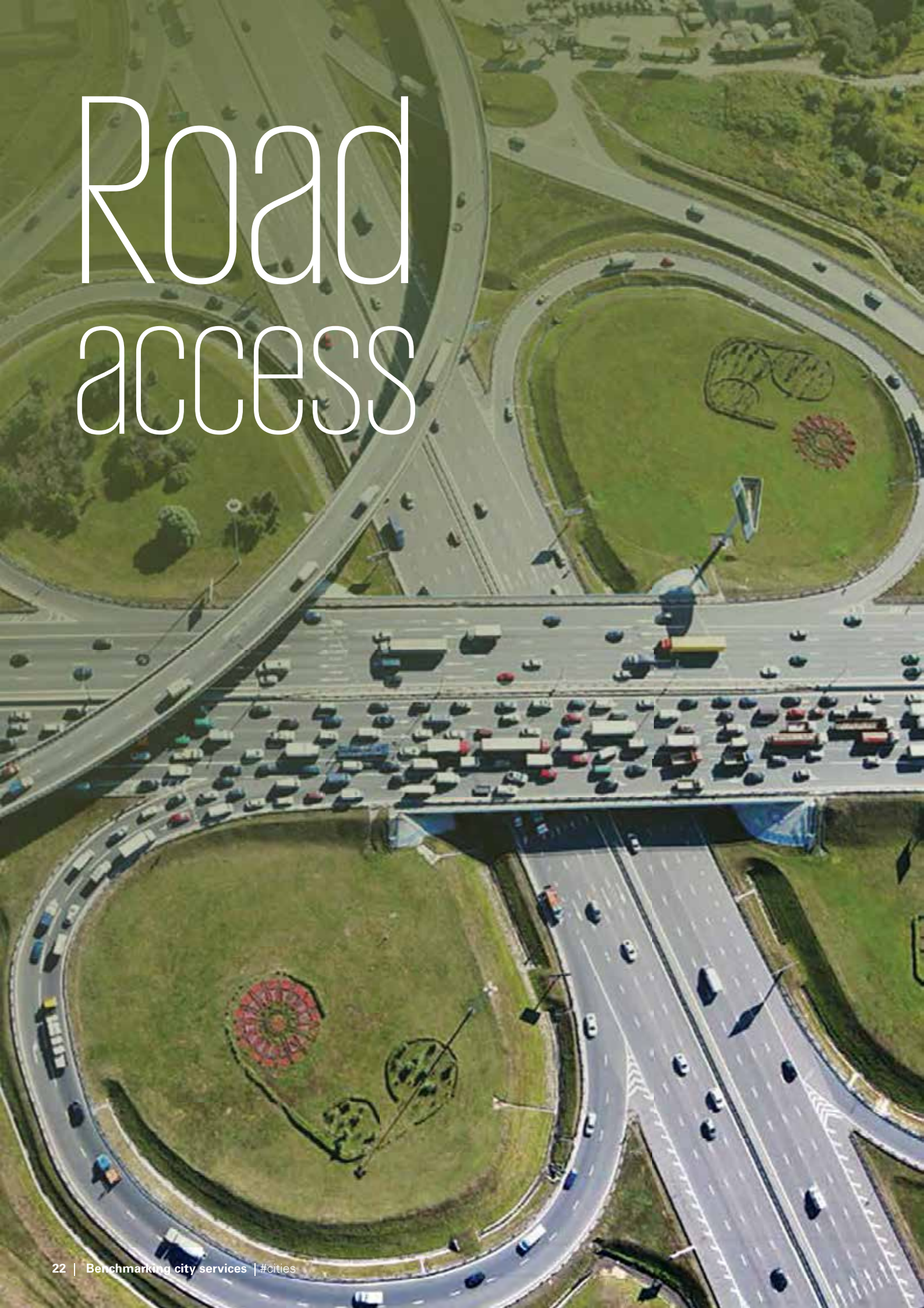
Road access



Roads are much more than just asphalt and lights. They are vital arteries along which commerce, society and development thrive; they unlock the value of government services; and they allow citizens to lead more active, social and productive lives. But poorly planned or maintained road networks can create serious challenges for cities and their citizens.

Defining the service

Road access services incorporate the design, construction, maintenance, repair and operation of city and urban roads, bridges, tunnels and boulevards. Significant focus was placed on determining the 'lane kilometers of road' (calculated by multiplying the total kilometer (km) length of roadways by the number of lanes provided) to standardize benchmark results.

Topline findings

- The average city spends approximately US$15,400 per lane km of road.
- The median city boasts 73 percent of roads in good condition.
- Vehicle accident rates vary across the world but are exponentially higher in large cities.
- Different approaches to allocating capital costs significantly impact unit costs per lane km.

Efficiency

Operating and capital cost per lane km of road. This measure reflects the costs (both operating and capital) for city roads averaged out by the number of lane km of road in the city.

Points to consider

The combined operating and capital costs for a lane kilometer of road range from US$3,000–US$107,000 depending on the city. When the operating and capital costs are separated, evidence suggests that some cities provided little to no capital costs while others spend more capital than operating funds.

For many of the 16 participating cities, there is a reasonable ratio of capital to operating costs but what separates a city spending US$3,000 per lane km from another spending US$107,000 per lane km? One explanation can be attributed to the location of cities relative to extreme weather or potential long-deferred maintenance. For example, City 20 may not experience extreme winter conditions such as that evidenced by City 31.

Few if any cities qualified the cost information they provided by stipulating what was included/excluded. Some did inquire about whether they should include street lighting costs, but by and large cost information was provided in an unqualified manner. Further work in qualifying road costs would enable us to derive better cost indicators than available at this point.

Benchmarking the cost of roads is still in its early stages. Advice on the optimal cost for a lane km of road still requires further research where US$15,000 per lane km (adjusted mean) may be appropriate or biased based on those cities that participated and their operating and capital costs. More observations will aid in closing in on such a cost target.

Figure 1: Operating and capital cost per lane km of road (000 US$)

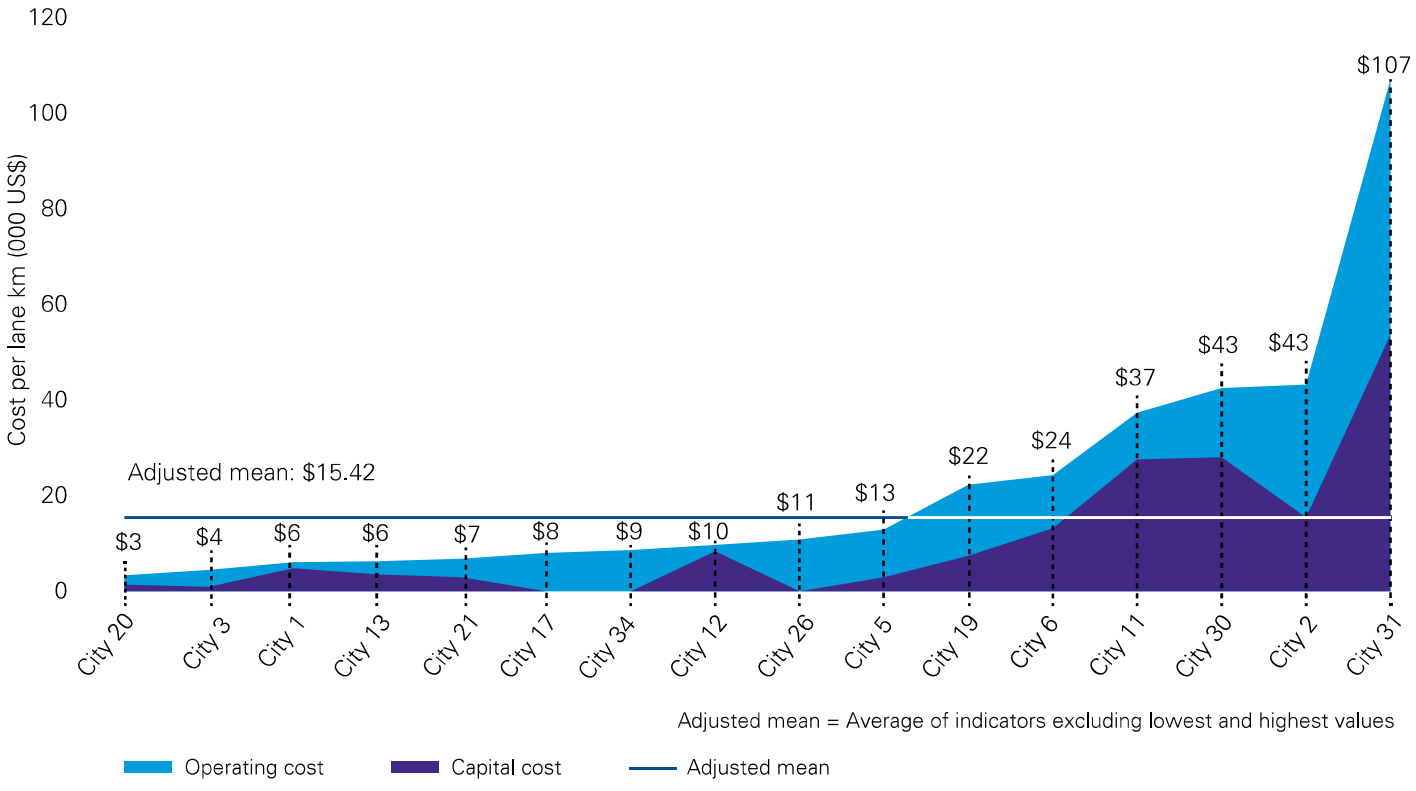
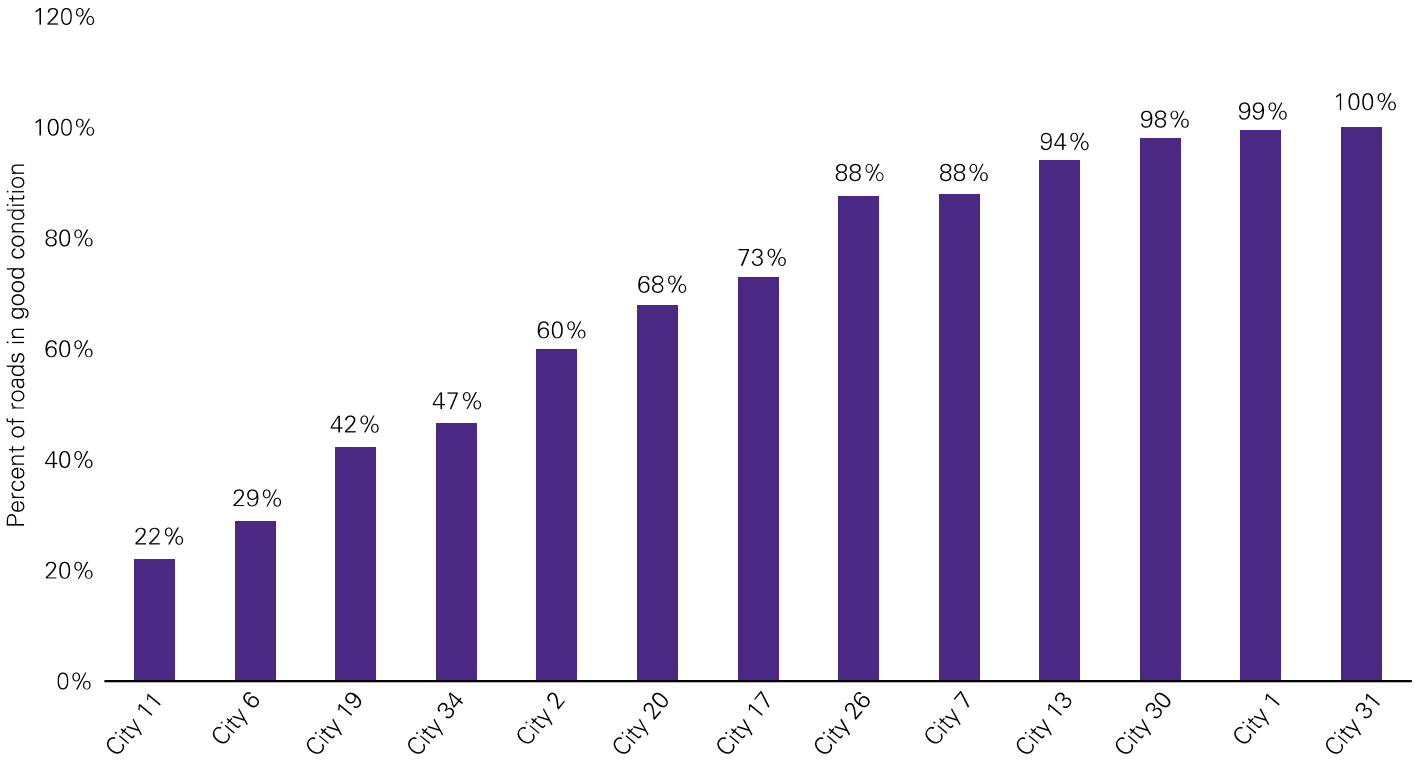


Figure 2: Percent of roads in good condition



Effectiveness

Percent of roads in good condition. While the exact methodologies for assessing road conditions vary by city, this measure asked respondents to report the percentage of roads classified as being in 'good' or 'excellent' condition according to their specific rating system.

Points to consider

KPMG mapped out several effectiveness indicators. One indicator was the percentage of roads in good condition. Clearly cities around the world will use different methods for ranking road condition, and one of the discoveries along the way was to see what different methods cities might use. Unfortunately KPMG did not receive any information about these methods. At one level, a city might argue that we are again comparing cities that use different techniques. However, at another level the good condition rating of a city in a developing country might equate to the same good condition rating for a city in a developed country where the perspective of 'good' may be substantially different in comparison.

One observation worth noting is that no city should rank all of their roads in good condition although some claim this to be case. Every city in the world is struggling to keep on top of road repair and reconstruction leading to road condition ratings that are below 100 percent in good condition. Furthermore, cities are struggling to justify sufficient capital expenditures to sustain their roads now and the foreseeable future so road condition ratings clearly should suffer in years to come.

Developing an international standard for measuring the road condition would be extremely worthwhile. Who should develop such a standard and is there a role for KPMG to play in helping in such a collaboration?

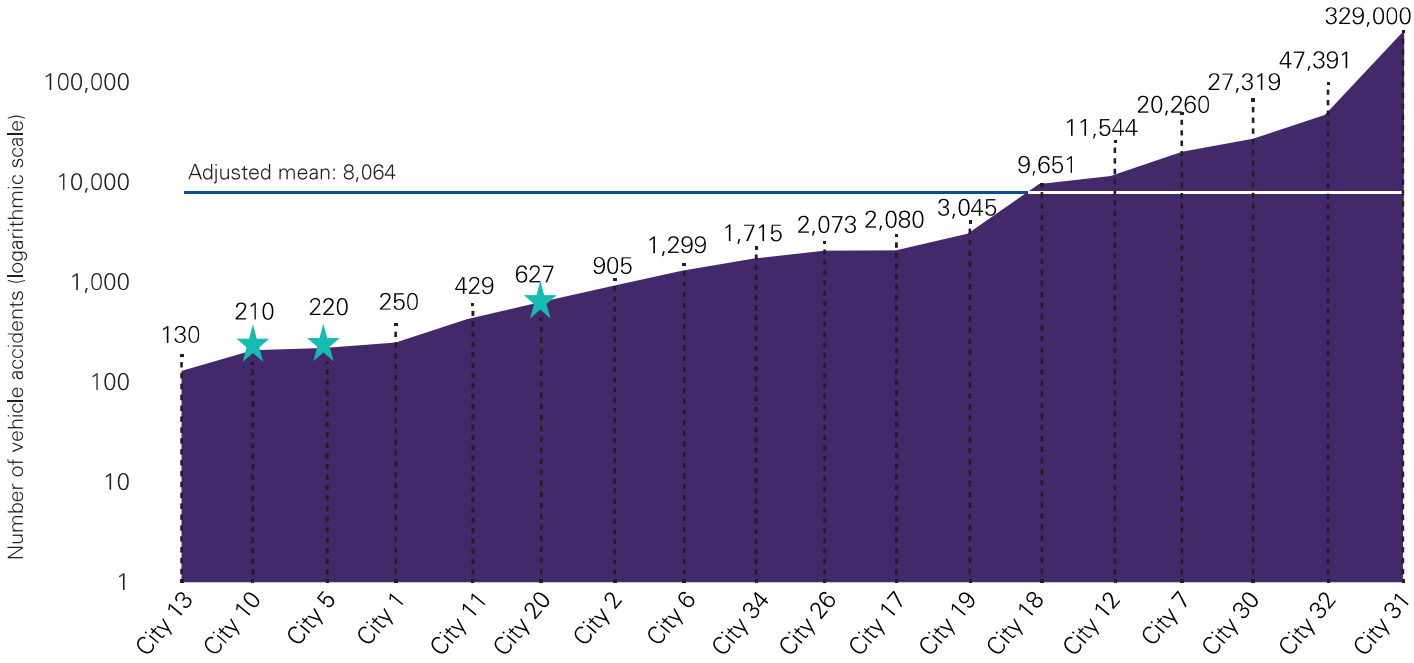
Number of vehicle accidents. Traffic accidents for a given year have also been analyzed to observe any correlations with road conditions. If they occur frequently on city roads, it may be an indicator that the road design is flawed.

Eighteen cities reported the volume of traffic accidents as an effectiveness indicator for roads. The average number of traffic accidents across these cities is more than 8,000. The smallest number of accidents is 130 in a fairly small suburban municipality while one very large city reported 329,000 accidents. Attempts were made to normalize this accident information by the number of lane km provided, but unfortunately not all cities could provide such a statistic.

Regarding the number of traffic accidents, it was surprising to discover that there are two different types of traffic accidents reported in this study: those that cause injury/death; and all traffic accidents. There are differences between the two statistics that we look to analyze should a subsequent study be conducted.

Ironically, some cities that reported higher costs than others, with high percentages of roads in good condition also reported higher than average traffic accidents. This finding is completely contrary to traditional thinking but does raise the issue of whether vehicle operators might travel at higher speeds or drive more dangerously when roads are in good condition leading to more traffic accidents.

Figure 3: Number of vehicle accidents (annual)



Note: values highlighted with a "star" symbol provided number of vehicle accidents that resulted in injuries and not the total number of vehicle accidents.

Adjusted mean = Average of indicators excluding lowest and highest values

Persistent problems

- Underdeveloped road infrastructure
- Deteriorating road quality
- Congestion and increasing volume
- Tighter environmental requirements
- Shifting attitudes towards public transportation
- Short construction windows in climate-affected regions
- Aligning service contracts to outcome expectations
- Investing in human capital and capacity development

Distinguishing cost factors

- Weather-related impacts and maintenance requirements
- Capital costs and the degree of asset lifecycle replacement
- Service levels and corresponding technical considerations
- Density of city and congestion on roads
- Presence of tunnels, bridges and special road construction materials (e.g. cobblestone roads)
- Asset complexity and variation

Innovative ideas

- In **Kazan**, Russia, authorities have invested in an automated traffic control system that has helped the city increase road capacity by 15 to 20 percent and improved average speeds by 25 percent.
- **Philadelphia**'s Vision Zero initiative aims to improve street safety and network integration through infrastructure improvements focused on traffic, pedestrian and bicycle safety.
- **Cape Town's** city council has approved the use of modified asphalts such as A-E2 and A-R1 on marginal pavements and is trialing grey water-resistant asphalt near informal settlements.
- Authorities in **Medellin**, Colombia are shifting to electric tramways and aerial cables to improve lane kilometers and reduce congestion.
- The **Sunshine Coast Council** publishes a 'schedule of work program' that provides citizens with timeframes for projects conducted as part of the city's annual road reseal and rehabilitation program.

Transformative trends

- *Shifting customer expectations and demand:* The widespread adoption of personal navigation apps, car sharing models and vehicle autonomy tools is changing demand for roads.
- *Adopting new approaches:* Traffic flow systems, free flow models and other alternative models can help reduce road volume and better manage new capital costs.
- *Promoting traffic safety:* Many cities are looking at ways to improve overall road safety for vehicles, pedestrians and bicycles while simultaneously improving traffic flow.
- *Improving outsourcing:* Municipalities are rethinking their existing outsourcing agreements to understand how value is created and captured.
- *Leveraging data:* As cities become smarter, many are using this data to drive improvements in operations, planning and investment.

What else did we measure?

For our benchmarking exercise, we collected a wide variety of data on the effectiveness and efficiency of this service area. The following indicators lacked sufficient data or respondents to illustrate in this report:

- Number of road service interruptions
- Revenue collected for roads.

Combined efficiency and effectiveness analysis

Points to consider

A new performance perspective on roads combines the efficiency and effectiveness indicators. The graph illustrated below combines the cost per lane kilometer of road ('000s USD) (efficiency) with the percent of roads in good condition (effectiveness) to demonstrate how cities might present a more compelling picture of performance. In this example, the cost per lane km of road (efficiency) is combined with the road condition rating (effectiveness). Twelve cities provided sufficient information to generate this fascinating picture of roads.

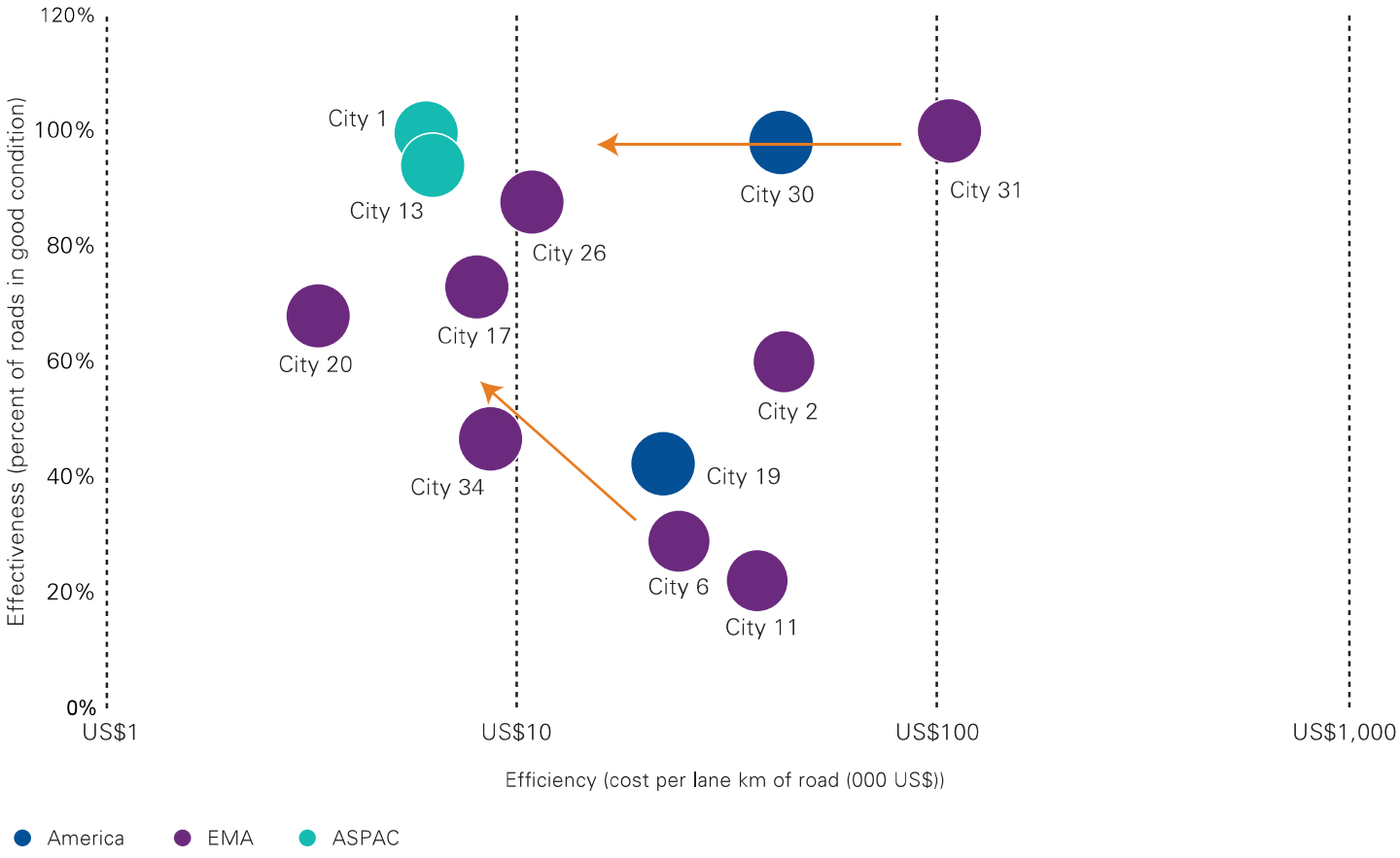
The ideal position in this chart is to be in the upper left quadrant, like cities 1 and 13. While one might question whether any city can attain 100 percent of its roads in good condition, this graph shows that not only was City 1 in this enviable position, but they were also really efficient spending less than US$10,000 per lane km of both capital and operating funds to achieve this state.

A city like City 34 may be spending the right amount of money but has more work ahead to improve the road condition rating. Similarly if you are City 30, your roads are in good condition but perhaps you are spending more capital and operating funds to achieve this state. One of the key points provided by this unique graph is the balancing act that cities face on satisfying customer demand while being thrifty in achieving satisfaction — a challenging dilemma that leading-edge cities can help to demystify.

Imagine what might be possible if we were able to cross reference efficiency and effectiveness against a third variable such as number of traffic accidents!

Clearly there are cities that are in the ideal spot of the graph (upper left quadrant) but the majority of cities have their work cut out for them to achieve this goal.

Figure 4: Road access — combined efficiency and effectiveness



Q&A with Cesar Diaz-Plaza Perez, Global Infrastructure Sector Lead, Roads, KPMG International

Cesar helps KPMG's clients deliver mega road projects across the Americas, leveraging more than 15 years of hands-on experience running daily finance operations at a major road concession and project operator.

Q: In your opinion, is there value in benchmarking road access services across cities?

A: Clearly, there are massive differences in the way that cities measure and report road costs, quality and efficiency. And that often makes it difficult to compare data across cities, particularly in different countries or climates. But it's the underlying insights — the trends and ideas — that really drive value for cities, not the raw numbers. And that is what makes benchmarking so important.

Q: Do you see a correlation between cost per lane km, road quality and effectiveness?

A: Interestingly, that is not as clear. One would intuitively expect that the more a city invests in its roads, the higher the quality and — therefore — the more effective they would be. But this research suggests that effectiveness is influenced by much more than just capital investment. It is also clearly influenced by factors such as population density, traffic safety, climate, labor costs and even the choice of material used.

Q: Are there ways that cities can reduce the overall cost of roads?

A: I think there are always ways to remove costs and leverage efficiencies, both in operations and in capital development. And benchmarking against other cities can help identify those. Some cities are now looking at both sides of the coin, reducing costs but also increasing revenues. And that can be done through tolls, congestion charges or special levies. Indeed, we are seeing many cities experimenting with various models aimed at reducing congestion which, in turn, helps manage both operating and capital costs.

Q: Has technology improved the way roads are planned and managed?

A: Absolutely. We have helped cities around the world leverage the power of data and analytics (D&A) to create unprecedented insights that vastly improve their road management and cost structures. For example, some cities are using D&A to reduce maintenance cycles, to predict future demand and to identify road congestion. But technology is also changing the way consumers interact with their roads and that, in turn, is creating new challenges for city planners.

Q: Do all roads require the same level of investment and attention?

A: That very much depends on their quality, volume, use and composition. The real challenge for cities is how to prioritize the work that must be done each year. And that is where cities are now starting to use more robust approaches that take into account other factors such as quality of life, critical access requirements and future demand.

Q: What advice would you offer city leaders and roads authorities?

A: Regardless of the city, the real objective for roads authorities should be to improve mobility and reduce congestion. And there are many ways that you can achieve that. In some cases, it may involve building more roads. But you can also achieve some of these goals through other means — encouraging flexible work days, restricting roads access, implementing high occupancy vehicle (HOV) lanes and so on. You need to think laterally about the problem and be willing to borrow ideas from other cities. ■

Transit

Around the world, cities are pouring millions — sometimes billions — of dollars into developing and improving public transit. But our benchmarking exercise suggests that when it comes to comparing services against other transit authorities more work can be done to collect and compare ridership and route effectiveness indicators. And, as a result, investments may be flowing into ineffective routes, modes and assets.

Defining the service

Transit services — also known as public transit — includes a wide variety of modes including bus, streetcar, metro rail and light rail. For this report, the service includes the design, construction, maintenance, repair and operation of transit routes and vehicles and excludes the para transit service.

Topline findings

- The average city spends US$1.67 per transit trip (not counting any revenues).
- The average cost per km of transit route is US$24.70.
- There are no consistently used measures for effectiveness across cites or transit modes.

Efficiency

Operating and capital cost per transit trip. This measure combines total public transit operating costs (including internal support service costs and management costs) with the total capital costs and divides the sum by the number of reported transit trips.

Percent of transit costs covered by revenue. The measure of how much operating and capital cost is covered by revenue.

Points to consider

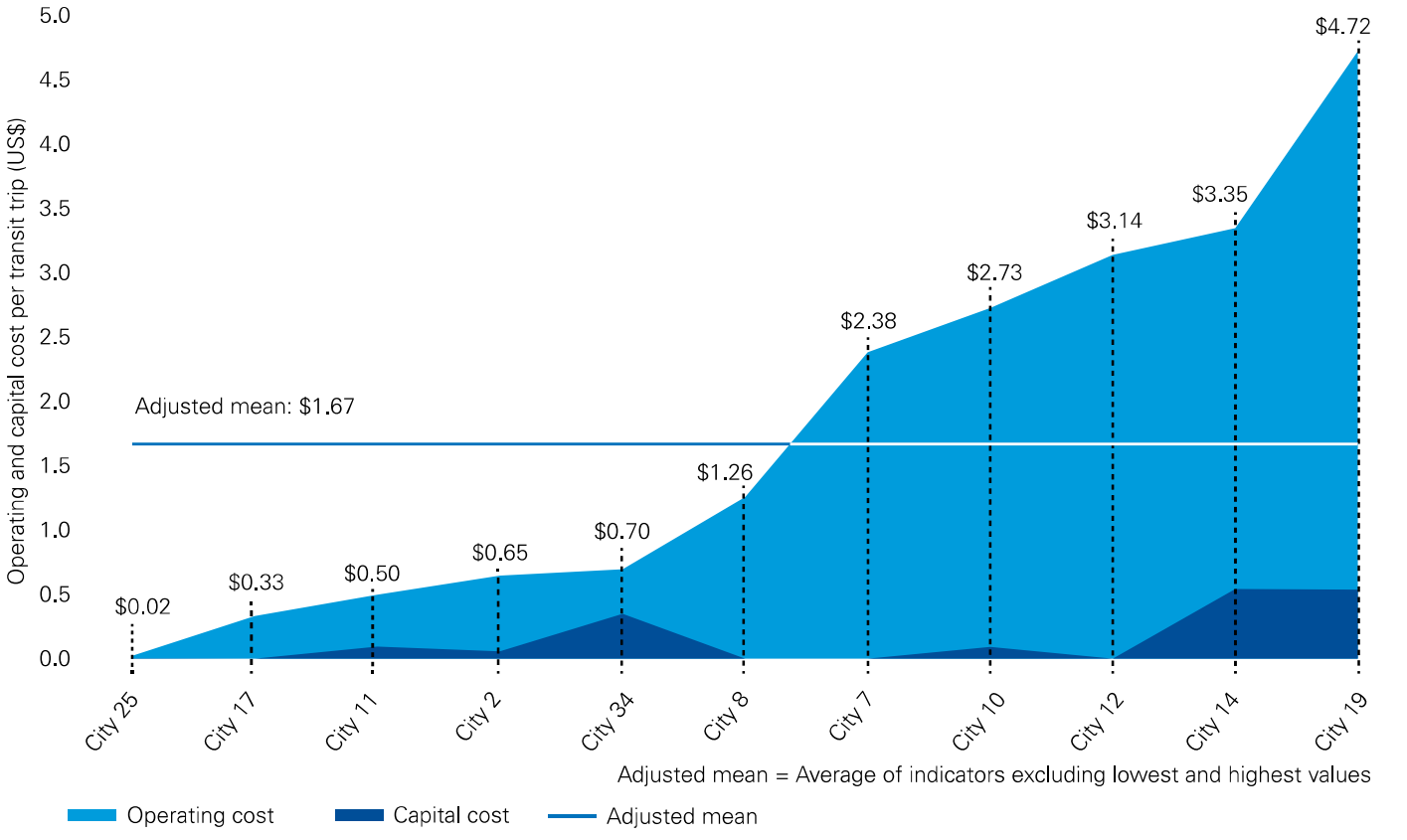
The cost per transit trip varies from US$0.02 to US$4.72 for 11 cities that were able to provide performance information. Further examination of the low cost may be explained by one city reporting total transit passenger trips but only showing the operating and capital costs for a portion of the transit operations. Other operations may be provided by transit authorities that are separate from the city but operating within its boundaries.

Few cities reported substantial capital budget amounts in support of transit. Is this because many are struggling to get replacement vehicle funding or are there other reasons that may be contributing to this fact?

The adjusted mean cost for transit is approximately US$1.70 per trip. This seems low but may be influenced by the currency conversion rates in respective countries, the cost of living in different countries, and a multitude of other factors. Variances may be explained by the passenger count information. Some cities are not entirely sure about the actual count of passengers as many passengers may use transit passes instead of individual tickets/tokens for their transit trip. Furthermore, transit passengers may double count a single passenger who may take multiple transit rides in the course of their commute.

More and more cities are trying to increase transit ridership. Mature, developed cities have invested considerably in their transit network and provide a variety of transit vehicle options, while less mature, developing cities are struggling to expand their transit network, especially when it comes to light rail and metro options. Further still there are mega cities that struggle to meet transit demand resulting in gray and black market service providers popping into the picture.

Figure 5: Operating and capital cost per transit trip (US$)



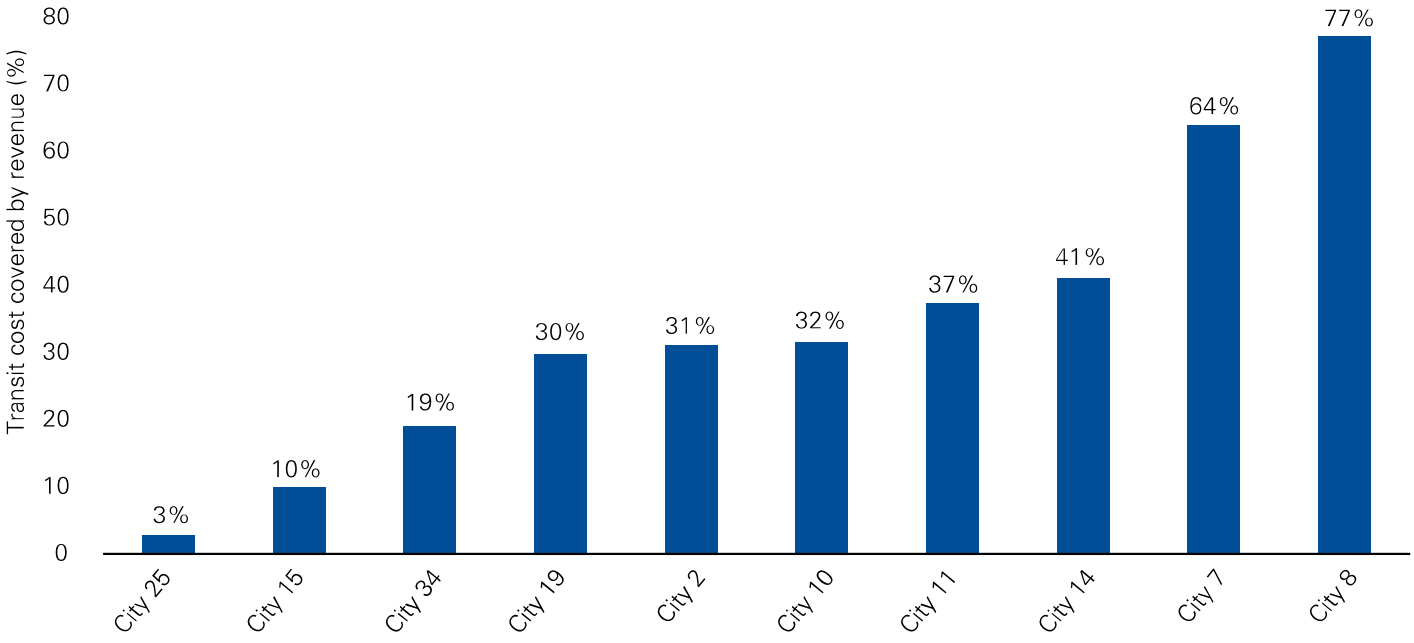
Subsequent studies should focus on distinguishing costs between types of transit vehicles (e.g. buses, light rail, trams, metros, etc.). Future surveys may also reach out to transit associations that may operate in specific countries or regions to increase participation rates and to standardize on metrics that are readily available.

Percent of transit costs covered by revenue.
For the 10 cities that provided costs and revenue, the percentage of costs covered by fees ranges from a low of 3 percent to a high of 77 percent. This wide variation cannot be readily explained. The lowest ratio comes from a well established European city (City 25) while the same can be said for the highest ratio (City 8). Clearly City 8 is in an enviable position where they seek a mere 23 percent top up to cover their costs. Half of the cities that responded appear to realize a cost recovery ratio of between 30–40 percent which means that two-thirds of the costs are covered off by funding beyond transit fares and likely from city financial resources or perhaps state supported grants.

The challenge with achieving full cost recovery is that it penalizes lower income families that desperately need an alternate source of transportation than the car. Conversely, a low cost recovery may inordinately penalize those commuters that don't wish to use the transit system, particularly if they support bicycle or walk to work commuting patterns.

Many cities are beginning to wonder what the impact of autonomous vehicles will have on their transit ridership. Will autonomous vehicles reduce transit ridership and increase traffic congestion? Will the cost per transit trip continue to compete with alternative forms of mobility? Regardless of the impact of disruptive technology, cities need to embrace change while continuing to supply affordable transit services.

Figure 6: Percent of transit costs covered by revenue



Effectiveness

It was surprising to find that few cities measure the average wait time between vehicles as an indicator of effectiveness. Indeed, with few consistent effectiveness measures being tracked across cities and transit modes, this exercise suggests that most cities are making transit investment and optimization decisions based on unreliable and incomplete data.

Persistent problems
- Improving travel times in the face of increasing road congestion
- Reducing environmental pollution and impact
- Increasing ridership as a percentage of total commuter trips
- Expanding capacity to meet growing demand
- Replacing outdated rolling stock and assets

Common cost factors
- Labor and operational staffing requirements
- Technology and rolling stock
- Fleet upgrades and network improvements
- Energy and oil inputs
- New capital investments and network expansions

Innovative ideas
- Responding to environmental concerns and targets, many cities — including **Dresden** — are working to replace existing bus rolling stock with e-buses and hybrid buses.
- Similarly, public transit authorities in **Philadelphia** are introducing new regenerative breaking electric vehicles to improve fuel efficiency and reduce greenhouse emissions.
- In **Łódź**, electronic passenger information boards have been installed at bus and trams stops, supported by in-vehicle GPS systems and locating devices.
- Authorities in **São Paulo** have created the Mobility Laboratory (MobiLab) to encourage innovation in public transit through partnerships with academics, entrepreneurs and private enterprises.
- To improve the efficiency of road-based transit, authorities in **Kazan** have implemented new automated traffic control systems and adaptive traffic management practices.

Transformative trends

— *Healthy lifestyles:* As populations seek more active and healthier lifestyles, demand for cycle paths and non-motorized transport options is rising.
— *Environmental stewardship:* Growing concerns about carbon emissions and new environmental policy targets are encouraging transit authorities to invest into low (or no) carbon transit alternatives and vehicles.
— *Capacity improvements:* Leveraging new technologies and process improvements, many cities are delaying new capital investments by focusing on improving the capacity of their existing assets and networks.
— *Intermodal connectivity:* Cities are increasingly focused on enhancing connections between various modes of transit in an effort to reduce passenger travel times and improve overall system effectiveness.

What else did we measure?

For our benchmarking exercise, we collected a wide variety of data on the effectiveness and efficiency of this service area. The following indicators lacked sufficient data or respondents to illustrate in this report:

— Percent of population served within 500 meters of transit stops
— Peak period headway time (by type of vehicle)
— Revenue vehicle hours
— Cost per revenue vehicle hours.

Q&A with Hugh Jones, CEO, Steer Davies Gleave LLP

Hugh is the CEO of Steer Davis Gleave, a leading independent management consultancy specializing in the transport industry. Prior to joining the firm, Hugh served as a senior analyst with London Underground Limited.

Q: How has technology influenced transit services over the past decade?

A: We have seen significant investment into 'pre-digital' technologies such as at-stop or on-vehicle information and real-time traffic management systems, all of which have generally made transit easier to use, more accessible, more reliable and — over time — have allowed authorities to enhance efficiency and effectiveness. We are experiencing the digitalization of transport, but greater change is ahead as we move towards autonomous vehicles, more efficient battery and alternative fuel models, alongside a shift towards digitally-enabled demand responsive schedules and fare payment.

Q: How quickly do you expect fuel technologies to change?

A: We've already experienced a greater refinement to diesel products and the adoption of new fuels as a result of greater environmental emphasis. But most of these non-diesel products are still in development and are therefore rather bespoke which means they can lack widespread and diverse supplier support. The emergence of a preferred alternative fuel is still to be achieved.

Q: What role should the private sector play in delivering and operating public transit?

A: Unfortunately, there is no one-size-fits-all answer. The reality is that the public and private sector strengths and capabilities vary by location and circumstance. In many cases, the public sector might be better placed to execute the longer-term strategic planning, keeping in mind the wide spectrum of policy issues that inform those types of decisions. But we have also seen many examples of private sector players demonstrating great innovation in long-term planning. In almost every case, however, there is a role for both the private and public sectors to participate.

Q: How important is regulation in ensuring an effective public transit service?

A: Regulation can be very helpful, particularly when cities are seeking to encourage and protect public-private partnership (PPP) arrangements. Regulation can help provide long-term stability to suppliers. It can help moderate competition risk — for both revenue and road access — where performance, usage or revenue risks are transferred. And it can protect the consumer and enforce standards. That being said, there are certainly examples of unregulated transit markets that have proven capable of supporting effective service delivery and market participation.

Q: Are subsidies necessary to ensure high quality service?

A: Subsidies are not just a function of cost but also fare levels, revenues and the balance of cost recovery between users and tax payers. But if transit is to embrace new technology, meet higher passenger expectations and deliver additional capacity, some level of subsidy will likely be required. Indeed, the investment cycle and the 'lumpy' nature of additional capacity costs would suggest that subsidies may continue to be required for many transit networks.

Q: How can higher levels of government better support city-level transit development?

A: I think higher levels of government can help by lending their major project and PPP expertise to the various lower levels of city government. At the same time, transit requires stable and foreseeable funding arrangements which requires longer-term commitments from higher levels of government. The bottom line is that you can't seek to develop major transit investment within fixed short-term budgetary cycles. It takes a longer-term view and strategy. ■