system of a city. To assess availability of the road infrastructure, we looked at three main types of use: roads used by cars and ground public transit, bicycle lanes, and pedestrian roads.

Leaders of this subdimension usually score high in at least two of three parameters considered. For instance, New York, Berlin, and Los Angeles show high performance across all three parameters, while Madrid, Paris, and Buenos Aires are more advanced in pedestrian connectivity and road quality.

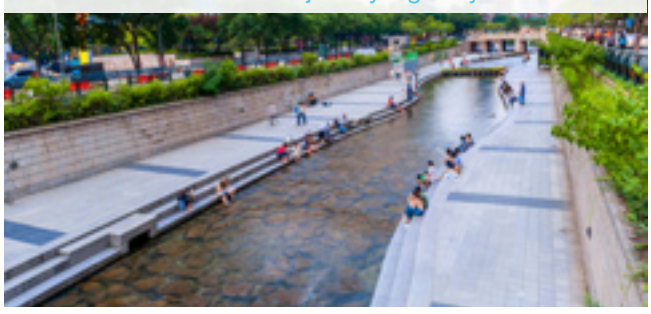
The general tendency for large cities is to consciously shift roads usage from cars to non-motorized transportation—cycling and walking. For example, New York has undertaken a thorough bicycle- and pedestrian-centric transformation over the last ten years, with more than 600 kilometers of bicycle lanes built and around 60 plazas and squares made pedestrian-only. Another example is in Seoul, where when one of the city's most vital highways, Cheonggyecheon Freeway, was removed in 2005 and a public recreation zone was built near the stream beneath it. Not only was the natural environment restored, but the number of vehicles entering downtown Seoul has decreased by 2.3 percent, while the number of bus users and metro users increased by 1.4 percent and 4.3 percent respectively.

Perception vs. reality: Availability of road infrastructure



The High Line park in New York was built on the site of an elevated railway[2]

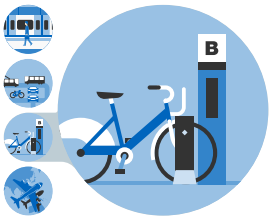
To recreate Seoul's Cheonggyecheon stream authorities removed a major city highway above it[3]



* Los Angeles—Long Beach—Santa Ana Urbanized Area.

BEFORE THE TRIP

Availability



Parameters

- Number of rental bicycles per million people
- Number of vehicles in car-sharing services per million people

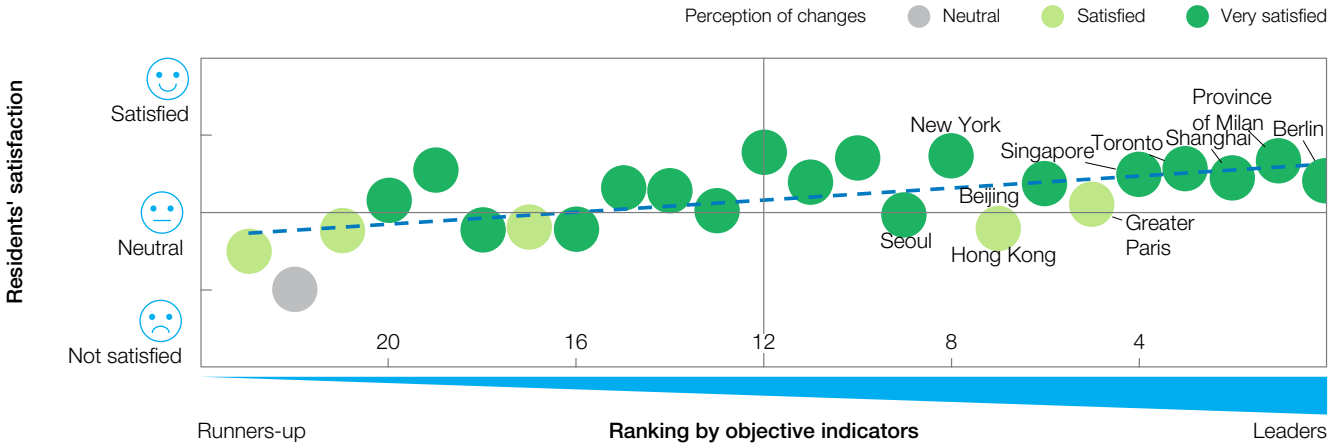
Shared transport

The blurring of borders between public and private transport is a previously identified trend in urban mobility.* To reflect this trend we measure not only availability of traditional infrastructure, but also level of shared transport availability as more and more residents choose shared usage over ownership.

Leaders of this subdimension are usually well balanced on car and bicycle sharing or have distinctive results in one of the two. For instance, Paris and Milan have relatively high penetration of both shared bikes and cars, while Berlin, Shanghai, and Beijing have more advanced bike-sharing systems rather than car sharing. All of the top five cities have also adopted the new bike sharing trend of dockless bicycle-sharing schemes. Car-sharing user surveys from different cities indicate that car sharing mostly substitutes car trips without significantly cannibalization public transport use, but the share of users who would sell or not buy a car in favor of car sharing is still relatively low. However, as shared transportation develops new options and conveniences, residents' ideas regarding car ownership will evolve: increased ease of shared transport will likely diminish the relative attractiveness of car ownership.

Residents globally tend to be excited with the advances in sharing schemes—most of them are satisfied with both current offerings and the dynamics. This interest stimulates continuous evolvement of sharing schemes, for instance e-scooters and even kick scooters are shared nowadays in several cities. Still other innovations that blur the distinction between shared and public transit, such as mini-buses on demand, which are now being piloted in Berlin, New York, Chicago and other cities, could have an even deeper effect on residents' response to shared transport.

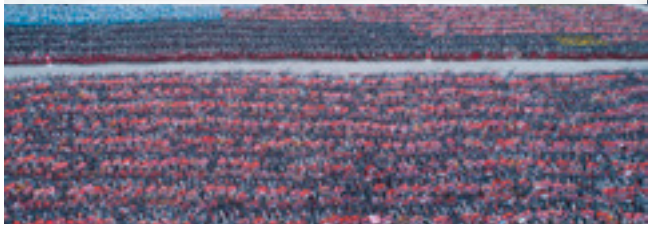
Perception vs. reality: Availability of shared transport



There are currently two main types of bike-sharing schemes: with and without docks

Docked bike sharing scheme in Toronto provides 2,750 bicycles[4]

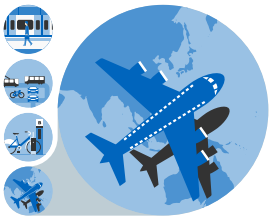
Dockless bike sharing in Shanghai currently accommodates more than 1 million shared bikes[5]



* Shannon Bouton, Stefan M. Knupfer, Ivan Mihov, and Steven Swartz, "Urban mobility at a tipping point," September 2015, McKinsey.com.

BEFORE THE TRIP

Availability



Parameters

- Number of destinations served by regular flights from city airports

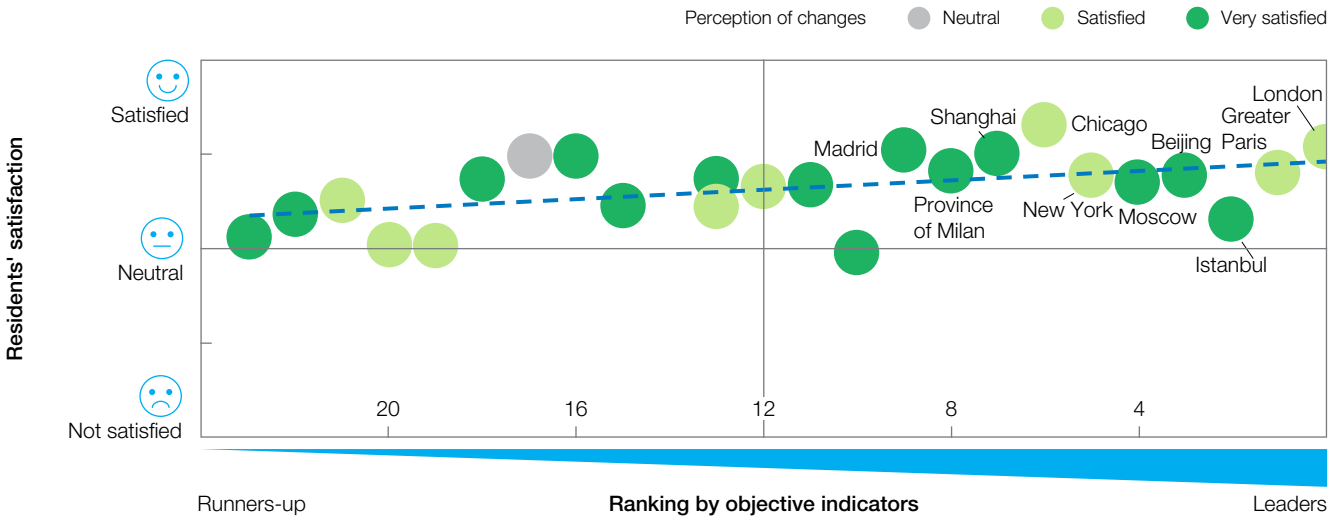
External connectivity

In addition to developed internal transport, external connectivity is also crucial for large cities. To measure how well the cities are externally connected, we analyzed the number of daily flight destinations from city airports.

The leading cities in this subdimension—London, Paris, Istanbul, Beijing, and Moscow—cover a relatively high number of destinations. They all serve more than 240 flight destinations, with the leaders, London and Paris, serving 381 and 330 destinations respectively[8]. In terms of flight destination structure, cities located in large countries (e.g., the United States and China) have a significant share of domestic flights, while, Singapore, for instance, has only international flights.

Most cities we researched serve as major air hubs, and doing it well, as measured by residents' opinions. In 23 out of 24 cities, the majority of residents surveyed were satisfied with their cities' external connectivity currently, and are either satisfied or very satisfied with recent changes.

Perception vs. reality: External connectivity



Seoul Incheon International Airport has been ranked as the best in the world for 12 years[6]

London has the biggest number of flight destinations[7]

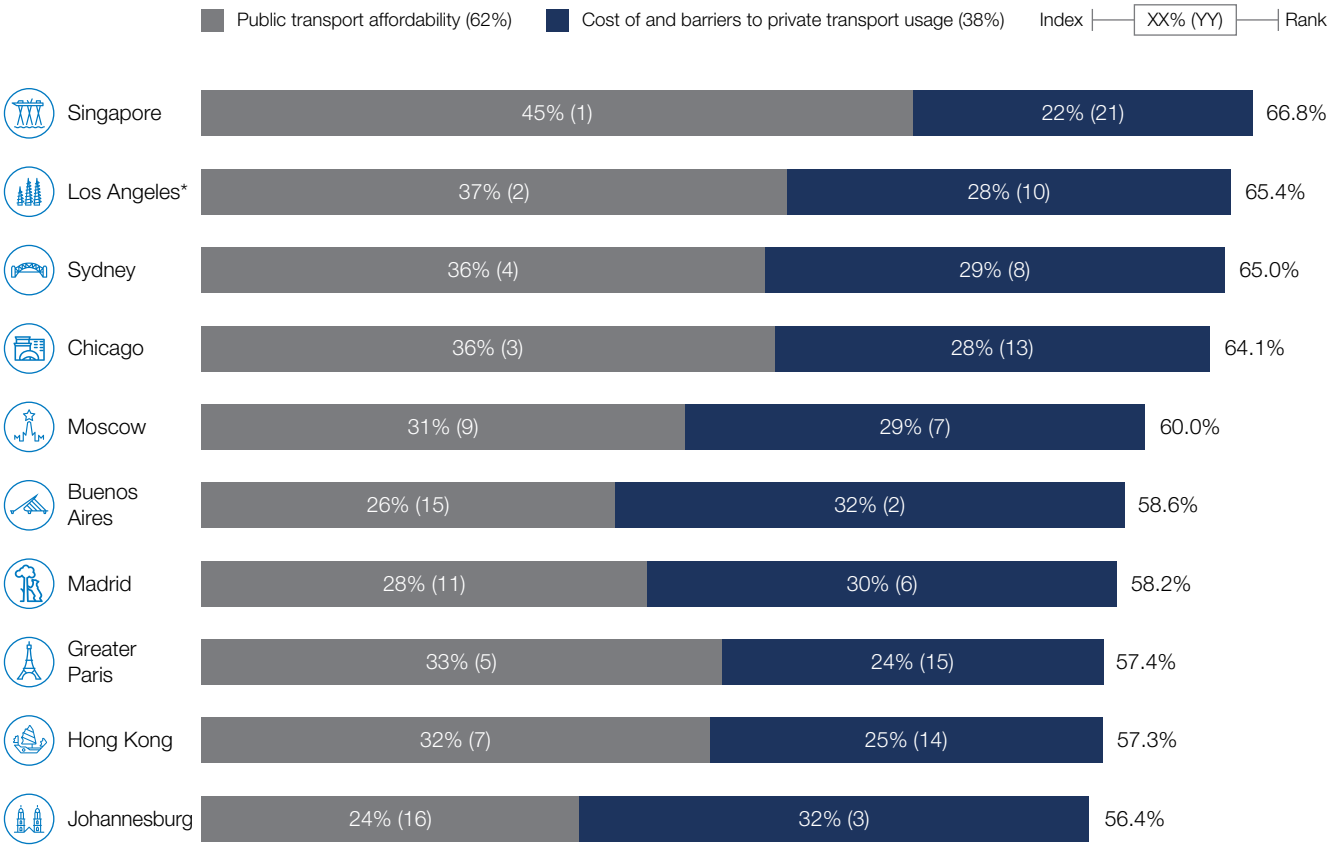
Affordability

The affordability index represents the relative cost of available transit options compared to average residents' income. The overall availability index is split into two subdimensions: Public transport affordability, and Cost of and barriers to private transport use. The weights were assigned based on surveys of urban mobility experts, with Public transit affordability getting 62 percent and cost of barriers to private transport usage getting 38 percent. Therefore, a city's position in the affordability dimension is primarily driven by higher positions in the public transport affordability ranking.

The most affordable transit is in Singapore, Los Angeles, and Sydney. In terms of public transport affordability, the leaders are Singapore, Los Angeles, and Chicago: they have relatively low monthly transport ticket prices compared to average monthly income, they provide subsidies for several passenger categories, and also have relatively affordable taxi fares. At the same time Buenos Aires is also among the leaders in overall affordability ranking, with relatively low parking costs and only one type of restrictions—odd-even rationing.

In general, cities that lead in terms of overall urban mobility, especially Asian cities with high densities such as Singapore, Beijing, and Tokyo, manage affordability of private transport to control congestion and make their transport systems sustainable. Expanding paid parking, imposing congestion charges, odd-even driving restrictions, new plates auctioning, requirements to own a parking space, and other initiatives are widely adopted by the leading cities to limit car traffic by managing its affordability.

Top ten cities: Affordability

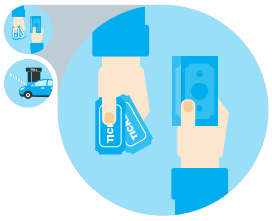


Figures may not sum due to rounding

* Los Angeles—Long Beach—Santa Ana Urbanized Area.

BEFORE THE TRIP

Affordability



Public transport affordability

In evaluating public transport affordability we considered the price of a monthly a public transport ticket (as the most commonly used option) relative to residents' income, inclusiveness of the pricing system in terms of subsidies for particular categories, and the relative cost of taxi fares.

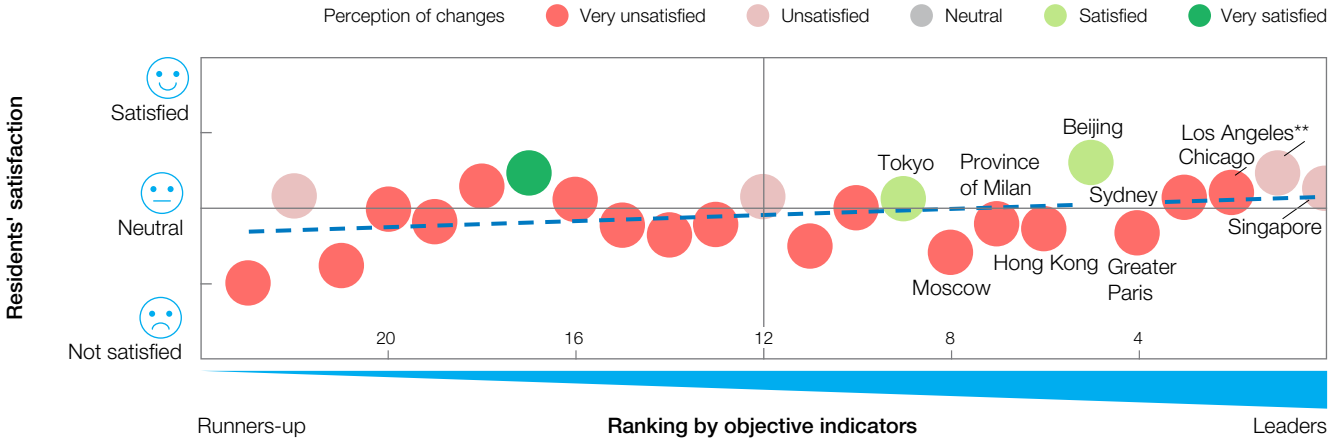
The three leaders in this subdimension, Singapore, Los Angeles, and Chicago, are well-balanced—they have strong positions in terms of affordability of monthly public transport tickets and the number of subsidized passenger categories, and most of them have relatively low taxi fares relative to residents' income. Public transport affordability is a sensitive issue for most residents surveyed in all cities—in the majority of cities people are not satisfied either by the current situation nor by changes in recent years. And while dissatisfaction with change seems to be almost inevitable, the leading cities manage to keep residents' perceptions in-line with reality.

Another typical challenge is to balance availability and convenience of public transit with its affordability and level of subsidies: operating at affordable tariff levels, metro systems rarely manage to collect the funds needed to cover expansion and operating costs. However, some cities have resolved the challenge. For instance, Hong Kong MTR applies a "Rail plus Property" financing model that follows TOD principles while steering land development around metro stations. This allows Hong Kong to achieve top levels of metro coverage and affordable tariffs without subsidies. The non-farebox revenue is generated as upside from property value increases after metro provision, higher passenger flows due to integration of stations with surrounding buildings and additional income from property management.*

Parameters

- Cost of monthly public transport ticket, as percentage of average income
- Number of subsidized passenger categories
- Cost of a one-kilometer taxi ride, as percentage of average income

Perception vs. reality: Public transport affordability



Affordability of monthly public transport ticket compared to average income, percent

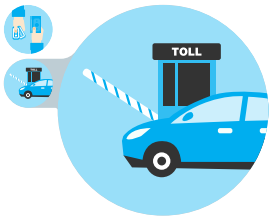
Top five	Milan 2.14%	Tokyo 2.50%	Seoul 2.51%	Hong Kong 2.55%	Los Angeles 2.68%
Bottom five	Bangkok 7.48%	Toronto 7.42%	São Paulo 7.41%	London 6.14%	Istanbul 6.07%

Numbers have been rounded

* Lincoln Leong, "The 'Rail plus Property' model: Hong Kong's successful self-financing formula," June 2016, McKinsey.com.
** Los Angeles—Long Beach—Santa Ana Urbanized Area.

BEFORE THE TRIP

Affordability



Parameters

- Cost of two hours of paid parking, as percentage of average income
- Taxes or license fees on purchase of a car
- Congestion charges for private vehicles
- Urban toll roads
- Restrictions on use of private vehicles

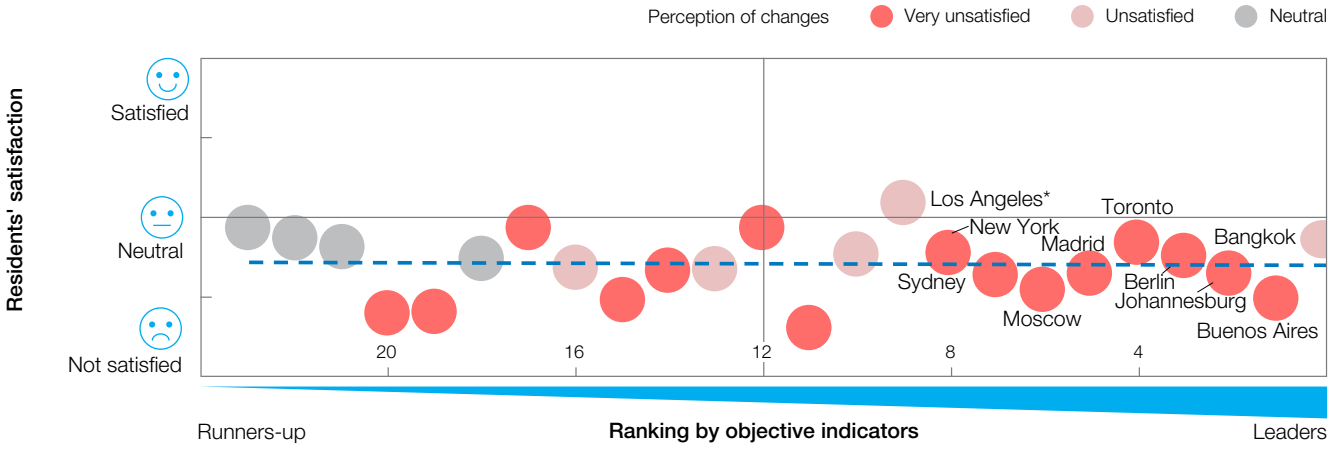
Cost of and barriers to private transport

To decide which mode of transport to take, residents compare public and shared transport offerings with driving their own cars. Given limited road space, cities use different sets of financial and administrative barriers to achieve a balance of traffic and roads capacity. To assess car usage barriers we analyzed how costly it is to use a private car in the city, taking only city-specific tolls and restrictions for private vehicles into account.

Most of the cities studied introduce car usage barriers to avoid congestion, balancing car ownership, car usage, and congestion. When a city reaches an economic development level that makes car ownership affordable for a majority of residents it is rare to have low barriers and low congestion levels at the same time. Although there is a long list of aspects influencing congestion (e.g., distribution of work and living places; roads density, connectivity, and quality; intelligent transport system [ITS] development; driver behavior, and traffic rules enforcement), but still there is a tendency for residents to rely more on their own cars than roads capacity allows. Hence, cities deliberately increase the cost of owning a car by imposing tolls (e.g., paid parking, odd-even rationing, preventive taxation, toll roads, plate auctions) and restrictions (e.g., speed limitations, requirements to own a garage) to limit seemingly inevitable traffic and control congestion.

Similar to public transport affordability, the cost of car usage also is one of residents' main concerns—they are disappointed with both the current situation and its dynamics. They feel the effects of increased restrictions and tolls, but often don't understand that the aim is not to oppress drivers, but to lower congestion and make roads more efficient. As more transportation options develop and become more attractive, the share of private transport will decrease, and hence residents' frustrations with the cost of car usage will diminish.

Perception vs. reality: Cost of and barriers to private transport usage



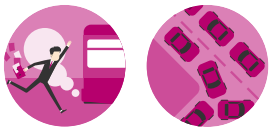
Shanghai sells a limited number of car plates using an auction system—the average price to win a plate is $13,000[9]

In Tokyo you are obligated to own a parking space or a garage to buy a car

* Los Angeles—Long Beach—Santa Ana Urbanized Area.

DURING THE TRIP

Efficiency

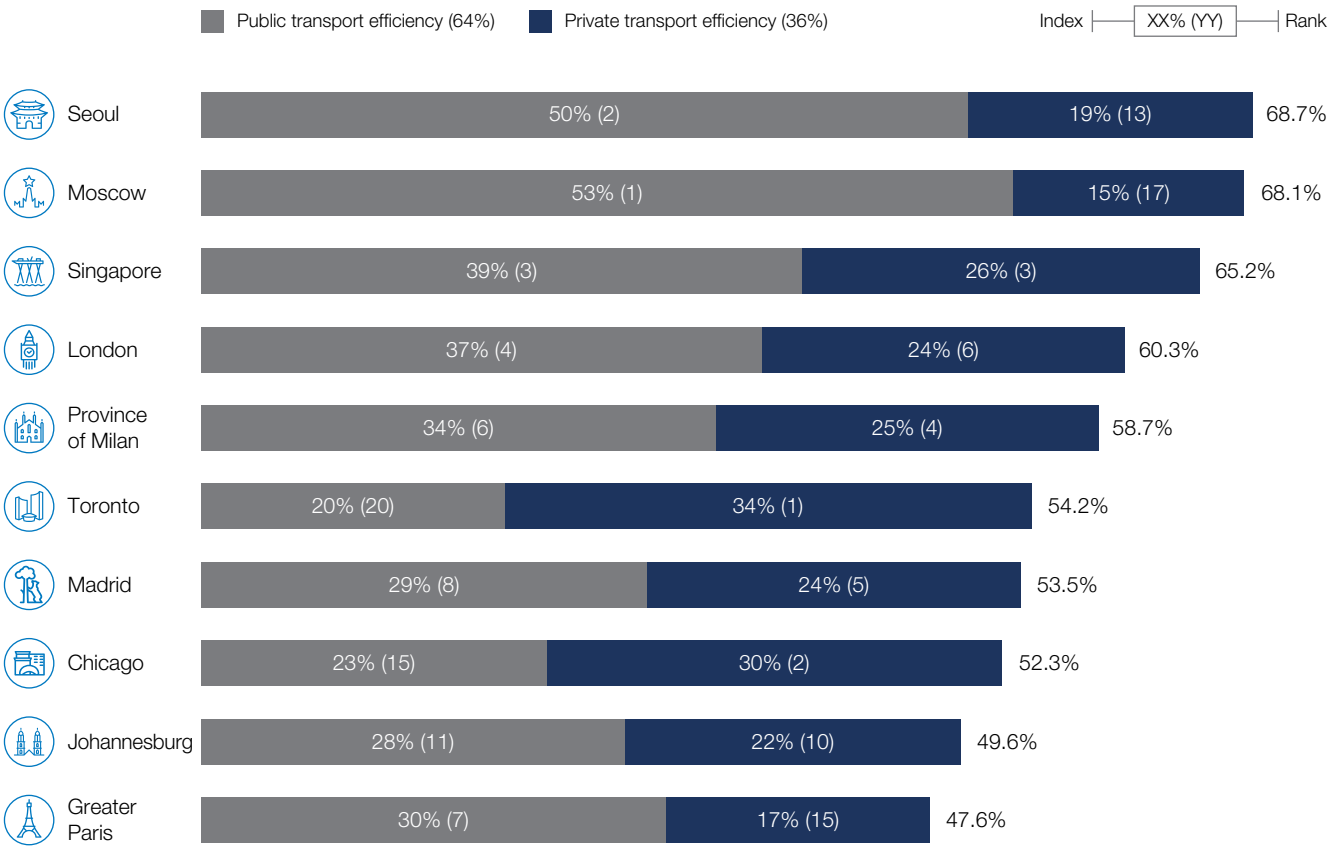


Efficiency

We defined efficiency as how quickly and reliably a trip can be done by either public or private transport. According to the experts survey, efficiency of public transport is almost twice as important as for private transport—64 percent versus 36 percent. Therefore, most of the leaders of the efficiency ranking also lead in terms of public transport efficiency, for example Seoul, Moscow, and Singapore.

However, there are also several exceptions. Toronto and Chicago, for example, show only average performance in terms of public transport efficiency, but are among the leaders in private transport.

Top ten cities: Efficiency



Figures may not sum due to rounding

DURING THE TRIP

Efficiency

Parameters

- Average effective speed during morning rush hour, km/h
- Average above-ground transport waiting time, min
- Dedicated bus lanes, as percentage of the road network (excluding highways)

Public transport efficiency

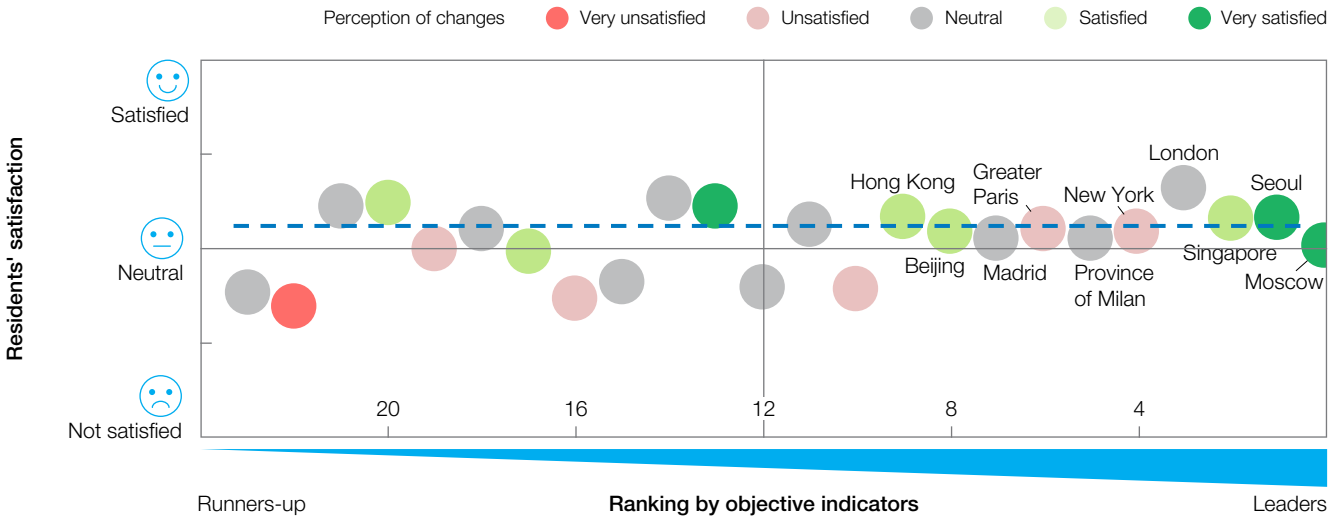
As the role of public transport in cities tends to grow, it becomes essential to ensure its efficiency, so that passengers feel confident they have quick, reliable transportation.

The leaders in terms of public transport efficiency have their own strengths. Moscow, for instance, is balanced, and is among the top five cities across all three indicators, while Seoul and Singapore are distinctive in average wait time and share of dedicated lanes, respectively, and are relatively good across the other indicators.

The residents on average are close to neutral when talking about current public transport efficiency in their cities and have mixed opinions of its dynamics.

In recent years several cities have installed intelligent transport systems (ITS), which can significantly enhance public transport service. For instance, in 2011 Moscow developed an ITS to improve traffic management and prioritize public transport service. The system tracks traffic in real time via more than 2,000 cameras and 3,700 sensors that react to almost all traffic problems. For instance, it can ease congestion by synchronizing traffic lights and creating “green waves” for public transport to move through an area more quickly. Dedicated bus lanes were also added to facilitate this even more. Since adoption of the new system the level of congestion has reduced by approximately 15 percent and the average speed during rush hour has also increased by approximately 15 percent.

Perception vs. reality: Efficiency of public transport

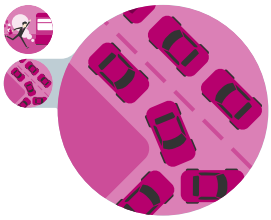


Information boards in Moscow show traffic jams

Since 2010 Moscow has created ~285km bus lanes and optimized ground public transport[10]

DURING THE TRIP

Efficiency



Parameters

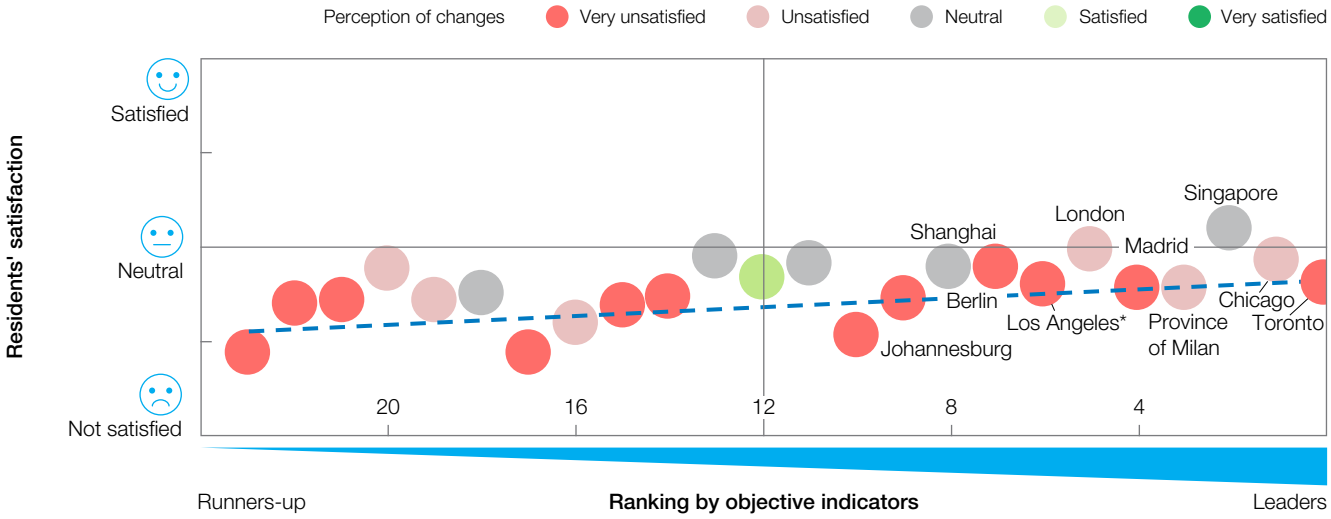
- Congestion: rush hour travel time compared to free flow travel time
- Average speed during morning rush hour, min
- Commuting time predictability index

Private transport efficiency

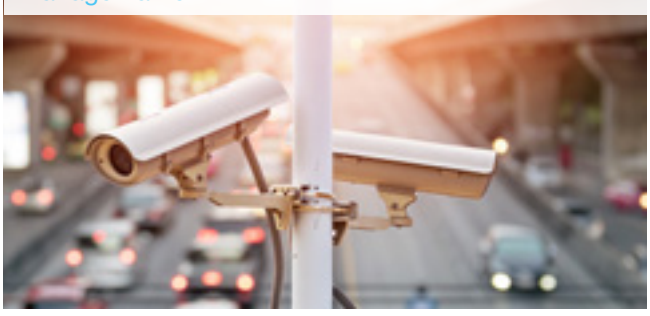
The private transport efficiency is one of the most visible and important for the residents' dimension of the transport system. It is also influences efficiency of ground public transport and sustainability. We measure private transport efficiency using a congestion index, rush hour speed and rush hour predictability. Toronto and Chicago have the most efficient private transport—these cities have some of the lowest congestion rates, high speed, and good day-to-day predictability of travel time.

Residents surveyed around the world are generally dissatisfied with the efficiency of their existing transport systems and are mostly discouraged with changes over the recent years. This reflects the real global growth in congestion by 15 percent from 2010 as recently reported by TomTom, with more cities reaching road capacity thresholds and limited opportunity to increase capacity by construction of new roads or via further ITS development. Asian cities represent a notable exception. Historically they've had higher densities and limited road space per resident, and so introduced policies to manage access to this scarce infrastructure. We expect to see adoption of Asian cities' practices (e.g., congestion charge, plate auctions, parking requirements) in other cities, despite a likely negative initial reaction from residents with London and Milan representing notable examples. At the same time, innovations such as e-hailing, e-car/van-sharing/pooling, autonomous/flying cars, big-data-enabled predictive traffic/users management, and distant working/virtual reality can become game changers.

Perception vs. reality: Efficiency of private transport



Singapore uses 400+ cameras to monitor and manage traffic[11]



Singapore determines congestion charges dynamically based on traffic flow and time of day

* Los Angeles—Long Beach—Santa Ana Urbanized Area.

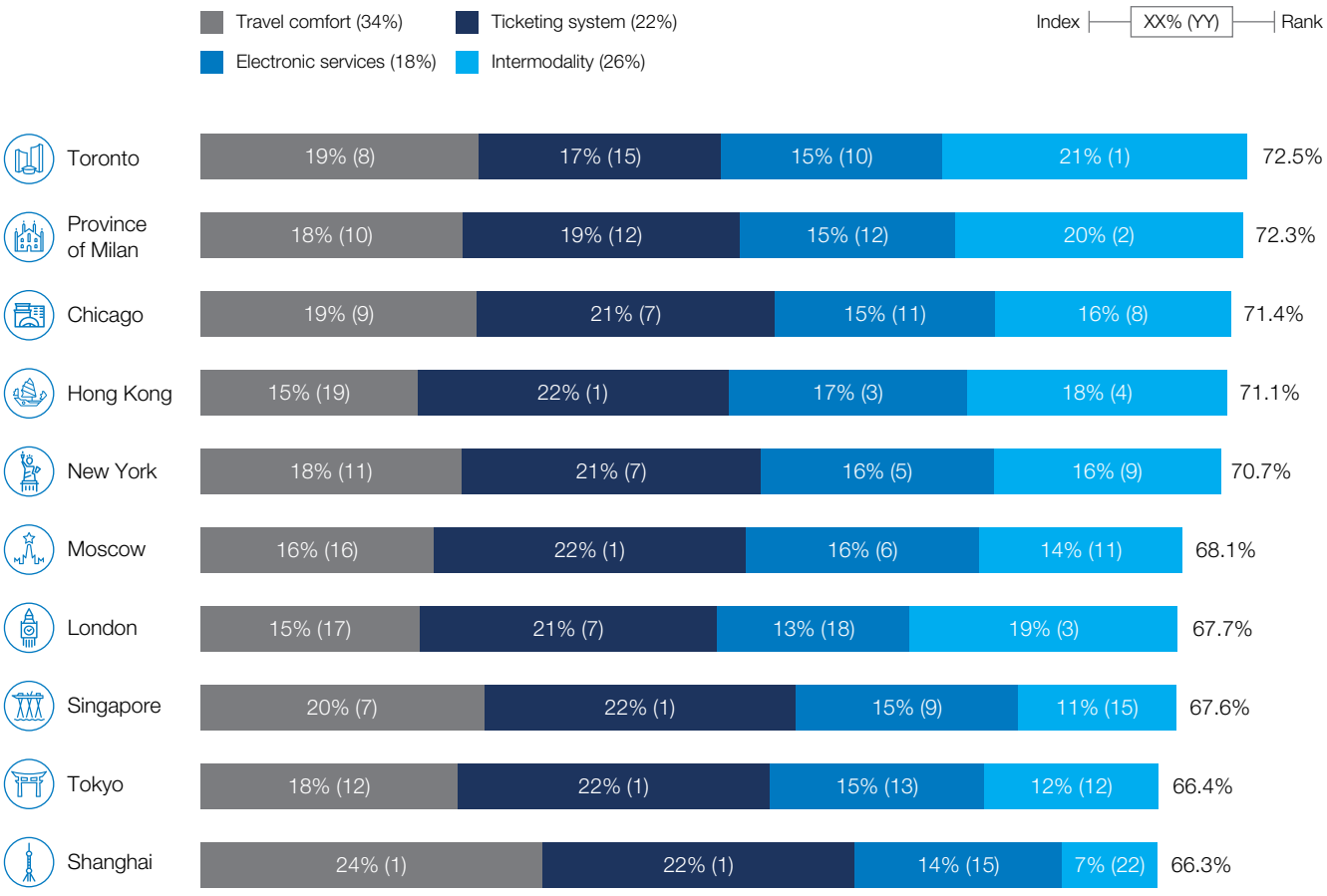
Convenience

Convenience complements efficiency to fully describe the quality of service provided by cities' transport systems. The overall convenience index is split into four subdimensions: Travel comfort, Ticketing system, Electronic services, and Transfers. The weights were assigned based on survey of urban mobility experts with travel comfort getting the highest weight (34 percent).

The competition in this dimension is very intense—all cities in the top ten are close to each by total number of points. Generally these cities placed in the upper half of the list in most subdimensions and show distinctive achievements in one of them. For example, Toronto, Milan, and London stand out in intermodality, or the ability to transfer from one mode of transport to another; Singapore, Hong Kong, Moscow, London, Shanghai, and Tokyo provide advanced ticketing systems; Shanghai is the best in the travel comfort.

A few global trends like growing smartphone penetration and development of ecosystems aimed at meeting of ultimate client needs will mostly impact the convenience dimension of urban mobility. We expect further integration of the four convenience subdimensions with a few or even just one smartphone application becoming residents' main interface with their transport system, including building of intermodal real-time routes, providing on-line data on transit arrival, taking payments for public transit and car-related services like parking, using shared transport, integrating loyalty programs, and personalized communication, among other uses. In this respect we anticipate that cities will collaborate on developing these with technology companies and, potentially, auto producers.

Top ten cities: Convenience



Figures may not sum due to rounding

DURING THE TRIP

Convenience

Travel comfort

Physical comfort during the trip is one of the key considerations for people choosing between using public and private transport. We measured travel comfort as the ability to use modern transport at any time for all categories of passengers.

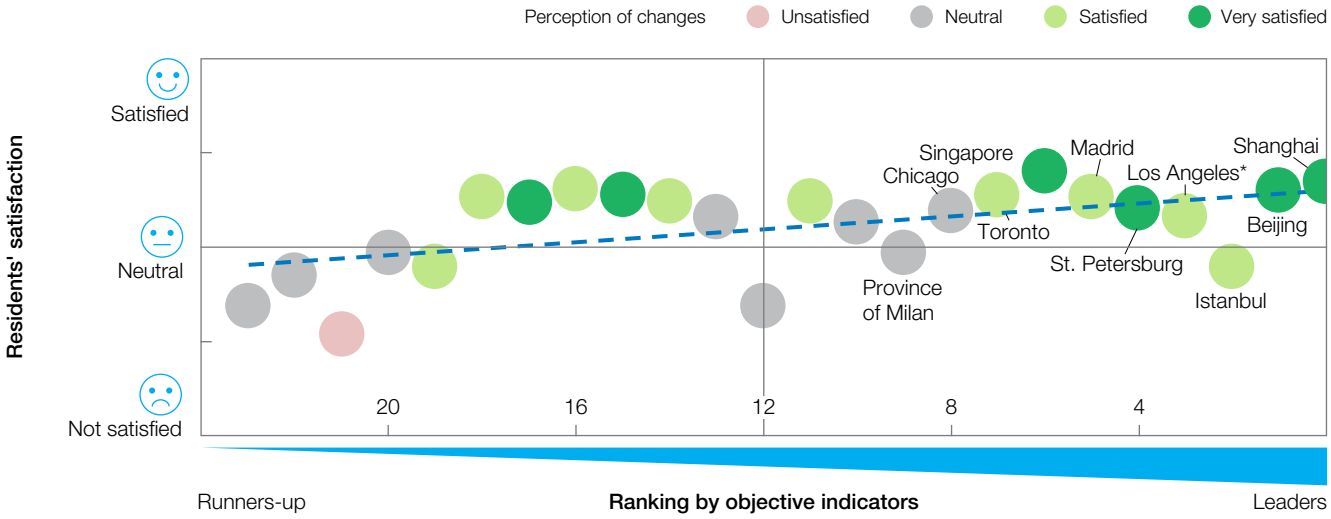
The cities with the most comfortable transport systems are Shanghai, Beijing, Istanbul, Los Angeles, and St. Petersburg. They are generally good at several aspects of comfort: wheelchair access is strong in Shanghai, Istanbul, Los Angeles, and St. Petersburg, and Beijing has one of the most modern transport fleets. Los Angeles Country Metro Rail system is fully wheelchair-accessible—every station has either a walkway, ramp, or elevator from the street level to the boarding platforms. The buses are equipped with lowered floors and wheelchair ramps, and the bus drivers are responsible for assisting the disabled passengers. Cities also introduce life-cycle fleet supply and maintenance contracts along with new contracting mechanisms for private bus operators to maintain modern fleet and balance city's annual budget.

Residents surveyed globally tend to be generally satisfied with the comfort level of their transport networks at the moment and its recent changes, with relatively few exceptions.

Parameters

- Average age of buses and subway/rail (metro) carriages, years
- Metro, operating hours per week
- Percentage of buses and metro stations that are wheelchair-accessible

Perception vs. reality: Travel comfort



All of Los Angeles County's Metro Rail system is fully wheelchair-accessible

Istanbul has one of the newest bus fleets with an average age of less than five years

* Los Angeles—Long Beach—Santa Ana Urbanized Area.

DURING THE TRIP

Convenience

Ticketing system

Having a chip card, which can be used across the main public transport services and remotely topped-up, is now not enough to make a ticketing system distinctive. The best-in-class ticketing now allows a variety of features, for instance, paying via PayPass and PayWave directly at pay gates and mobile ticketing. The leading cities, Shanghai, Tokyo, Moscow, Hong Kong, Singapore, and Beijing, have already successfully implemented these features.

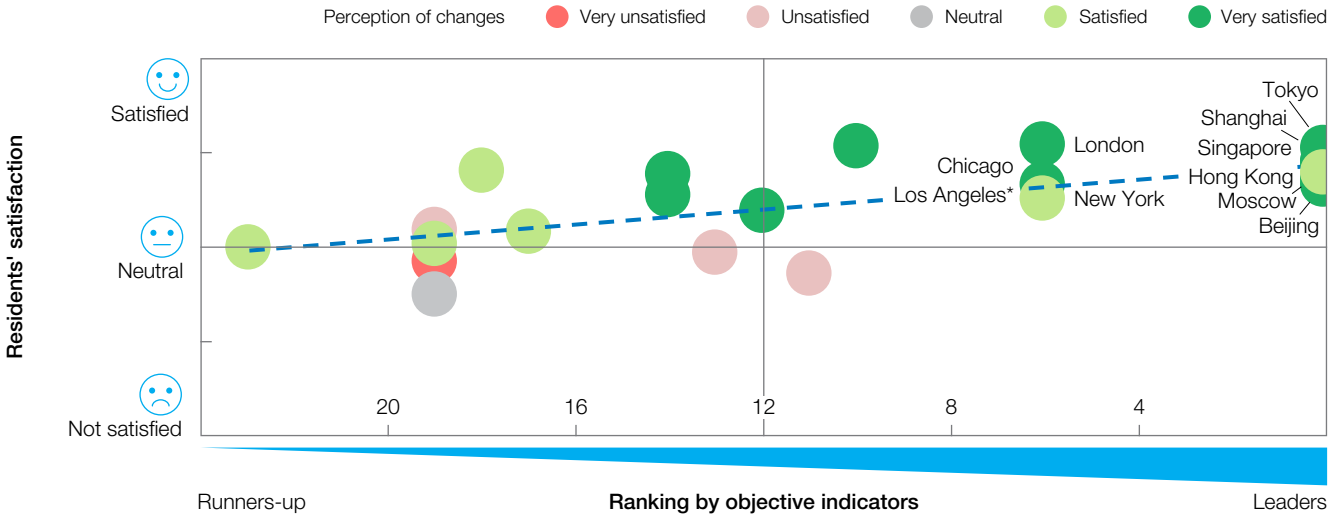
Ticketing is one of the public transport spheres where residents benefit from changes immediately, since it affects all public transport passengers. That's fully reflected in our survey results: neutral attitude to changes is rare—people are either excited about changes or feel unsatisfied. In talking about the current perception, residents generally enjoy the existing opportunities of their ticketing systems with only few exceptions.

Moscow has significantly improved its tariff and ticketing system by launching a unified chip card "Troyka," which is currently used by more than 90 percent of passengers.[13] In the last few years a variety of alternative payment methods were added, including credit card, Pay Pass/Pay Wave, Apple Pay/Samsung Pay/Android Pay, and Yandex Money. To further enhance the passenger experience, the Moscow metro created a limited edition of bracelets and rings, which serve as ordinary chip cards and can be used to pay for the public transport rides. Currently Moscow plans to launch a loyalty program for "Troyka" users—passengers would get discounts and bonuses from the partners of the program.

Parameters

- Availability of travel chip card for several types of public transport
- Possibility of remote top-up
- Availability of mobile ticketing
- Possibility to buy ticket/ chip card using a bank card
- Possibility to use contactless cards and mobile applications directly at pay gates
- Possibility to pay for non-transport services using chip card

Perception vs. reality: Ticketing system



25 percent of transactions of Hong Kong unified chip card, Octopus, are related to non-transport services[12]

Moscow is planning to equip all metro pay-gates with PayPass and PayWave in 2018[14]

* Los Angeles—Long Beach—Santa Ana Urbanized Area.

DURING THE TRIP

Convenience

Electronic services

Electronic services, in particular mobile apps, drive improvement of service levels and change of business models in almost all customer-facing industries, and urban mobility is no exception. For our research we defined electronic services as presence and quality of transport apps, availability of information in real-time and Wi-Fi coverage.

The leading cities, Paris, Beijing, Hong Kong, Seoul, and New York generally score high across most of the aspects. In these cities we observe a universe of apps to support residents in every interaction with the transport system. For instance, Hong Kong has introduced an app to help the visually impaired use, for instance, Google maps. VoiceMap HK identifies the user's current position, searches for nearby transport links and amenities and derives detailed directions.

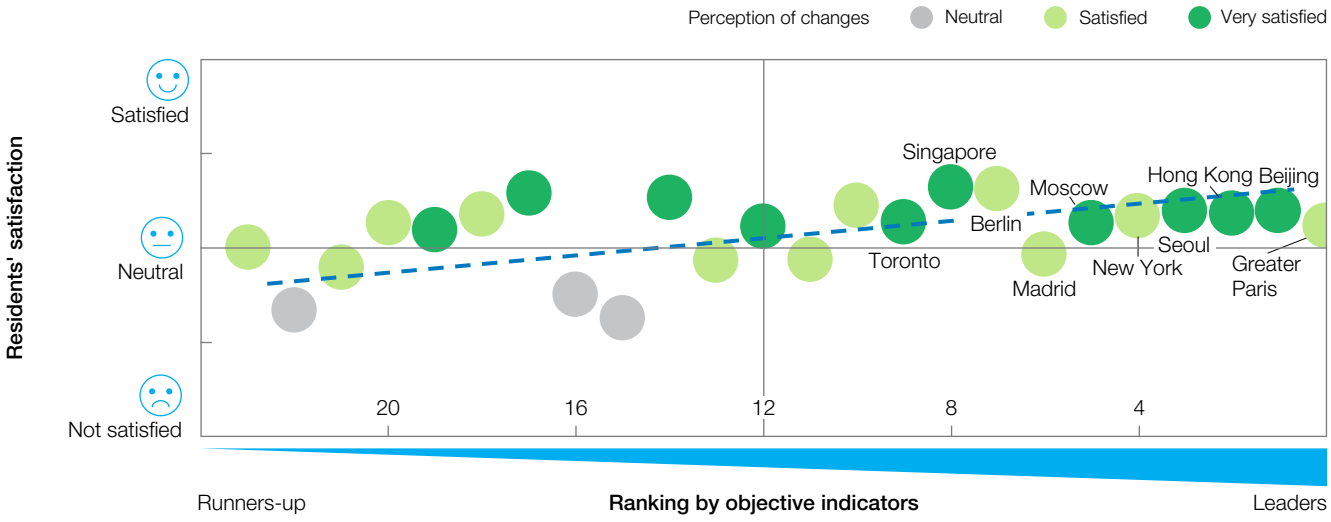
The ubiquity of these services is a comparatively new phenomenon. In the majority of cities it only became widespread in the last five years. Since the nature of these services makes peoples' lives easier without trade-offs, residents are generally satisfied with them.

One of the larger trends in this dimension is further development of transport e-services as an ecosystem for residents' needs, raising the question of who would play the leading role in managing the most important customer interfaces—city administrations or technology companies. This would involve questions around who will collect most of the personalized geodata, influence passengers' transport behavior, manage transport systems in real time, and get opportunities to earn additional revenues from selling aggregated data and doing personalized targeting.

Parameters

- Penetration of the most popular official transport app, percent
- Average rating of official transport apps
- Wi-Fi availability in metro carriages, at metro stations, in buses, and at bus stops
- Availability of real-time online information about public transport
- Online information about parking; ability to pay for parking online

Perception vs. reality: Electronic services



Many cities like Berlin have real-time arrival information on bus stops

Hong Kong provides internet service in some metro stations

DURING THE TRIP

Convenience

Parameters

- Average distance, in meters, from metro station to the three nearest bus/tram/trolley stops
- Average transfer time between public transport modes
- Availability of citywide wayfinding system

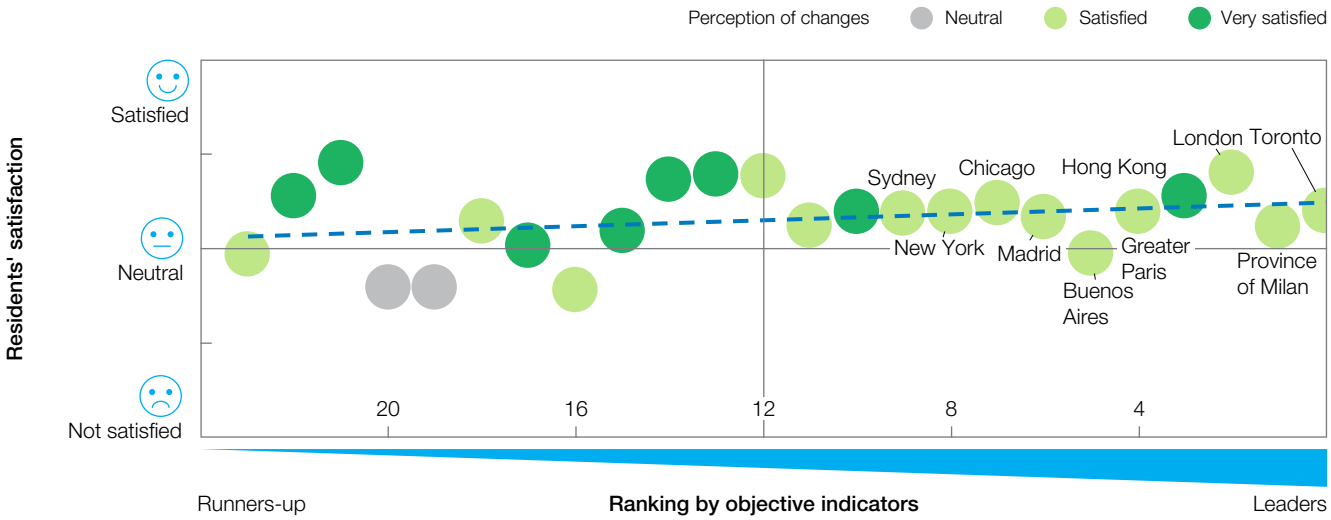
Transfers

While electronic services tend to bind transport virtually, transfers, or mixed-mode transportation, allows its physical connectivity. We measured such intermodality based on how quickly and easily residents can switch between transport types to get where they're going.

The leading cities, Toronto, Milan, and London, generally aim to have a seamless transport system, where, for instance, ground transport stops are located close to metro stations and can be easily found and reached. For example, one of the principles of London public transport planning is ensuring efficiency and usability of interchange facilities. In that regard, the city was also among the first to create a standard for pedestrian wayfinding. Since 2006, 1,700 totems and signs have been installed all over London.[15]

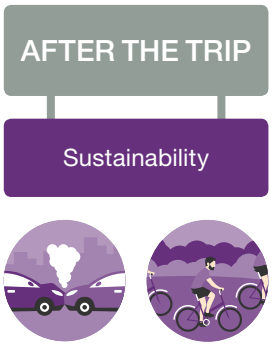
Residents generally enjoy the connectivity of their current transport networks and are, moreover, satisfied with the progress in the field over the last years. However in many cities the major challenge to providing a seamless transport journey is the increasing share of passengers traveling higher distances away from cities' suburbs. To provide decent alternatives to using cars cities have to go beyond their typical zone of responsibility and ensure seamless intermodal transportation services in suburban areas, including effective suburban bus routes seamlessly integrated with suburban rail, convenient park-and-ride facilities near stations, ticketing integration, and more strategically balanced development of suburban workplaces. The Paris metropolitan area represents a good example of how joint transportation management for an entire agglomeration can create seamless integration of suburban areas. There, an integrated authority manages the transportation systems of both Paris and the Greater Paris region.

Perception vs. reality: Transfers



London has a unified wayfinding system—there are more than 1,700 Legible London signs all over the city

The Canary Wharf station's internal space is simply laid out, with clear paths from entrance to platform



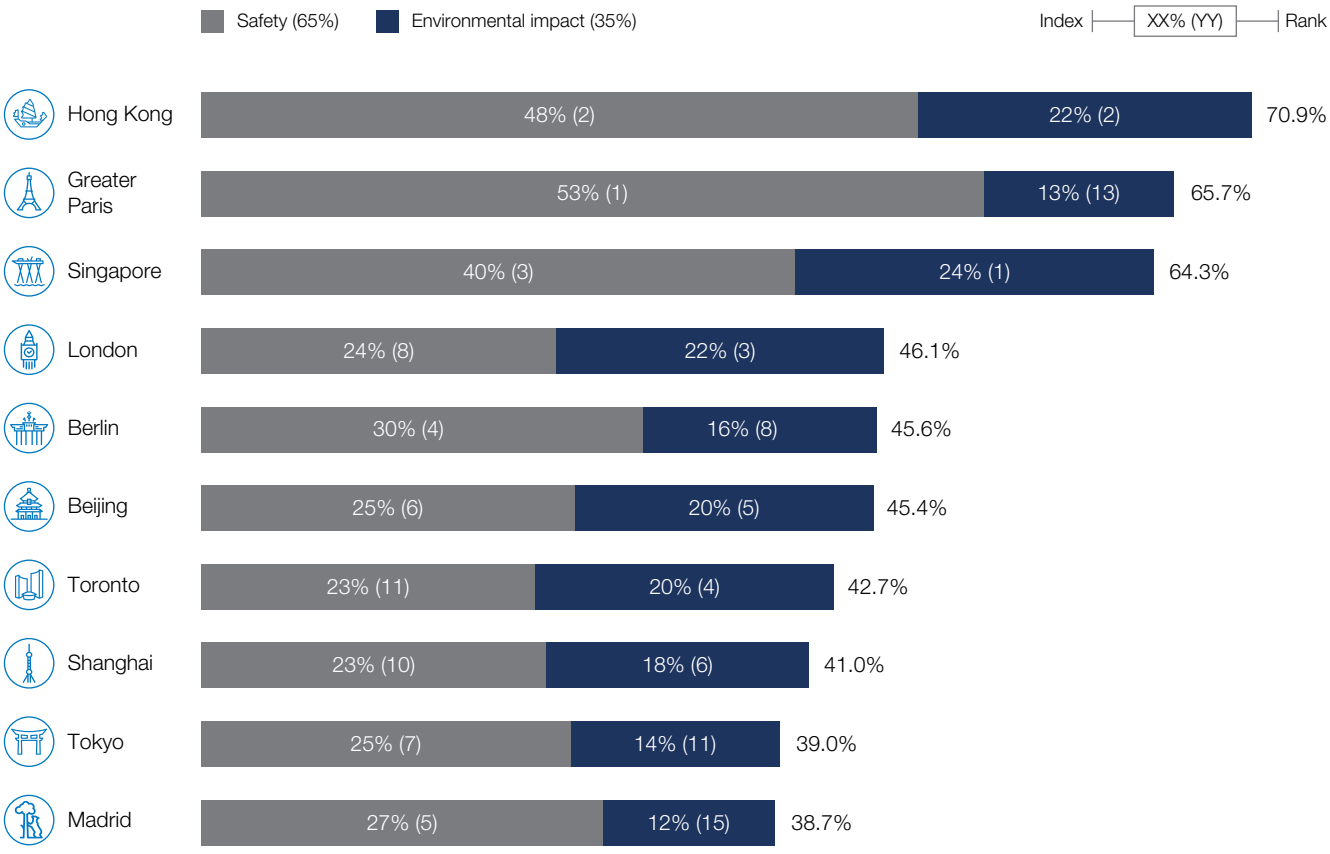
Sustainability

To complete the overview of transport system effectiveness from the residents' perspective we assessed sustainability of provided services. We believe that the best-in-class transportation system should not only provide a great experience before and during the trip, but also be safe and environmentally responsible.

Based on the survey of experts almost twice as much weight was assigned to safety than to environmental impact—that's why the leading cities in this dimension are usually scored in the top ten in safety. The three leading cities, which are far ahead of the competitors, are Hong Kong, Paris, and Singapore. These cities have the safest transportation systems—the number of road casualties is on average the lowest there.

However, environmental impact of transport systems shall not be underestimated, as transport is considered to be one of the main reasons for increasing pollution in cities globally. Moreover, in contrast to safety, the consequences of poor ecology are unlikely to be limited to passengers only, but also children and older people who typically have less active transport usage patterns.

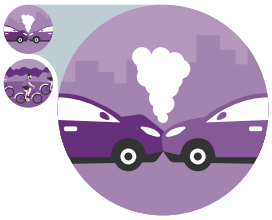
Top ten cities: Sustainability



Figures may not sum due to rounding

AFTER THE TRIP

Sustainability



Safety

Based on the residents survey, transportation safety is the most important element of all urban mobility aspects for people around the globe. For the purpose of this ranking we measured safety as the number of accidents on roads leading to deaths and as level of enforcement of relevant rules.

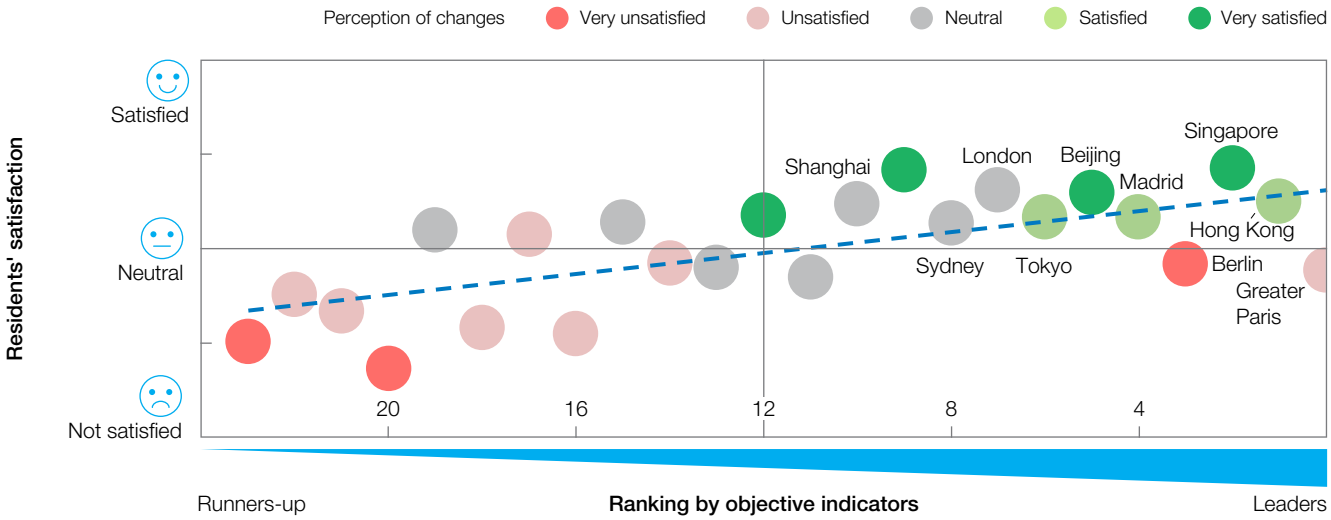
Paris, Hong Kong, and Singapore have the lowest road accident rates and are among the leaders in ensuring the road safety measures. For instance, Singapore has developed a comprehensive safety policy that is being run jointly by Land Transport Authority and Traffic Police of Singapore. It relies on the ITS solutions—cameras, sensors, signage, and signaling – and allowed one of the safest cities to become even safer: the number of fatal accidents fell by 21% since 2013[16].

Comparing safety rankings by objective indicators and survey results we can see that perception reflects the factual safety levels well, both compared to perception of the current situation and changes in recent years.

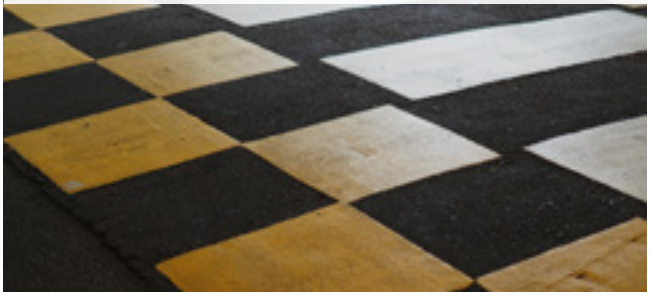
Parameters

- Number of road casualties, per million people
- Number of public transport casualties, per million people
- Safety enforcement index

Perception vs. reality: Safety



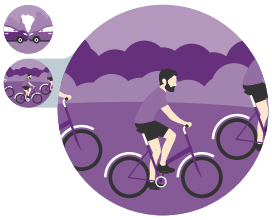
Raised zebra crossings in Singapore force drivers to slow down, and allow pedestrians to be seen better



37% of Parisian roads are limited to 30km/h, reducing accidents and their severity[17]

AFTER THE TRIP

Sustainability



Environmental impact

We asked people only about the impact of transport systems on ecological sustainability. Hence, the main focus was to estimate the impact of cars on cities' ecology based on the volume of car-hours spent on roads, ecological and fuel requirements.

The leading cities, Singapore, Hong Kong, London, Toronto, and Beijing, manage ecological sustainability by enforcing various restrictions. For instance, most of them enforce a Euro-6 fuel standard, have relatively strict limits on the times trucks can enter their city centers, and actively develop the market for electric vehicles (EV).

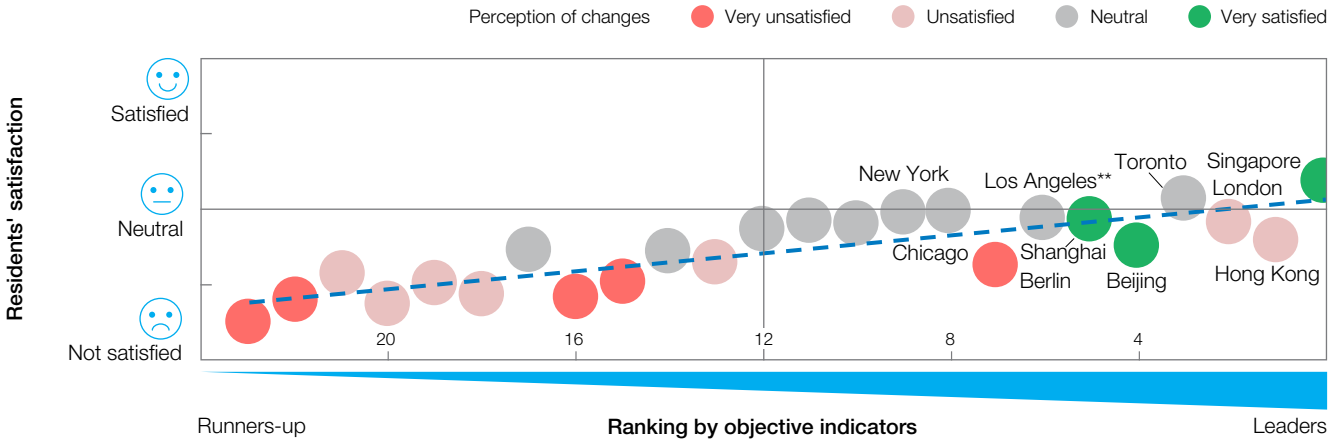
Ecological sustainability of the transport system is a top-of-mind concern for residents. They are mainly dissatisfied with the current state of cities' transport systems' eco-friendliness. Moreover, residents' perception is that transportation is becoming less eco-friendly in most of the cities surveyed, possibly because they connect increased congestion with a lack of sustainability.

While McKinsey and C40 Cities, a network of mayors of the world's megacities committed to addressing climate change, sought in its 2017 report* to prioritize 12 out approximately 400 possible sustainability initiatives, we still don't observe a unified approach applied by cities on how to make an overall city, and its transport system in particular, ecologically sound. For instance, Hong Kong actively promotes the use of EV cars and is one of the leaders in this area—more than 6 percent of passenger cars sold are EVs, which is a result of complex governmental policy[18]. At the same time the Mayor's Transport Strategy in London is actively encouraging more sustainable means of transport, through a cycling revolution, improving conditions for walking, and enhancement of public transport.

Parameters

- Diesel and gasoline fuel standards, Euro
- Average age of vehicles on the road, years
- Electric vehicles, as percentage of car sales
- Machine hours worked per 1 sq km of defined area weekly, hours

Perception vs. reality: Environmental impact



London cycle flows have increased by more than 50 percent from 2014 levels[19]

Hong Kong tramcars emit zero roadside emissions

* "Focused acceleration: A strategic approach to climate action in cities to 2030," The McKinsey Center for Business and Environment & C40 Cities, McKinsey Global Institute, November 2017.
** Los Angeles—Long Beach—Santa Ana Urbanized Area.

Top ten city profiles

Singapore

Analyzed area: 697 sq km

General information

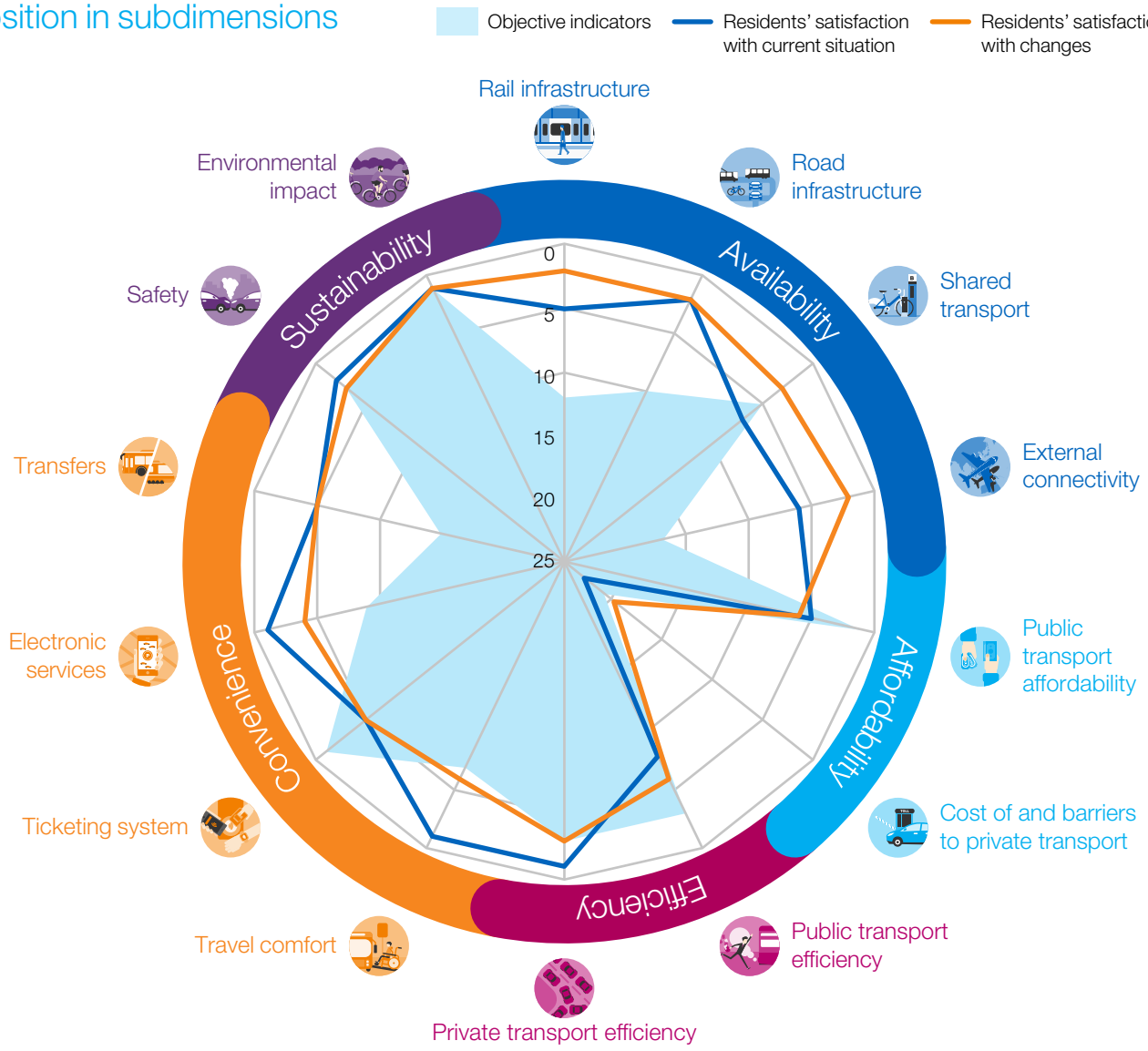
City population, millions	5.6
GRP per capita, in US$ thousands, PPP	66.9
Population density, people per km²	8,100
Cars per 1,000 people	101

People satisfied with overall situation in public transport, %	86
People satisfied with recent changes in public transport, %	83

People satisfied with overall situation in private transport, %	71
People satisfied with changes in private transport, %	73

Numbers have been rounded

Position in subdimensions



Singapore

Singapore is among the top-ranked cities for public transport, and also has among the safest and most ecologically sustainable systems. However, the city continues to evolve. As the population is expected to grow to more than six million people by 2030, the government is improving the existing transport network by building a new terminal and runway at Changi Airport, extending and increasing the reliability of the Mass Rapid Transit (MRT) system, opening more cycling paths, and launching EV sharing and taxis, among other initiatives.

Objective achievements

Singapore has created a best-in-class public transport system, which is accessible, efficient, convenient, sustainable, and at the same time affordable.

- One distinctive feature of Singaporean public transport is efficiency—the country's Land Transport Authority (LTA) is now working on developing a system of predictive maintenance.
- Affordability is another advantage. A major step toward affordability was made in 2013, when the fares were reviewed and new measures were introduced, including a 15 percent discount on adult fares for low-wage workers, free travel for children, and seven other concessions. As a result, more than one million public transport passengers benefited from the new scheme.
- The convenience and flexibility of the Singaporean ticketing system is another outstanding feature. The EZ-link card is the unified contactless stored-value card, introduced for public transport in 2002. The scheme successfully blends the major ticketing advances—it can be topped-up via multifunctional EZ-Link App, lets users earn and redeem reward points for all transactions made with the EZ-Link card, including non-transport services. In 2017 LTA piloted paying for bus and train rides with credit cards.

Residents' perceptions

The residents greatly appreciate their transport system and how it has evolved over the last years—they are the most satisfied on 13 out of 14 aspects analyzed, both in terms of their transportation's current state and its changes, as compared to residents globally.

- The electronic services and their evolution are among the transport features that residents enjoy most. LTA continues to enhance these: in 2016 it started partnering with four leading tech companies, Citymapper, Google, Hugo, and Quantum Inventions, to develop new enhanced trip planners, which incorporate transfers into planning intermodal public transport routes.
- Singaporeans tend to be very satisfied with their city's external connectivity, although it lags that of other cities. Given that it is an island/city-state, the city's absence of domestic flights is expected, and undiminished by the number of international flights offered.
- The only concern of the residents is affordability of private transport, which coincides with the objective indicators. However, this is the result of deliberate a car limiting policy, which includes relatively high costs of buying a new car (more than $74,000 for a small SUV), the requirement for a special certificate from the government to start driving (up to $37,000) and a charge to drive to the city center.

Aspects where Singapore is in the top ten cities

LTA is now working on developing a system of predictive maintenance. The Rail Enterprise Asset Management System, which would consolidate and integrate information collected from all train lines into one database. This would predict potential faults, enhance prevention, and determine an optimal maintenance scheme.

Metropolis of Greater Paris

Analyzed area: 762 sq km

General information

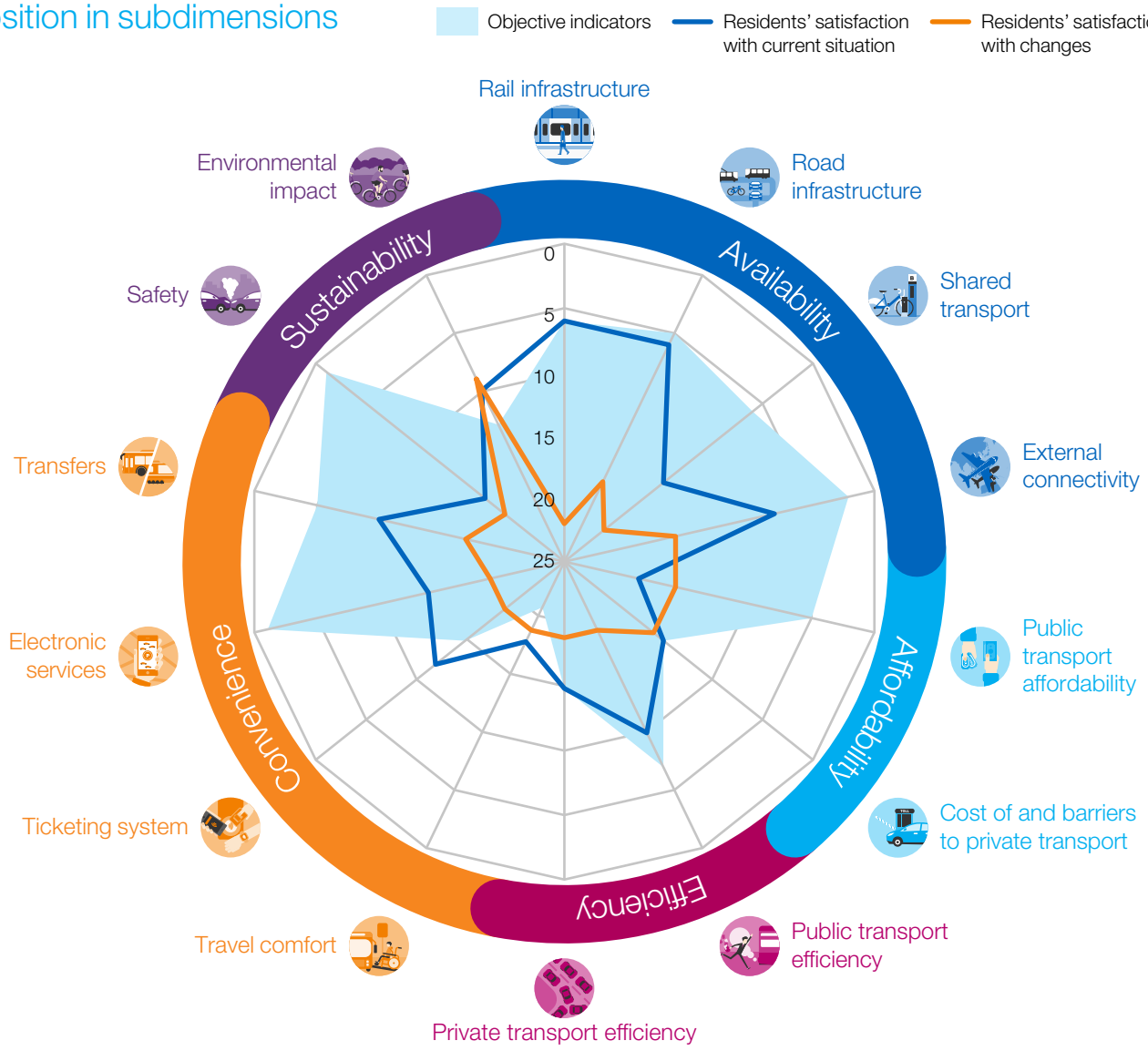
City population, millions	7
GRP per capita, in US$ thousands, PPP	57.2
Population density, people per km²	9,200
Cars per 1,000 people	530

People satisfied with overall situation in public transport, %	68
People satisfied with changes in public transport, %	67

People satisfied with overall situation in private transport, %	60
People satisfied with changes in private transport, %	56

Numbers have been rounded

Position in subdimensions



Metropolis of Greater Paris

Paris has one of the most developed transport systems and is among the best cities for public transportation. Committed to a focus on pedestrian- and bicycle-centric programs, Paris has already ensured a sufficient infrastructure for non-motorized transport and is planning to further develop this by creating more car-free zones and promoting public transportation. The city's focus on prevention of road accidents and making passenger safety the main priority of public transport network makes Paris distinctive at ensuring passenger safety.

Objective achievements

Paris has a distinctive and passenger-friendly transport system that emphasizes public transportation and non-motorized transport modes.

- One of the strengths of the Parisian transport system is its developed road infrastructure, yet the mayor of Paris, Anne Hidalgo[20], has deliberately initiated a shift from cars to pedestrian and bicycle friendliness. A number of districts and streets have been already turned car-free and the city does not plan to stop. For example, in 2016 2.4 km of River Seine quayside—an important thoroughfare—was turned car-free and the plan is to further expand car-free zones and restrictions.

- Paris has also ensured best-in-class transportation safety and managed to decrease traffic fatalities by 40 percent since 2010[21]. As public transport safety is one of the major priorities of the RATP, the state-owned transport company, it enforces a variety of safety-oriented initiatives from metro tracks maintenance and replacement programs to more than 40,000 cameras, ensuring passenger safety control onboard and at stations.

- Another outstanding feature of the Parisian public network is a focus on passenger-friendly service, especially via sophisticated electronic services. For example, 2,400 real-time information screens help Parisians and visitors navigate the multi-modal public transport network better.

Residents' perceptions

Although Paris has one of the most sophisticated transport systems, its residents tend to be more skeptical about it and its recent changes—the resident satisfaction level is generally lower across most of the subdimensions.

- However, the residents feel excited about transport sustainability, especially about the eco-centric initiatives, which Paris has actively implemented in recent years. One of the most distinctive ones is opening the first fully electric bus line, and a plan to equip two other lines to test an alternative battery mechanism. The city plans to have a 100 percent "green bus" fleet by 2025.

- Public transport is also generally appreciated—residents like how efficient it is at the moment and how developed the rail infrastructure is. This seems reasonable, as the Parisian metro is known to be one of the densest metro systems in the world, with 245 stations. Moreover, it plans to extend to suburbs by opening new lines and stations with the Grand Paris Express project.

- One of the major concerns is relatively low travel comfort, as the Parisian metro is hardly accessible to the disabled. The metro is relatively old and was constructed without elevators, making it impossible to add them now. However, the city is working to make public transport more usable for the disabled. Ground transport is currently 100 percent accessible.

Aspects where Paris is in the top ten cities

The Grand Paris Express project is a massive public transport network expansion aimed at delivering high-class rapid transit to more than two million passengers daily. The project includes building four new automated metro lines around Paris and extending two existing lines, for more than 200 kilometers of new track and 72 stations in total. The first stations are planned to open in 2020, while the full deployment is expected in 2030.

Hong Kong

Analyzed area: 90 sq km

General information

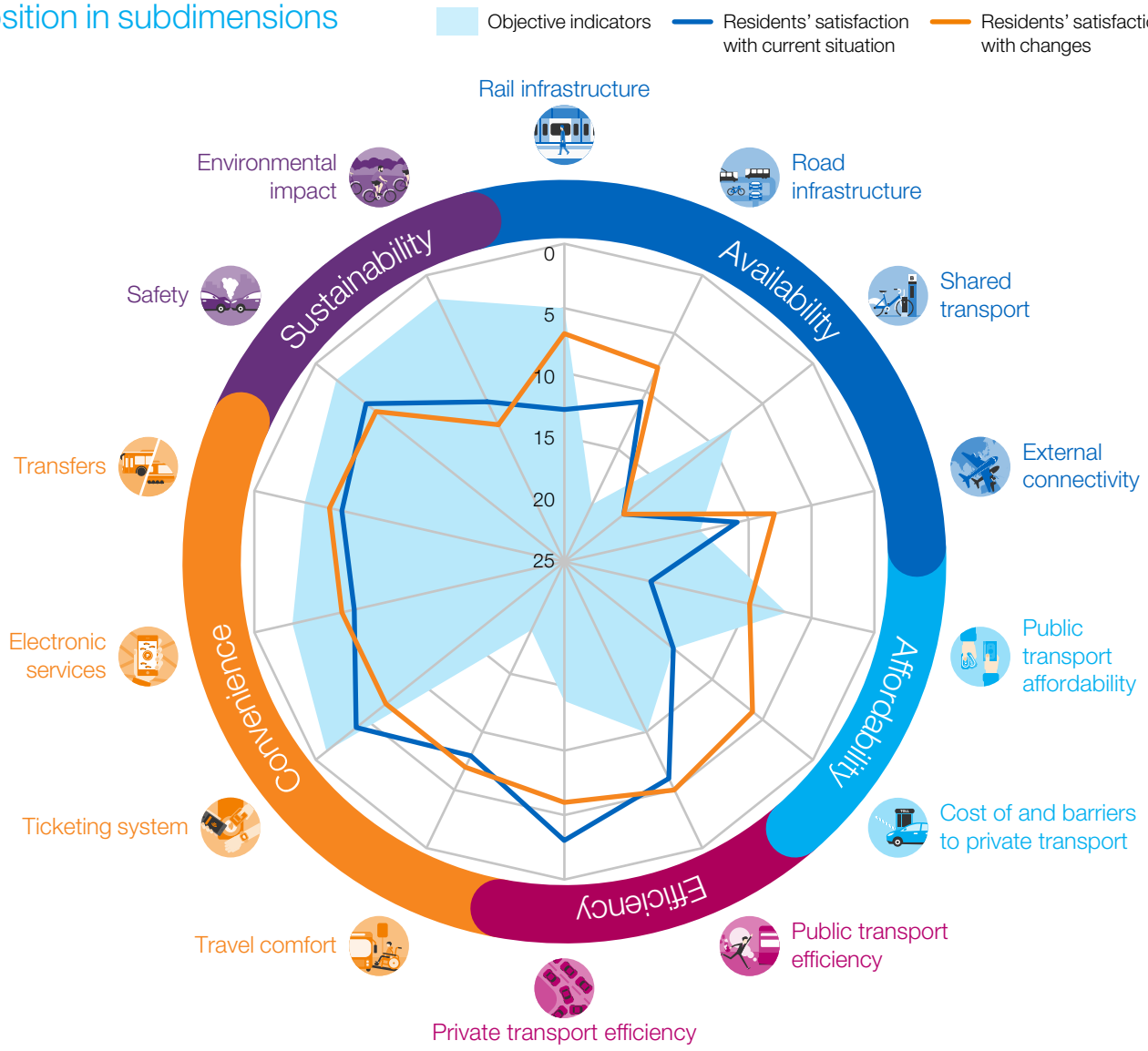
City population, millions	3.3
GRP per capita, in US$ thousands, PPP	57.2
Population density, people per km²	36,300
Cars per 1,000 people	63

People satisfied with overall situation in public transport, %	83
People satisfied with changes in public transport, %	81

People satisfied with overall situation in private transport, %	72
People satisfied with changes in private transport, %	77

Numbers have been rounded

Position in subdimensions



Hong Kong

Being among the most densely populated cities and one of the Asian financial centers that attracts daily commuters, Hong Kong faces the challenge of providing reliable and efficient transportation for its 7.4 million residents and approximately 58 million visitors annually. The city manages the challenge well and ensures best-in-class public and private transportation. Hong Kong is working on expanding the transport network, easing congestion, and managing sustainability issues.

Objective achievements

Hong Kong has a well-developed transport system, which is among the top-rated globally in rail infrastructure, safety, environmental impact, ticketing system technologies, and electronic services.

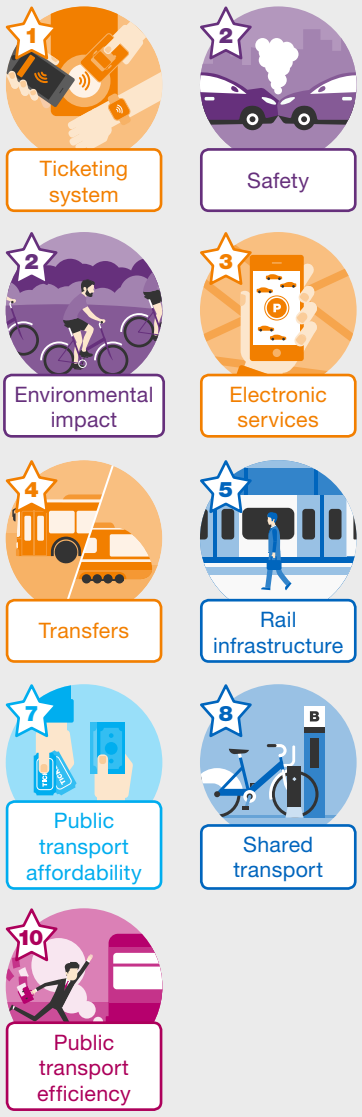
- Public transport is a special distinction of Hong Kong—the city has one of the best public transport coverage ranges in the world, with 75 percent of the population and 94 percent of workplaces being within one kilometer of a metro station. The backbone of public transport is heavy rail, accounting for 37 percent of trips, and the system is complemented with light rail in the Northwest New Territories, and trams mostly along the northern side of Hong Kong.
- Hong Kong is actively applying modern technologies, and is among technological leaders. The city's advanced ticketing system, Octopus chip card, is well known around the world as an example of innovative solutions. It is used by 99 percent of residents and can be used not only to pay for transport and non-transport services, but also for non-payment purposes, such as access control for office buildings.
- Hong Kong shows high progress in sustainability and safety in recent years. The city is one of the global leaders in EVs popularization—the current number of EVs on roads is more than 10,000, while in 2011 there were only 69 of them. Regarding safety, the number of fatal road accidents decreased by approximately 15 percent in last ten years.

Residents' perceptions

Hong Kong residents are satisfied with their existing transport system and recent changes, especially in safety, convenience, and efficiency.

- Residents perceive as outstanding the ticketing system, and electronic service and safety, which are one of the best-in-class globally.
- Notably, Hong Kong residents are generally satisfied with the dynamics of public transport costs, while the perception is usually negative for all other cities. Hong Kong is implementing initiatives to further improve transport affordability by providing a variety of fare promotions for regular users, the elderly, and disabled passengers.
- Residents tend to underestimate sustainability of their transport system, although Hong Kong is among the leaders in this regard. Moreover, the perception of change is also lower, than one might expect.
- The major potential for Hong Kong, based on residents' perceptions is transport sharing schemes, which are only emerging there. The sharing is already a part of a long-term strategy for the city, and planned actions include developing bicycle lanes and public parking facilities at major transport hubs.

Aspects where Hong Kong is in the top ten cities



Mass Transit Railway (MTR) is the major public transport network in Hong Kong carrying around 4.8 million passengers daily. The network has quadrupled in length over the last 20 years and now is 231 kilometers long with 91 stations. Additional expansion will increase its length by 25 percent, which would include building new stations and lines.

London

Analyzed area: 1,607 sq km

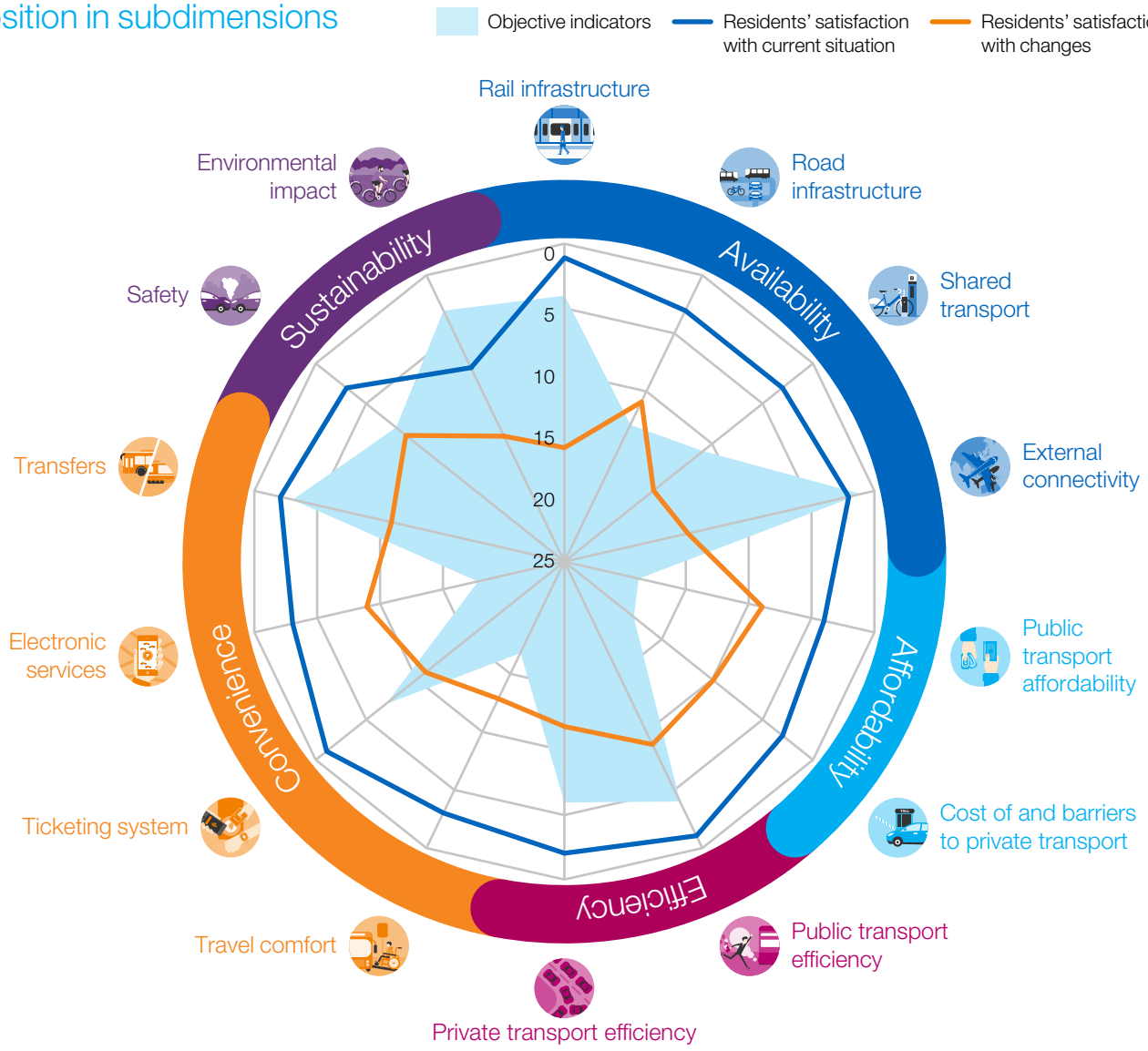
General information

City population, millions	8.4
GRP per capita, in US$ thousands, PPP	57.2
Population density, people per km²	5,200
Cars per 1,000 people	213

People satisfied with overall situation in public transport, %	85
People satisfied with changes in public transport, %	79
People satisfied with overall situation in private transport, %	69
People satisfied with changes in private transport, %	61

Numbers have been rounded

Position in subdimensions



London

London has faced substantial population growth over the last decade, and expects an increase of more than a million over the next 20 years. Such rapid growth is a challenge to the London transportation system. The city is investing to manage the issue, spending around US$11.8 billion in 2015-16 to expand the transport network, and to make it more efficient and passenger-friendly. More changes are to follow—London is prioritizing public transportation, cycling, and walking, aiming to increase their share of usage to 80 percent by 2041.

Objective achievements

London has well-developed private as well as public transport; it is among the most efficient, safe, and sustainable globally, and continues to evolve.

- The London transport system is highly efficient both for private and public vehicles. Ensuring reliability of public transport is one of the major priorities of Transport for London (TFL), the government body responsible for transport in Greater London. Regular maintenance, track renewal, and increasing numbers of trains at peak hours are just a few of TFL's recent initiatives. Efficiency of private vehicles is driven by advanced ITS that allows better monitoring and management of traffic, while congestion charges and high costs of parking help limit the number of cars in the city center.

- Intermodality, or mixed-mode transit, is one of London's distinctive features: in 2006 the city introduced a unified wayfinding system, Legible London, to make the streets more convenient for residents and travelers. Since 2006 more than 1,700 signs have been installed all over the city. Legible London is recognized as one of the best wayfinding systems globally and has won a number of awards.

- Safe transport is another of London's significant achievement. Having adopted Vision Zero, London has implemented a number of safety initiatives in recent years and has decreased fatal road accidents by 45 percent on average between 2005 and 2009. The city aims to completely eliminate deaths and serious injuries on the London transport system by 2041.

Residents' perceptions

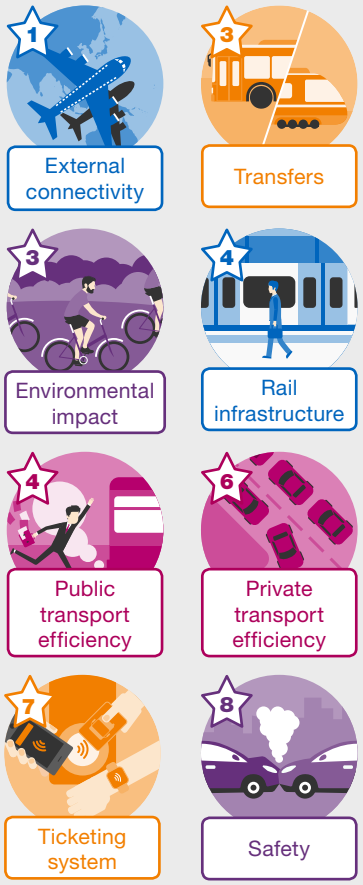
The survey shows residents are extremely satisfied with almost all aspects of the transport system, although objective indicators and qualitative feedback show there are a few areas for improvement. Londoners are also satisfied with the recent changes, however to a lesser extent than their overall perceptions of the system.

- Londoners especially appreciate the recent changes in public transport fares, since the city is now aiming to make public transport more affordable. The mayor committed to freezing public transport fares at the 2016 level until 2020, which is expected to save up to US$280 for an average household over the four-year period.[22]

- Ticketing is also among the features residents appreciate at most. Oyster card, which can be used across most of the transport services in London, makes payments more convenient by providing a wide range of online features.

- Although London transport is among the most ecologically sustainable systems, residents still see room for improvement there, and are a little conservative about the recent changes in this aspect. Residents are also skeptical about the recent changes in the coverage of rail infrastructure. However, major extensions are yet to come—the city plans to expand two existing Tube lines (see box), and the Elizabeth Line, which extends out beyond the city itself is set to launch in December 2018.

Aspects where London is in the top ten cities



The London Underground, the Tube, is currently 402 kilometers in length and is the world's third-longest metro system. The Tube is planning two major expansions, of the Northern and Bakerloo lines. The new stations have the potential to support 45,000 homes and 30,000 jobs. The increased capacity would ease morning and evening peak commute times and relieve congestion on local bus and National Rail services.

Madrid

Analyzed area: 604 sq km

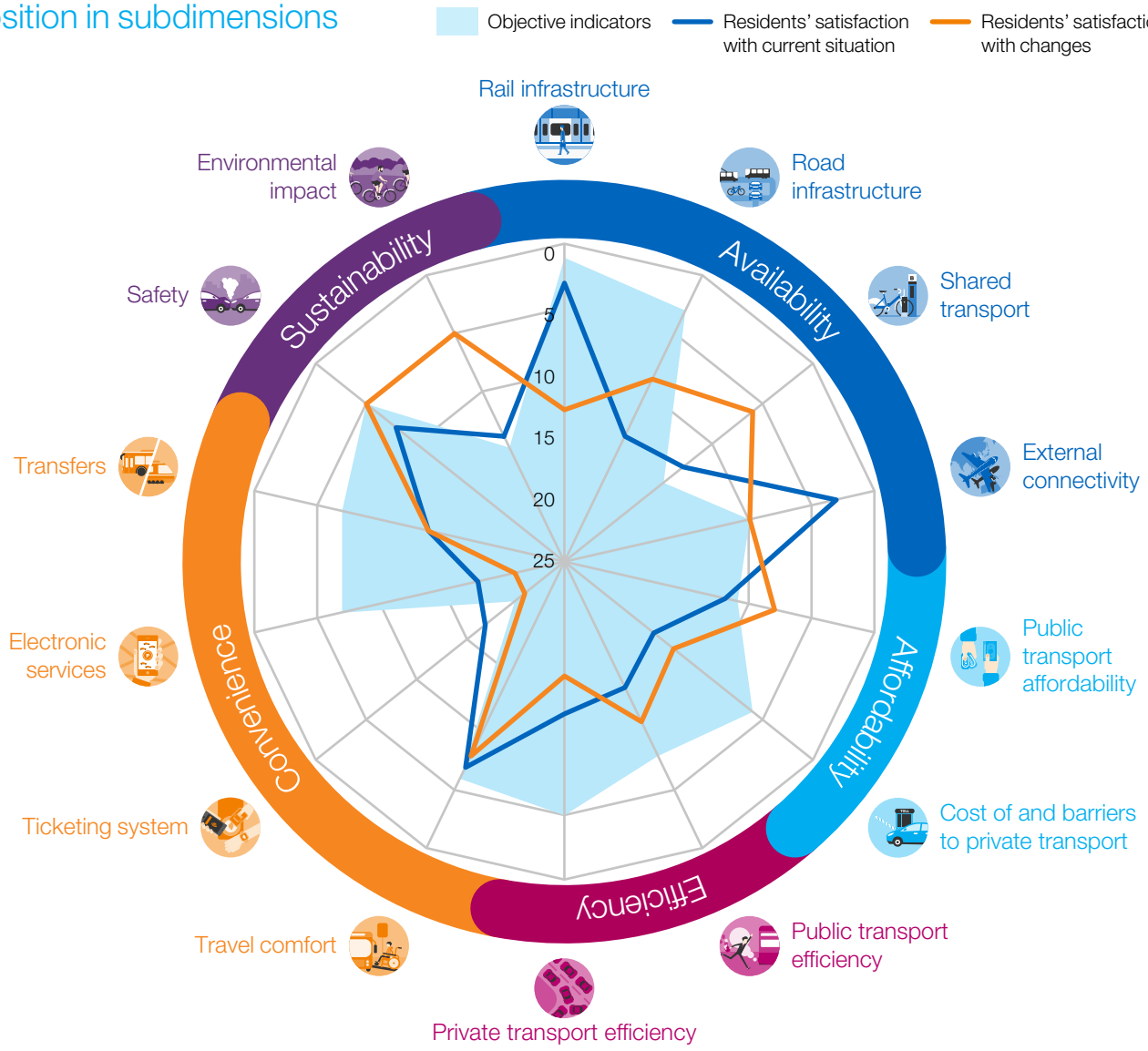
General information

City population, millions	3.2
GRP per capita, in US$ thousands, PPP	39.3
Population density, people per km²	5,200
Cars per 1,000 people	563

People satisfied with overall situation in public transport, %	76
People satisfied with changes in public transport, %	79
People satisfied with overall situation in private transport, %	61
People satisfied with changes in private transport, %	64

Numbers have been rounded

Position in subdimensions



Madrid

Madrid shows outstanding performance, despite its unique challenges. Madrid Central Almond area accounts for only 0.5 percent of surface area, yet concentrates more than 35 percent of jobs. Due to such imbalance more than 1.25 million commuters come to the city on an average work day. The developed radial roads serve as arteries for them, but such significant passenger traffic inevitably boosts congestion. However, the city has a plan in place to address the issue.

Objective achievements

Madrid managed to create a well-balanced transport system, which enables best-in-class mobility for both private and public transport. The major distinctive features of Madrid transport are its efficiency and strong coverage.

- The Madrid underground provides the greatest coverage in comparison with other metro and subway rail networks analyzed—more than 89 percent of the population and 97 percent of jobs are within a one-kilometer radius from a station. Metro de Madrid's network is 294 kilometers long and comprises 13 lines with 301 stations.[23] To ensure better availability for private transport, from 2004 to 2007 a number of new sections of M-30 (inner ring) roads with 99 kilometers in total length were added. These allow better connection between the city and the suburbs.

- One of the greatest features of Madrid transport is efficiency, which is being continuously improved. The Municipal Transport Company of Madrid has recently enhanced bus service and decreased average waiting time by improving maintenance and operations management, renewing the bus fleet, increasing the workforce of drivers, and extending the bus lines. Regarding private transport efficiency, Madrid is a unique case as it manages to ensure highly efficient private transport without introducing significant costs and restrictions to limit cars.

Residents' perceptions

Residents of Madrid are highly satisfied with the current state of some aspects of their transport system and appreciate the recent changes in most of the other aspects.

- The features, people enjoy most are rail infrastructure and travel comfort which are in fact well-developed. Regarding travel comfort, Madrid transport is highly accessible; 60 percent of metro stations and 100 percent of bus stations are wheelchair-accessible, and the quality of transportation service is constantly controlled.

- The major changes people appreciate at most are in shared schemes, safety, and environmental impact. Madrid is aiming to further improve shared transport and is doubling the number of shared bikes to 4,000 and is expanding the dock stations beyond the M-30 circle. To make transport more eco-friendly, the city is planning to promote non-motorized transport, for instance, widening sidewalks for pedestrians and creating segregated cycling lanes. The city is also planning to create zero-emission areas in the city center in 2018.

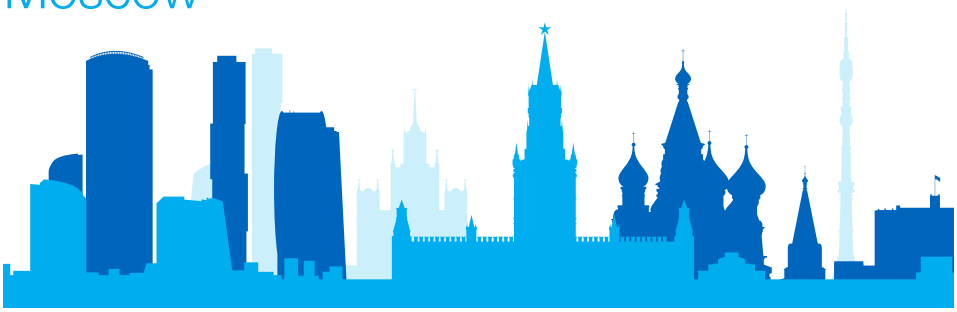
- Residents tend to be concerned about convenience aspects such as ticketing, electronic services, and the ability to transfer between transit types (intermodality), both their current state and the changes to the system. This might serve as a signal that an area for improvement exists there.

Aspects where Madrid is in the top ten cities

Gran Vía, a busy six-lane shopping street in the heart of Madrid, is planning to get car-free until May 2019. There has been a long debate of its future, and in the beginning of 2017 it was decided to make the street accessible only to pedestrians, bikes, buses, and taxis. Gran Vía was already partionally closed to non-residents' cars for nine days over the Christmas holiday.

Moscow

Analyzed area: 1,096 sq km



General information

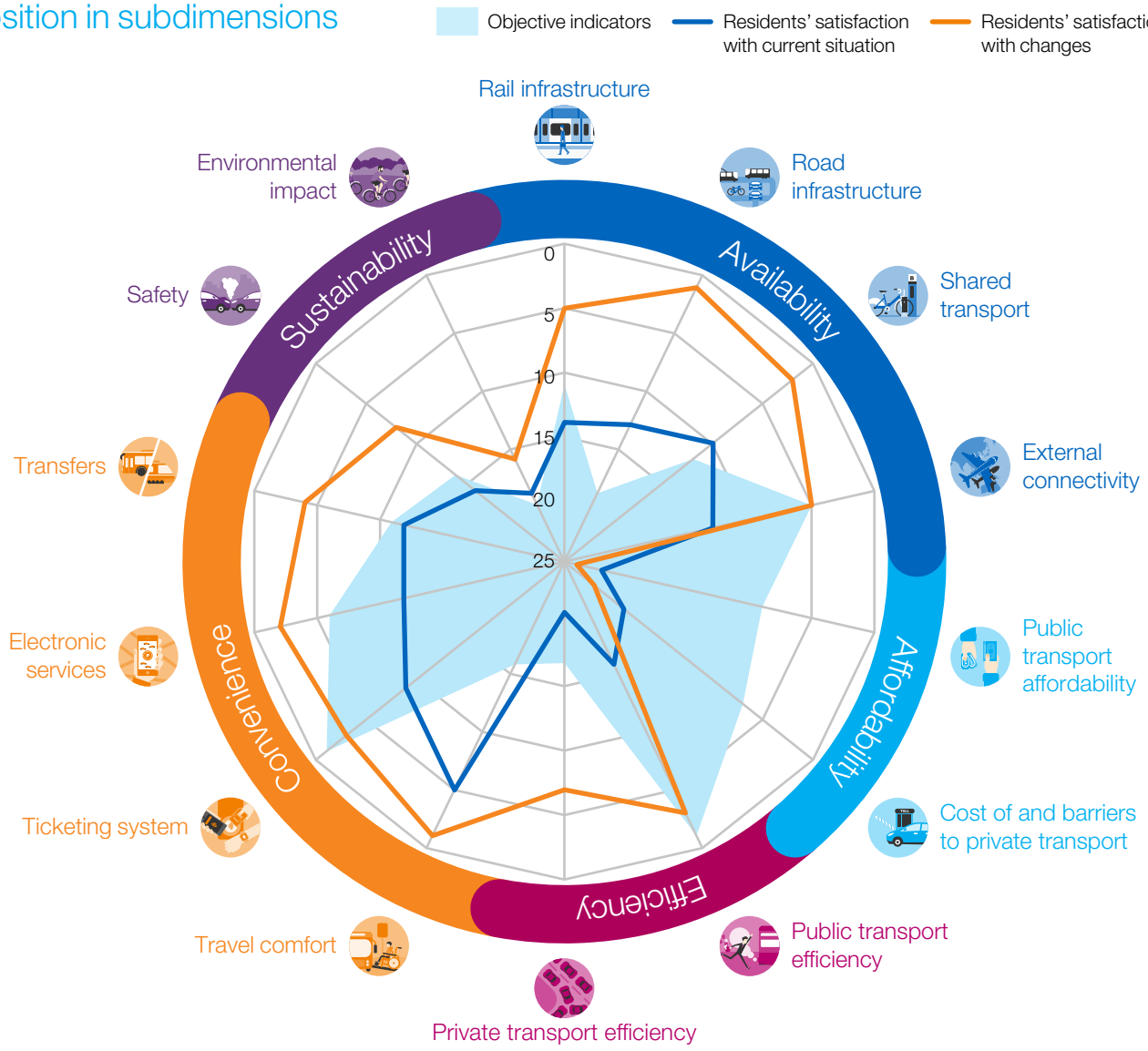
City population, millions	12.4
GRP per capita, in US$ thousands, PPP	45.8
Population density, people per km²	11,300
Cars per 1,000 people	341

People satisfied with overall situation in public transport, %	75
People satisfied with changes in public transport, %	79

People satisfied with overall situation in private transport, %	48
People satisfied with changes in private transport, %	64

Numbers have been rounded

Position in subdimensions



Moscow

The Moscow transport system faces three major challenges: 1) inflow of residents from all over Russia, 2) rapidly increasing numbers of commuters from the greater Moscow region, where the number of jobs is lagging behind steady population growth, and 3) residents' desire to own a car, as it is still a symbol of success and luxury. In response to the challenges, in 2012 Moscow updated its transport strategy and prioritized public and non-motorized transportation. The strategy sought to popularize public transport and significantly decrease congestion levels.

Objective achievements

The distinctive feature of Moscow is that it is one of the best-in-class public transport systems: it's highly efficient, relatively affordable and convenient, and, moreover, its use, as a share of all transportation, has increased by 10 percent from 2010.

- Rail infrastructure has tangibly improved over the recent years. One of the major steps was a large-scale metro expansion: 61 metro stations were built from 2010 to 2017, including the launch of Moscow Central Circle.
- Efficiency of public transport was significantly increased with optimization of ground public transport routes, a significant increase in dedicated bus lanes (an addition of approximately 285 kilometers since 2010) and renewal of the bus fleet. These initiatives helped to avoid unexpected failures, speed up ground transport, and make the service more reliable.
- In terms of convenience, Moscow's strongest attributes are its ticketing system and electronic services. The advances include adopting a unified chip card with the possibility of remote top-up and payments for activities beyond transport services, such as museums. Also, a number of alternative payment options are offered, such as mobile ticketing and PayPass/Apple Pay/Android Pay are currently being introduced. Additionally, the Moscow government has recently digitized most of the services and designed a variety of widely used transport apps.

Residents' perceptions

Moscow residents surveyed conveyed excitement about most of the changes implemented in recent years, yet the Moscow transport system is still generally undervalued by its residents as compared to other cities.

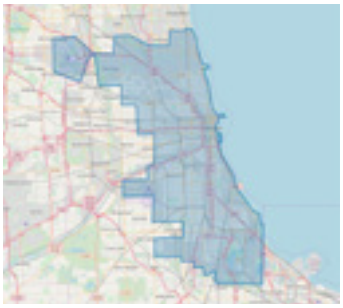
- Both current satisfaction and satisfaction with changes are highest in the availability and convenience dimensions, especially the ticketing system, electronic services, intermodality, and shared transport. The latter is the result of the active development of a municipal bike-sharing scheme, "Velobike," and of burgeoning car-sharing schemes, under which more than 6,500 cars currently operate. The success of intermodality seems to be to a large extent attributed to organizing convenient transfer hubs, adding more than 8,000 intercept (commuter) parking lots and launching a unified wayfinding system all over the city.
- Residents' key concerns are affordability and sustainability of the transport system. While sustainability can be a future point of growth, the system's true affordability is extremely undervalued, which possibly can be attributed to recent income stagnation. A point of satisfaction dissonance is public transport efficiency. While residents agree that recent positive changes were tremendous, their satisfaction lags the objective measures by a wide margin.

Aspects where Moscow is in the top ten cities

In September 2016 Moscow opened Moscow Central Circle, an orbital rail line with 31 stations that encircles historical Moscow and connects 11 radial lines. Also, an increased number of Lastochka trains circulate on the Moscow Central Circle on working days, carrying more than 430,000 passengers per day.

Chicago

Analyzed area: 621 sq km



General information

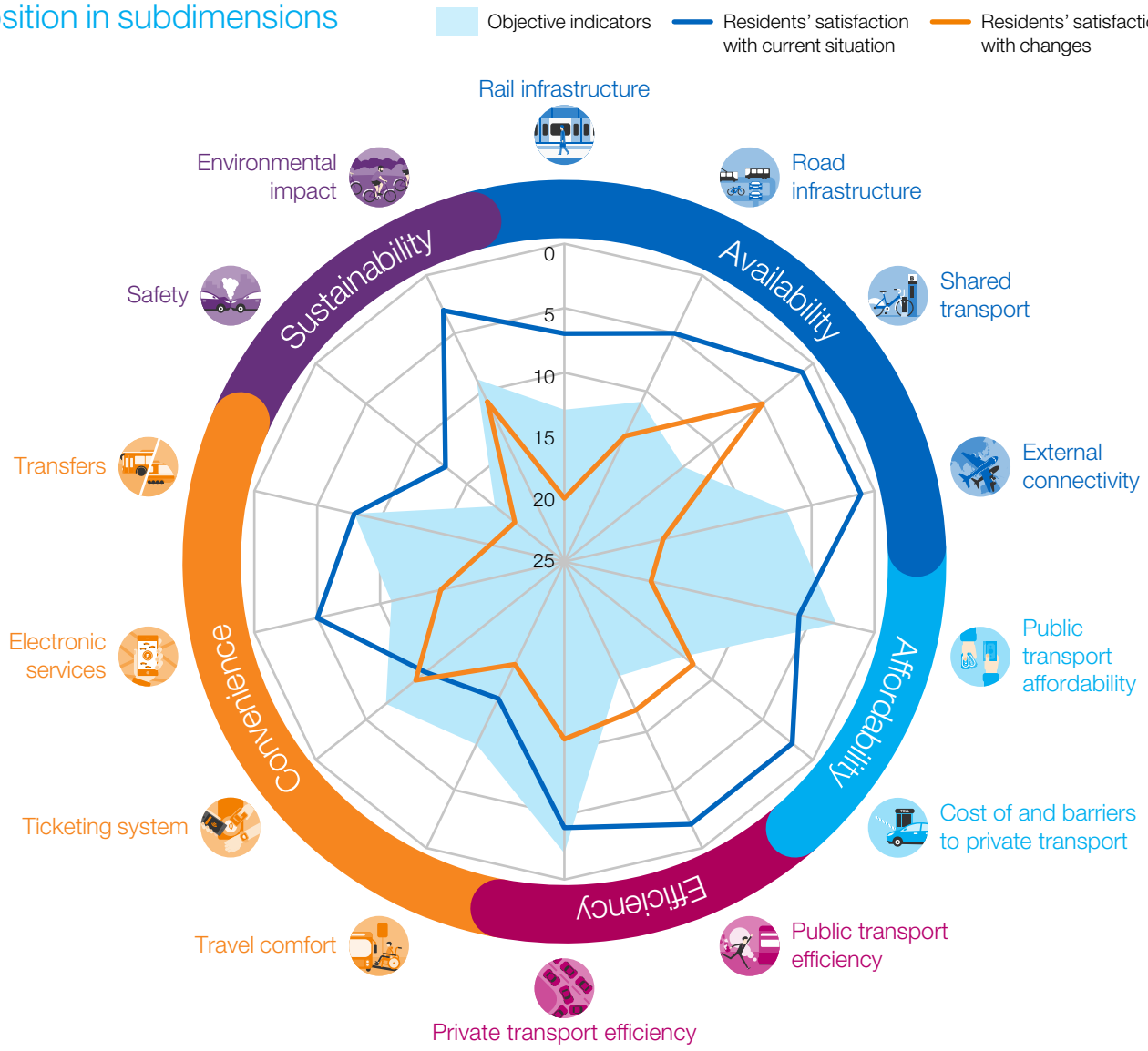
City population, millions	2.7
GRP per capita, in US$ thousands, PPP	58.9
Population density, people per km²	4,400
Cars per 1,000 people	436

People satisfied with overall situation in public transport, %	77
People satisfied with changes in public transport, %	71

People satisfied with overall situation in private transport, %	65
People satisfied with changes in private transport, %	57

Numbers have been rounded

Position in subdimensions



Chicago

Chicago is a unique city among the top ten. Despite having a well-developed transit system, the residents mostly rely on private vehicles—77 percent of trips are made by car, which is fairly high for a top ten city, but this is typical for most of the US cities. The city acknowledges its challenges of high motorization and is planning to enhance its public transport, cycling, and pedestrian infrastructure to ensure sustainable and efficient transportation in the future.

Objective achievements

The Chicago transport system offers highly convenient and affordable service.

- Private transport in Chicago is quite affordable, as there are no significant car limitations: the city only has paid parking and several toll roads within the area as restrictions. The city does not have any congestion charges, paid entrances to the city area, preventive taxes on car acquisition, or other similar methods of dissuading private car use.
- The city's public transport is also among the most affordable, although a monthly ticket is costly in absolute terms, it is counterbalanced with relatively high average income. Moreover, Chicago mass transit pass prices have been stable since 2013, and a variety of reduced-fare and free-ride schemes (for disabled people, military personnel, and seniors) is available.
- Another distinctive feature of Chicago transport is its convenience—the city ensures high travel comfort, advanced ticketing and electronic services, and offers multiple modes of transit. One of the priorities of the Chicago Transit Authority (CTA) is to make the transport accessible to anyone—currently 100 percent of buses and railcars and 70 percent of metro stations are accessible. As far as technological advances, more than 20 apps are available to passengers, with services that have a variety of functions, from real-time information on bus arrival to managing a chip card account.

Residents' perceptions

Residents are very satisfied with the transport system, especially with its availability, affordability, and efficiency. Moreover, the residents appreciate the recent changes in environmental friendliness, road infrastructure, and shared transport.

- Notably, the residents are satisfied with ecological sustainability and its changes, despite the city's relatively high motorization level. Chicago has prioritized sustainability and addressed the issue in multiple ways. For instance, since 2007 the new buses have clean-diesel engines and special filters to meet the US Environmental Protection Agency emissions standards. Also, the city aims to increase its fleet of electric buses in the future. To make the facilities more eco-friendly, CTA equipped its amenities with more energy-efficient lighting, including LED lighting.
- Under the sustainability-oriented vision, the city has also promoted cycling and walking, and accordingly, Chicago residents appreciate the shared schemes and road infrastructure, both in terms of their current development and their recent changes. In 2013 the city launched Divvy bike sharing, which currently provides approximately 6,000 bikes at 580 stations. The infrastructure for bikes has also been significantly enhanced, with more than 400 kilometers of dedicated bike lanes, and a plan to create more than 1,000 kilometers of continuous cycling network by 2020.
- Residents are concerned with safety and its recent changes, which seems to be the effect of relatively high motorization level and consequently a relatively high accident rate, in comparison with other transport networks, which are more oriented toward public transport.

Aspects where Chicago is in the top ten cities

Chicago Loop Link, constructed in 2015, was an upgrade of bus service in the central business district, which enabled reliable and speedy transportation. The project included building six bus routes, dedicated bus lanes and bus-level stations/stops, and enhancing pedestrian and cycling infrastructure. More than 30,000 bus passengers benefit from faster and more reliable service, not taking into account bicyclists and pedestrians, who benefit from enhanced safety and more space.

Seoul

Analyzed area: 606 sq km

General information

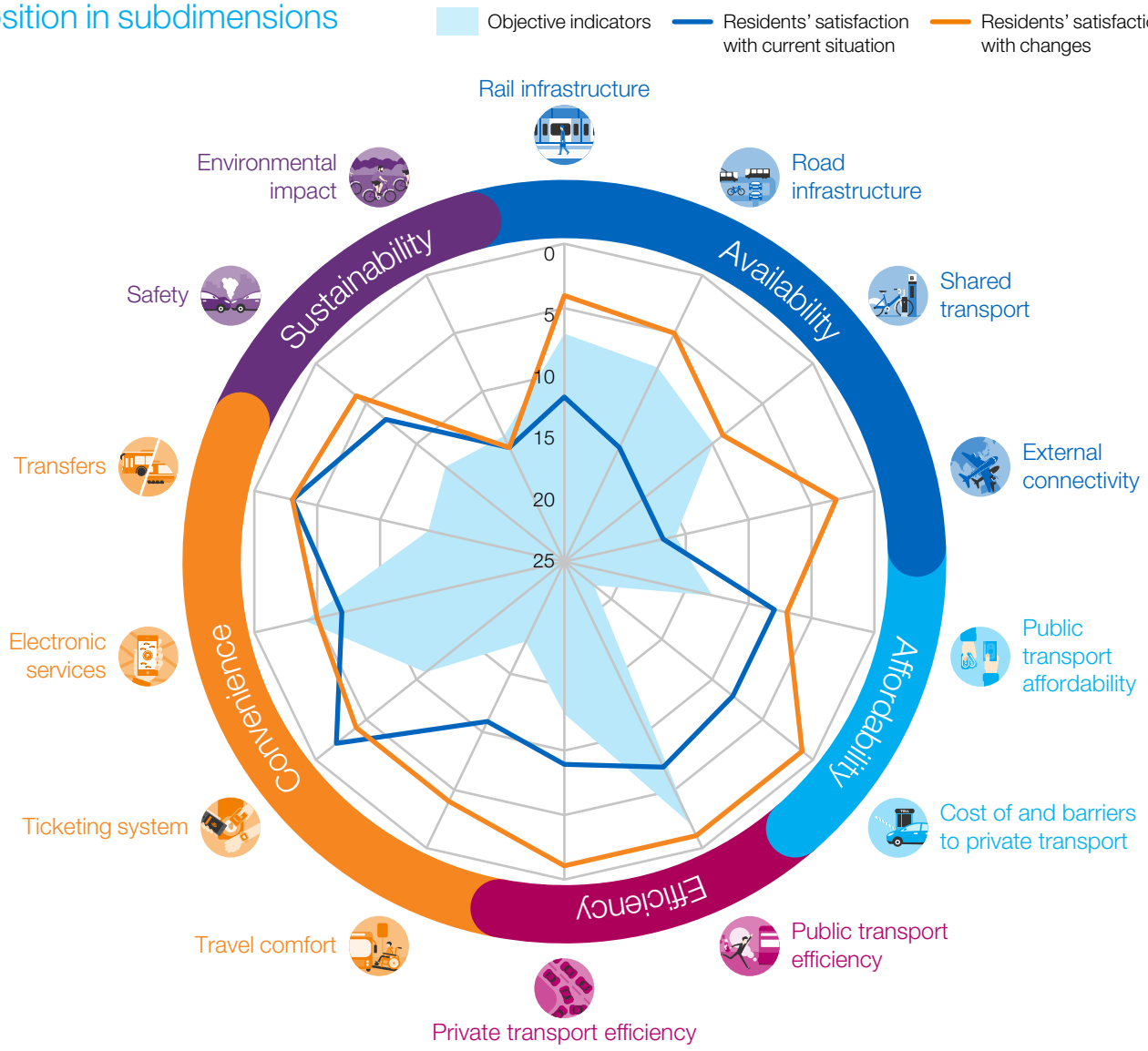
City population, millions	10.1
GRP per capita, in US$ thousands, PPP	34.4
Population density, people per km²	16,700
Cars per 1,000 people	308

People satisfied with overall situation in public transport, %	84
People satisfied with changes in public transport, %	90

People satisfied with overall situation in private transport, %	65
People satisfied with changes in private transport, %	89

Numbers have been rounded

Position in subdimensions



Seoul

Motorization levels have steadily increased over the last decade and with almost 1.5 million people commuting to Seoul from the nearby provinces for work it inevitably adds pressure to the transport system. Seoul realizes the challenge and since 2004 has been primarily focusing on enhancement and promotion of public and non-motorized transport. This people-oriented approach is the cornerstone of Seoul's transport system and its continued progress.

Objective achievements

Focusing on development of public and non-motorized transport, Seoul managed to create a highly public transport system with wide coverage enhanced by well-developed technological solutions.

- Seoul public transport ensures one of the best-in-class rail coverage. The foundation of the network is the Seoul Metropolitan Subway, which consists of 21 lines that interlink city districts and provide connections with the suburbs. In addition, the bus network is also well-developed and accounts for approximately 28 percent of trips. There are four types of buses with various functionalities: inter-regional, trunk, feeder, and circular.

- Seoul has also achieved significant results in public transport efficiency, being ranked among the top three cities in this aspect. Such progress is driven by the optimization of bus routes and construction of exclusive median bus lanes that increased bus speeds by an average of 30 percent. Development of an intelligent Bus Management System also played a crucial role in optimizing bus headway and staying on schedule, making bus service more reliable.

- Efficiency of private transport is another of Seoul's relatively developed features and is driven by the enhancement of TOPIS, an integrated data center that allows the control and management of road traffic. The success of TOPIS was also recognized globally—in 2011 it won the International Association of Public Transport award.

Residents' perceptions

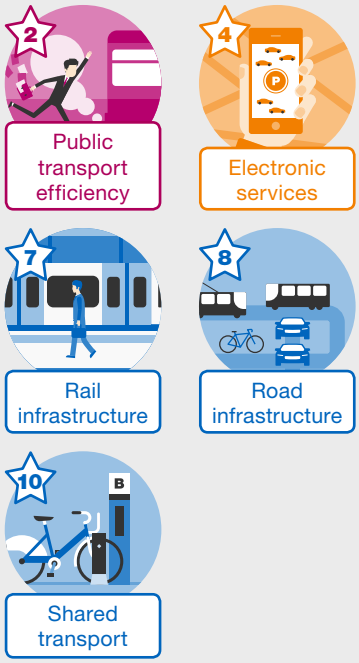
Notably, Seoulites are very encouraged with most of the recent changes in transport and are also especially satisfied with the convenience of their current transport system.

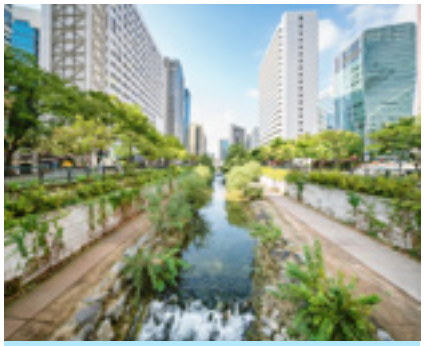
- The residents especially value the technological advances, including electronic services and ticketing, which are fairly advanced. Residents can access real-time information about arrivals of public transport both online and at stations, they can benefit from multifunctional transport apps, and access Wi-Fi in buses and in metro and bus stations.

- The residents view the recent enhancements in shared transport and road infrastructure as being successful. In recent years Seoul has expanded pedestrian and cycling infrastructure and is planning to create "special pedestrian zones" in Seochon and the Eulji Road area in the near future. The public bike sharing scheme will also expand with an additional 8,400 shared bikes and 262 dock stations all over the city.

- Sustainability is an issue residents are concerned about, both in terms of the current state and changes to the system, despite the introduction of eco-friendly policies.

Aspects where Seoul is in the top ten cities





The restored Cheonggyecheon Stream was opened to the public in September 2005 after a $900 million renewal project. For almost 30 years the stream was covered with a busy elevated highway. The park helped to restore the natural identity of the area and is now a favorite attraction for both residents and tourists.

New York

Analyzed area: 806 sq km

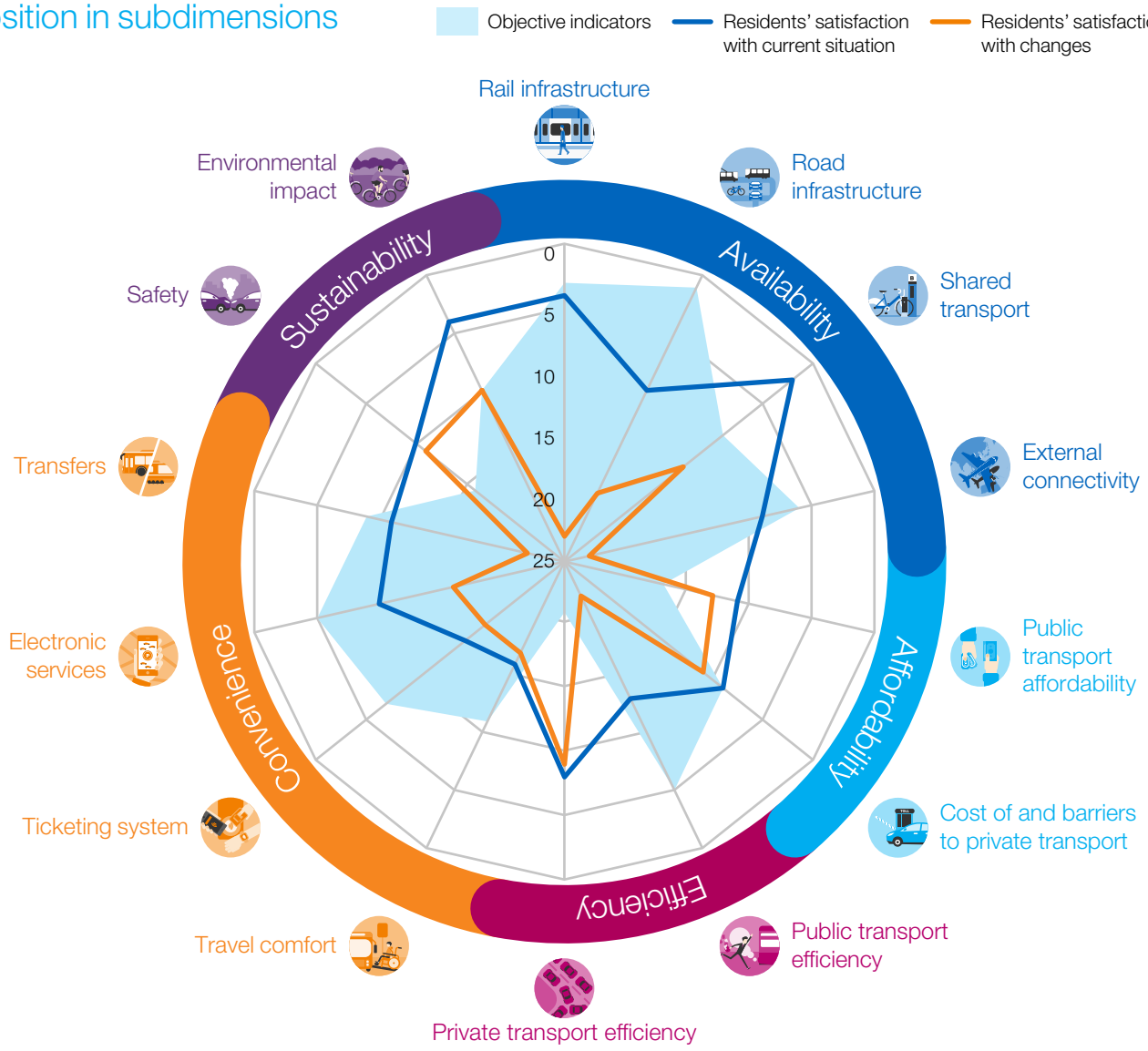
General information

City population, millions	8.5
GRP per capita, in US$ thousands, PPP	69.9
Population density, people per km²	10,600
Cars per 1,000 people	305

People satisfied with overall situation in public transport, %	77
People satisfied with changes in public transport, %	72
People satisfied with overall situation in private transport, %	57
People satisfied with changes in private transport, %	57

Numbers have been rounded

Position in subdimensions



New York

The population of the city exceeded 8.5 million in 2016 for the first time and continues to grow, imposing additional pressure on its transport network. Moreover, New York welcomes hundreds of thousands commuters from New Jersey and other surrounding areas, who come to the city for work on a daily basis. New York is one of a few top cities in the ranking which have managed both to build strong public transport systems, but also keep strong private transportation in place.

Objective achievements

The major outstanding features of New York transport are public transit and developed infrastructure for cycling and walking.

- New York has a distinctive transportation system offering the world's largest metro network with 472 stations, an extensive bus system and more than 13,000 taxi cabs. The metro and suburban rail systems make a network that covers 73 percent of the population and 93 percent of jobs. The city is planning to further expand the service by adding 21 new bus routes, which would cover new territories and improve service.
- Over the last 10 years, New York started enhancing bicycle and pedestrian infrastructure—the city has turned approximately 60 plazas and squares to pedestrian-only, added more than 10,000 square meters of pedestrian space and created 600 kilometers of lanes for bicycles.
- The city is innovating in public transportation, in recent years developing intelligent traffic signal management and off-board fare collection, and adding dedicated bus lanes that reduced average travel time at peak periods by 12 percent.

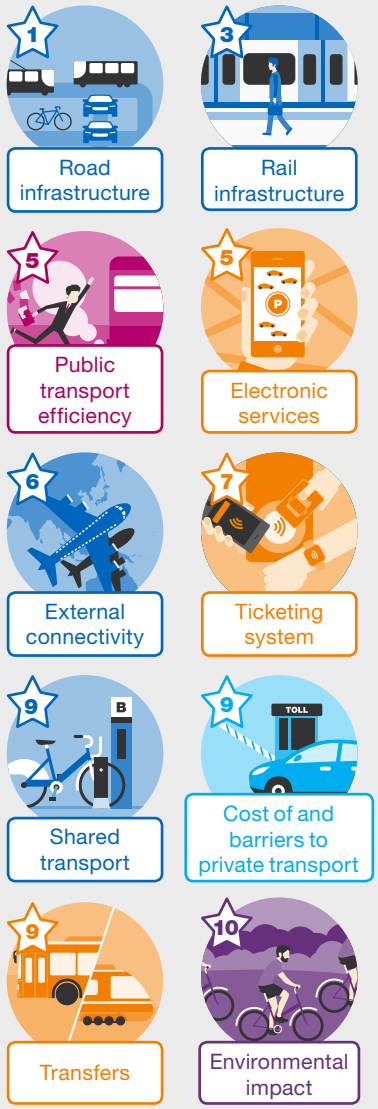
Residents' perceptions

The residents appreciate New York's transport system, especially availability and efficiency. However, residents are less positive about recent changes in the convenience of transfers, external connectivity, and availability of rail and road infrastructure.

- The major feature the residents appreciate is sharing services, which are well-developed and actively being enhanced—the city is considering providing more shared bikes with a dockless sharing scheme and is piloting a new car-sharing scheme in 2018. Residents also enjoy how sustainable transport in New York is, which is likely the result of its Department of Transportation's commitment to reducing its own energy footprint and enhancing sustainable travel options for New Yorkers.
- New Yorkers also favor safety initiatives. In 2014 New York was the first city in the United States to adopt Vision Zero.* In three years New York has achieved notable results—the road fatalities have declined by 28 percent with 45 percent decrease in pedestrian fatalities.
- Residents appreciate private transport efficiency too, and evaluate positively recent changes in the city. New York introduced a number of new technologies in recent years, including sensor technology, data analytics for more efficient traffic management and road rules enforcement, to reduce congestion.
- Residents are concerned about recent changes in the ability to transfer between transit modes, external connectivity, and road infrastructure. While this is not reflected in objective indicators and current residents' perceptions, it might serve as a sign for potential concerns in the future.

* The Vision Zero Network seeks to eliminate all traffic fatalities and severe injuries nationwide while increasing safe, healthy, and equitable mobility for all.

Aspects where New York is in the top ten cities



In 2017 New York launched the last phase of the Manhattan Waterfront Greenway, a 51-kilometer waterfront for walking and cycling. The project was started in 1993 and has developed steadily since then. The last phase of the Greenway is expected to be completed in 2022 with a continuous waterfront esplanade and a bikeway for about 100 blocks along the east side of Manhattan.

Province of Milan

Analyzed area: 1,575 sq km

General information

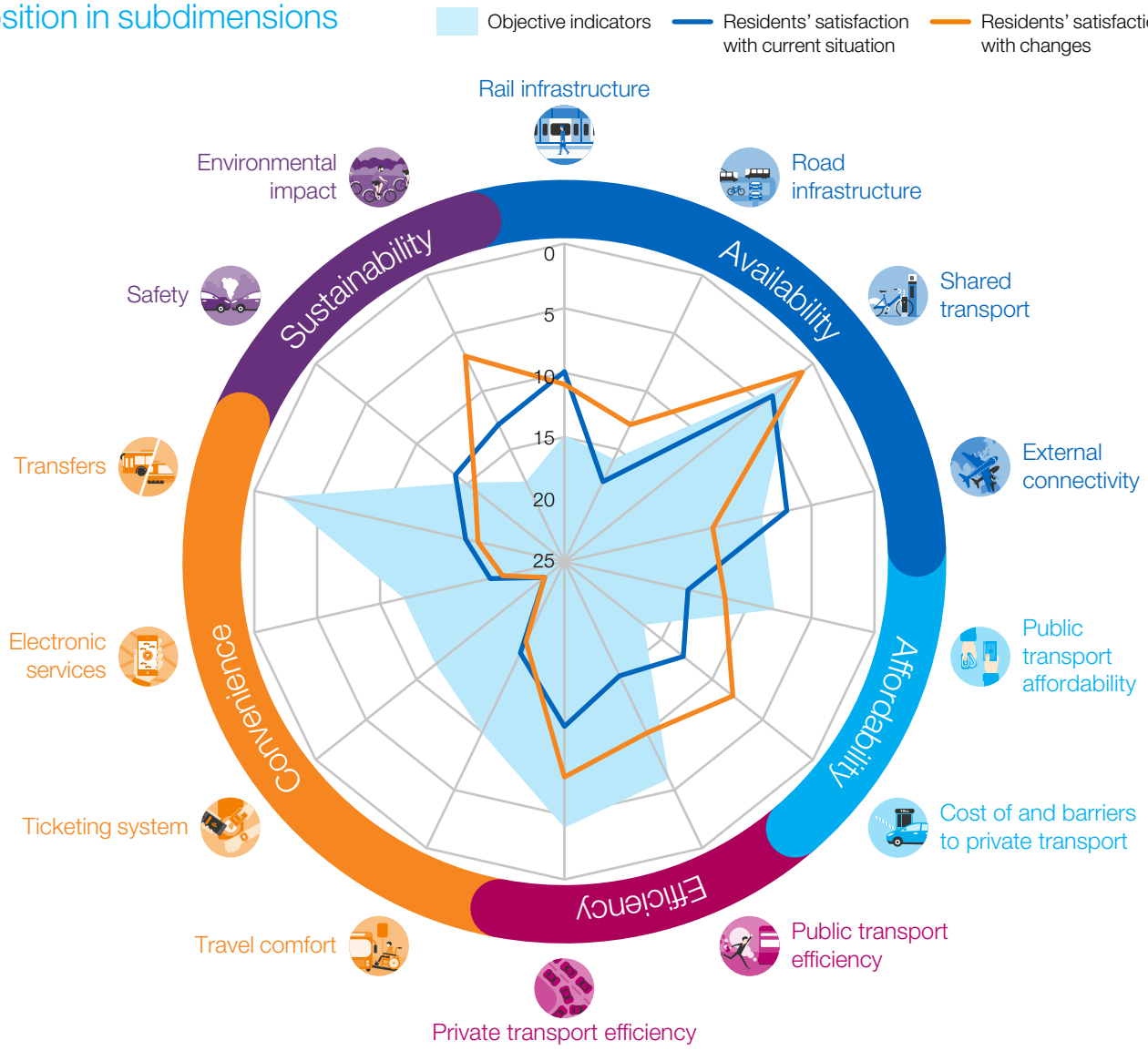
City population, millions	3.2
GRP per capita, in US$ thousands, PPP	41.1
Population density, people per km²	2,000
Cars per 1,000 people	518

People satisfied with overall situation in public transport, %	70
People satisfied with changes in public transport, %	77

People satisfied with overall situation in private transport, %	57
People satisfied with changes in private transport, %	68

Numbers have been rounded

Position in subdimensions



Province of Milan

Milan is currently among the most motorized European cities, welcoming around 850,000 commuters daily, which is a significant amount, considering the relatively small city population. These are great challenges for the transportation system. However, the city addressing the challenge, aiming to rebalance its transportation network toward more sustainable transport modes, and has already achieved significant progress there.

Objective achievements

Milan succeeds at coping with its relatively high motorization rate and ensures efficient private transport. Additionally, the city has best-in-class shared schemes and is highly convenient for transfers.

- Despite the high motorization level, the city manages to have efficient private transportation, however, at an expense of its affordability. In 2012 Milan introduced "Area C," a congestion charge applied in the city center. The scheme lowered traffic by 33 percent, which is approximately 40,000 cars daily, in the first month. The long-term effect was also significant, and led to lowering the number of cars by approximately 28 percent. The scheme also bans the entrance of vehicles that do not meet required emission standards.

- One of the greatest features of Milan's transport system is the shared transport—since shared mobility is one of the pillars of Milan's sustainability plan, it has developed significantly over recent years. The city currently offers approximately 3,000 shared cars, of which almost 30 percent are electric, about 4,650 dock-sharing bikes, of which 1,000 are electric, around 12,000 dockless shared bicycles, and even 100 fully electric scooters. Enhancement of shared transport has already shown results: about 12 percent of respondents have already decided to give up a private car and about 8 percent are likely to do so in the future.

Residents' perceptions

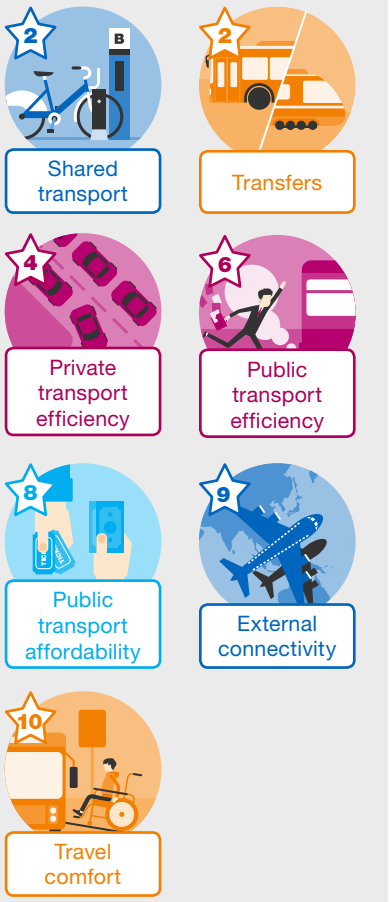
Residents are satisfied with both the current state and the changes in rail infrastructure, efficiency, shared transport, and environmental impact, while being more skeptical about other aspects.

- Milan residents appreciate the availability of rapid rail service. Its network ensures coverage of 75 percent of jobs and 54 percent of the population and includes four metro lines and 12 lines of suburban rail, which together serve more than 1 million passengers daily.

- Sustainability is also an aspect in which people favor the recent changes, implemented under the city's Plan of Sustainable Mobility. Its cornerstones are popularization of shared transport and enhancement of pedestrian and cycling infrastructure—the city has added more than 70 kilometers of cycling lanes since 2011 and plans to add 250 more by 2024.

- Residents' major concern both in terms of the current state and the changes is about convenience and especially ticketing, which is in fact comparatively well developed.

Aspects where Milan is in the top ten cities



Milan is currently expanding its metro rail network with Line 4, which is planned to open in 2022. The line would be 15 kilometers long with 21 stations, and all the trains would be automatic. This would provide more frequent service and increase capacity up to 24,000 passengers per hour.

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