Strategic Directions and Ecosystems to Address China's Urban Mobility Challenges

November 2014

Arthur D Little FUM

MICHELIN CHALLENGE BIBENDUM
KNOWLEDGE PARTNER

Content

Foreword 3

1. Challenges and opportunities for Chinese urban mobility systems 4
   1.1 Urban mobility trends and challenges for China 4
   1.2 Initiatives undertaken by the Chinese government to shape the future 7
   1.3 Comparative assessment of Chinese urban mobility systems 7
   1.4 Conclusions - Urgent needs for urban mobility transformation 13

2. Vision and solutions for China to set the foundations of superior urban mobility systems 15
   2.1. Which strategic directions for Chinese cities? 15
   2.2. "Rethink the system" by developing a sustainable urban mobility vision, strategy and policies 16
   2.3. "Network the system" by setting up innovative mobility ecosystems 23

Insights for the executive 27

Appendix –
High-level profiling of Greater Chinese cities in the scope of the Arthur D. Little Urban Mobility Index 28

Authors:

François-Joseph Van Audenhove
Partner, Brussels

Antoine Doyon
Head of China, Shanghai

Oleksii Korniichuk
Manager, Frankfurt

Jeff Hou
Manager, Shanghai

Acknowledgements for support and valuable input: Marc Durance (Principal, Paris), Arnaud Schoenmackers (Consultant, Brussels) and Matthieu van der Elst (Michelin's Anticipation Strategy Group).

This Arthur D. Little report was released for the 2014 edition of the Michelin Challenge Bibendum (November 10th–14th 2014, Chengdu), of which Arthur D. Little is knowledge partner. The report summarizes some of the key insights from the "Future of Urban Mobility 2.0" study and puts them in perspective by looking into specific challenges and opportunities within Greater China.

Foreword

The mobility industry is entering what could be called a fourth industrial revolution, represented by industry and technology convergence, leading to the emergence of, for example, clean energy vehicles or connected mobility solutions. In this new world, in order to meet the key challenges of today and the future, organizations cannot only rely on optimizing their operations or pushing the next product generation to market. To be successful and meet evolving customer needs, they must adapt to this changing world by continuously finding ways to reinvent themselves. This successful transformation can only be enabled by system-level collaboration and innovation.

As a global management consultancy llinking strategy, innovation and transformation, Arthur D. Little aims to help its clients succeed in this "new world of innovation." The Future of Urban Mobility (FUM) Lab is our contribution to tackling the urban mobility challenge. With its FUM studies, Arthur D. Little aims to support cities and nations in shaping the extended mobility ecosystems of tomorrow and facilitate an open dialogue between urban mobility stakeholders.

January 2014 saw Arthur D. Little release the second version of the "Future of Urban Mobility" study, including an updated version of the Urban Mobility Index. In this study, Arthur D. Little highlighted what was holding cities back, and, together with its partner, the UITP – the International Association of Public Transport – identified strategic directions and imperatives for cities to consider when defining sustainable urban mobility policies and strategies.

This report, "Strategic Directions and Ecosystems to Address China's Urban Mobility Challenges", was released for the 2014 edition of the Michelin Challenge Bibendum (November 10th–14th 2014, Chengdu) of which Arthur D. Little is knowledge partner. It summarizes some of the key insights from the "Future of Urban Mobility 2.0" study, and puts them in perspective by looking into specific challenges and opportunities within Greater China.

With an economy that has achieved major transformations over the last decade, China can be considered a country that has broken world records. Looking ahead, China will become more urban and at a higher speed than most countries around the world, with 77% of its population living in cities by 2050 (vs. 50% in 2010), driven by economic growth and development of the service industry. Such urbanization is producing huge mobility challenges around congestion, pollution and accessibility of transportation, which are already experienced by millions of citizens. Yet Greater China also has some of the most advanced cities worldwide in terms of urban mobility systems, such as Hong Kong and Shanghai, which constitute a source of inspiration for other cities across the country. With many cities still in their development phase, China's thirteenth five-year plan, and the top-down planification system, there is a unique opportunity for China to transform itself into a pioneer of tomorrow's superior mobility systems. The objective of this report is to provide a framework and guidelines for China's urban mobility stakeholders and decision-makers to take the right actions going forward.

We hope you will find this report useful, and we would be pleased to discuss its conclusions and the implications for your organization.

Sincerely

François-Joseph Van Audenhove
Partner

Antoine Doyon
Head of China

1. Challenges and opportunities for Chinese urban mobility systems

1.1 Urban mobility trends and challenges for China

China has undergone a huge transformation of its urban landscape for the last 10 years, fueled by high-speed growth and urbanization. The urbanization rate in China increased from 26% in 1990 to 54% in 2014, and is expected to reach 69% in 2030 and 77% in 2050.

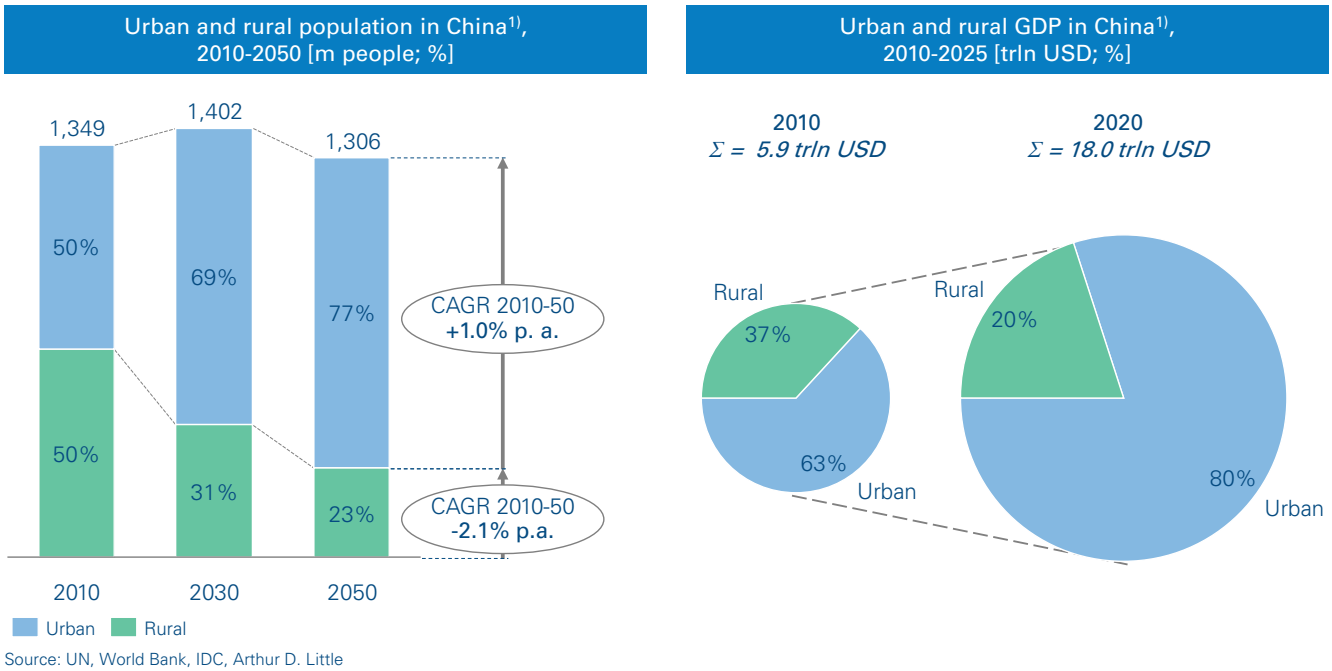
The urban population of China is set to grow from 740 million today to more than 1 billion by 2050, and this presents intimidating challenges in a range of spheres, from land development to climate change. But, as this growth will be accompanied by an exodus from the countryside to cities, there are few issues set to become thornier than the provision of urban transport. Indeed, according to the United Nations, there will be seven megacities with populations of above 10 million and another 12 large cities with populations of 5–10 million by 2020 in China. As existing urban mobility systems are already showing crisis symptoms in many cities, this represents a burning platform for all stakeholders involved.

The situation is exacerbated by the fact that city workers are responsible for creating a disproportionate amount of national GDP. By 2020, their contribution is expected to reach 80%, compared to 63% in 2010 (see figure 1.) In 2020 China is also expected to overtake the US economy to become the largest in the world. In such a context, it is vital that urban residents are in a position to move around freely.

This mushrooming of the urban population will be accompanied by massive growth in the motorization rate, as well as in demand for passenger and goods mobility in Chinese cities (see figure 2).

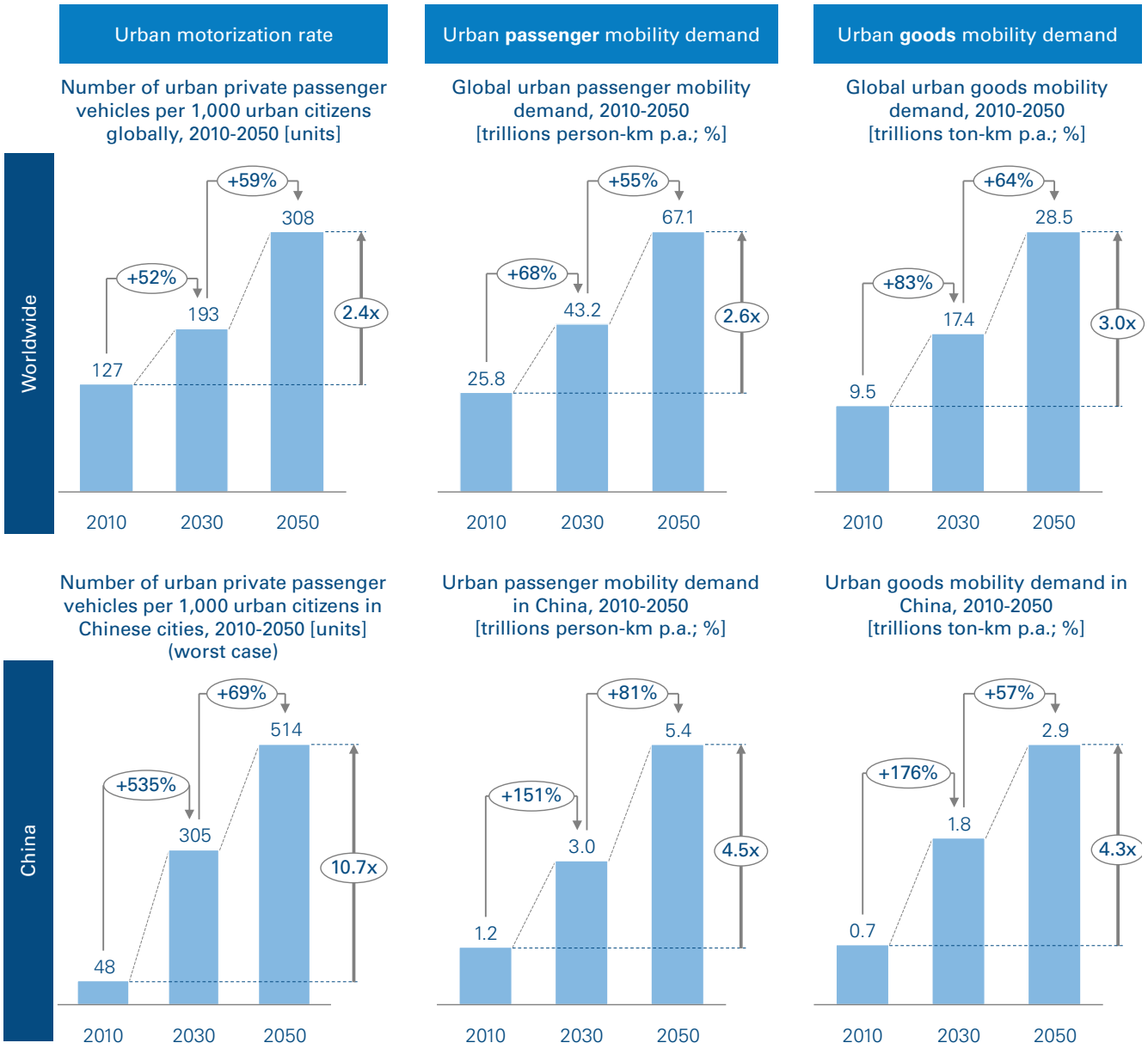
- In 2010 Chinese cities had a low motorization rate – on average, only 48 private passenger vehicles were registered per 1,000 citizens in urban areas. But the situation is changing rapidly. For example, over the past five years the number of cars has increased by 20% in many Chinese cities and, in the worst case scenario, the motorization level in Chinese urban areas is expected to reach 305 vehicles per 1,000 citizens in 2030 and 514 in 2050 – a 10.7-times growth

Figure 1: Urban and rural population and GDP in China



Source: UN, World Bank, IDC, Arthur D. Little
1) Incl. Hong Kong SAR and Macao SAR

Figure 2: Development of urban motorization and mobility demand worldwide and in China



Source: UN, IMF, Worldbank, OECD, ITF, Schäfer/ Victor 2000, Cosgrove/ Cargett 2007, Schäfer 2007, CAERC (Hao et. al. 2011), Arthur D. Little

by 2050 compared to 2010. Worldwide, only 2.4-times growth within the same period is expected – from 127 vehicles per 1,000 citizens in 2010 to 308 in 2050. This will imply severe challenges for the economy, society and environment if no radical measures are implemented to curb the trend.

- In a "do-nothing" scenario, the demand for urban passenger mobility in China will increase 4.5 times from 2010 to 2050, reaching 5.4 trillion people per kilometer p.a. At the same time, global urban passenger mobility demand will grow only by a factor of 2.6.
- Urban goods mobility demand will increase 4.3 times in this timeframe, compared to global growth, by a factor of 3.0. In 2050 the demand for urban goods mobility in China is estimated to reach 2.9 tons per kilometer p.a.

In addition to an increasing demand for a larger capacity for urban mobility, the demand for quality of experience of mobility is also evolving in China, just as in other developing countries. People's travel habits are changing, as is the mix of transport modes and services offered to them. But it is clear that, going forward, in addition to providing accessible transport services

at reasonable prices, Chinese transport providers will have to satisfy demand for services that are increasingly convenient, fast and predictable. At the same time, with a more educated and wealthier customer base, expectation will move toward further individualization of services. At the same time, customers will be increasingly concerned about the sustainability of their modes of travel, and some will be prepared to sacrifice individual forms of transport to further that cause, leading to the rapid increase of the penetration rate of new mobility services such as car, bike or ride sharing.

When it comes to mobility performance, the three dimensions of sustainability – people, planet and profit – need to be taken into consideration:

- **People**: An inevitable consequence of an unreformed and under-invested urban mobility system is gridlock. Extensive urban traffic congestion is already spreading to medium-size Chinese cities. By 2050, the average time an urban dweller will spend in traffic jams will be 106 hours per year (worldwide average) – twice the current rate – with all that entails for the quality of life of the average citizen. In large China sprawling cities, this situation is also affecting low income residents who use public transportation or non-motorized transportation as it translates into long and uncertain travel time, as well as an overcrowded and unfriendly environment.
- **Planet**: At a time when sustainability of resources and the environment is increasingly at the forefront of one's mind, a logarithmic increase in the use of motorized transport implies a vast rise in air and noise pollution and CO_2 emissions. Indeed, it is predicted that by 2050, urban mobility systems will use 17.3% of the planet's bio capacities – five times more than they did in 1990.
- **Profit**: Unless far-sighted decisions relating to service expansion and innovation are made now, the cities of the future are likely to sleepwalk into a situation in which they have insufficient public transport, overloaded infrastructures, a default expansion of motorized means of transport, and a concomitant parking capacity problem. Given that urban infrastructure is a key factor in luring businesses to cities, this would be highly damaging commercially. It is forecasted that annual spending on urban mobility (worldwide) – including infrastructure – will have to rise to $1,140bn per annum by 2050, more than four times the figure in 1990. And yet its services must remain affordable for all citizens.

One of the most substantive impacts of urban mobility for citizens is air pollution. Besides being a major health issue, **air pollution** impacts the overall well-being of citizens and the attractiveness of cities, with at the end impact on economy. The study[1] of World Bank finds that the health costs of air and water pollution in China amount to about 4.3 percent of its GDP. By adding the non-health impact of pollution, which is estimated to be about 1.5 percent of GDP, the total cost of air and water pollution in China is about 5.8 percent of GDP.

According to EIA, China's CO_2 emission was 5.9 trillion tons in 2013, and will increase by 31% to 7.7 trillion tons by 2020. China has approved the Kyoto Protocol to the UN Framework Convention on Climate Change; thus, efforts will have to be made to control CO_2 emissions.

Traffic **congestion** is another challenge of urbanization in China. According to Beijing Municipal Commission of Transport, Beijing's daily traffic congestion reached 105 minutes in 2013, compared to 80 minutes in 2012. According to Beijing Zhonglin Asset Evaluation Co. Ltd., traffic congestion causes economic losses of 105.6 billion RMB each year for the city of Beijing, or 7.5 percent of its GDP.

Safety and the high rate of accidents are other challenges posed by the extension of the road network and the car park surge, impacting the lives of millions of citizens and creating a roadblock to economic growth. An official source reported 918 deaths in road traffic in Beijing in 2012. The government aims to reduce this figure considerably, which will require a major effort in management of mobility system and safety. The estimated annual direct economic loss due to traffic accidents in Beijing is about 30 million RMB.

Overall accessibility to transportation, congestion and pollution can be major sources of citizen dissatisfaction and social unrest in the rapidly growing cities, as they are related to fundamental expectations of the population around health and well-being; thus, those are critical topics to be addressed by the Chinese government in order to develop a more urbanized and service-oriented economy.

Public transport stakeholders are struggling to improve the attractiveness, capacity and efficiency of public transport, and **system-level innovation** may be the best answer. But specialized players from other sectors – notably automotive OEMs, financial institutions/payment providers and telecom operators – are also assessing opportunities to play roles in China's extended mobility ecosystems of tomorrow. All this raises the question: what will the future business model(s) of the Chinese urban mobility be, and to what extent could mobility ecosystem extensions lead to superior mobility performance?

1 "Cost of Pollution in China Economic Estimates of Physical Costs", 2007, World Bank

1.2 Initiatives undertaken by the Chinese government to shape the future

Major initiatives (investment in infrastructure, incentives and regulatory measures) have been launched at national and local levels in recent years to improve urban mobility systems of Chinese cities and attempt to provide answers to increasing urban mobility needs.

In the twelfth five-year plan, one of the most critical official report to release the nation's development strategy, central China's government pointed out clear objectives for transportation – to make it safer, more efficient, more convenient, more reliable and more environmentally friendly. The role of central government is to set medium- to long-term targets so that functional authorities and local government can develop action plans with clear measures and budgets. For example, in the twelfth five-year plan, the Chinese government set the guideline to develop a BRT (bus rapid transit) system; meanwhile, the Shanghai government is investing and specifically planning the BRT pilot in South Shanghai. The approval from the central government has already been received.

On the **supply side,** major investments around public transportation infrastructure are under way. By 2015, the total public investment in public transportation will reach 1.2 trillion RMB (193 billion USD). Within all 11 cities that were surveyed in the index, a total of 3,900 kilometers of new subway are planned by 2020, which will need funding of roughly 2 trillion RMB (322 billion USD). In addition, more than 600 billion RMB (87 billion USD) investments are planned on green urban mobility from 2010 to 2020, including a 100 billion RMB (16 billion USD) subsidy to manufacture and purchase electric vehicles.

Chinese cities are also managing the **demand side**, with multiple policies and regulations to promote public transportation and calm the usage of private vehicles. Most Chinese Mainland cities only charge marginal prices for their public transportation systems. All subway systems in China charge less than 3 RMB (0.5 USD) for 5 kilometers, and most bus lines cost less than 2 RMB (0.3 USD) for 10 kilometers. Such policy makes public transportation financially attractive for citizens. On the other hand, municipal governments have accumulated large burdens of debt, ranging from 100% to 250% of their annual revenue as a result of financing large-scale construction projects and subsidizing daily transport operation costs.

Another way to manage demand is by restricting use of cars. There are currently 5 cities in mainland China that have introduced restrictive policies on passenger car registration – Shanghai, Beijing, Guangzhou, Guiyang and Tianjin. It is expected that other cities will follow. Some cities have also introduced limitation policies for private vehicles – each day about 20% of vehicles are not allowed to drive fully or partially (e.g. vehicles with number plates ending with 0 and 5 may not be allowed to operate on Mondays). A more extreme scenario is known as "even/odd restriction": every day only 50% vehicles are allowed to drive.

On the **public transport financing side**, Chinese cities are experimenting with several initiatives. For example, the city government of Beijing has implemented the public-private-partnership (PPP) model for construction and operation of the metro line 4. The initial investment is funded purely by government budget, but the operation and maintenance is given to a public-private joint venture between the Beijing government and the Hong Kong MTR, which bears the operation cost and earns the ticket fee, as well as advertisement and real estate related revenues, etc. The government does not subsidize the operation of the system.

1.3 Comparative assessment of Chinese urban mobility systems

To what extent are initiatives currently undertaken leading to superior urban mobility systems for Chinese cities? How does China compare to the rest of the world in terms of performance and maturity of its urban mobility systems?

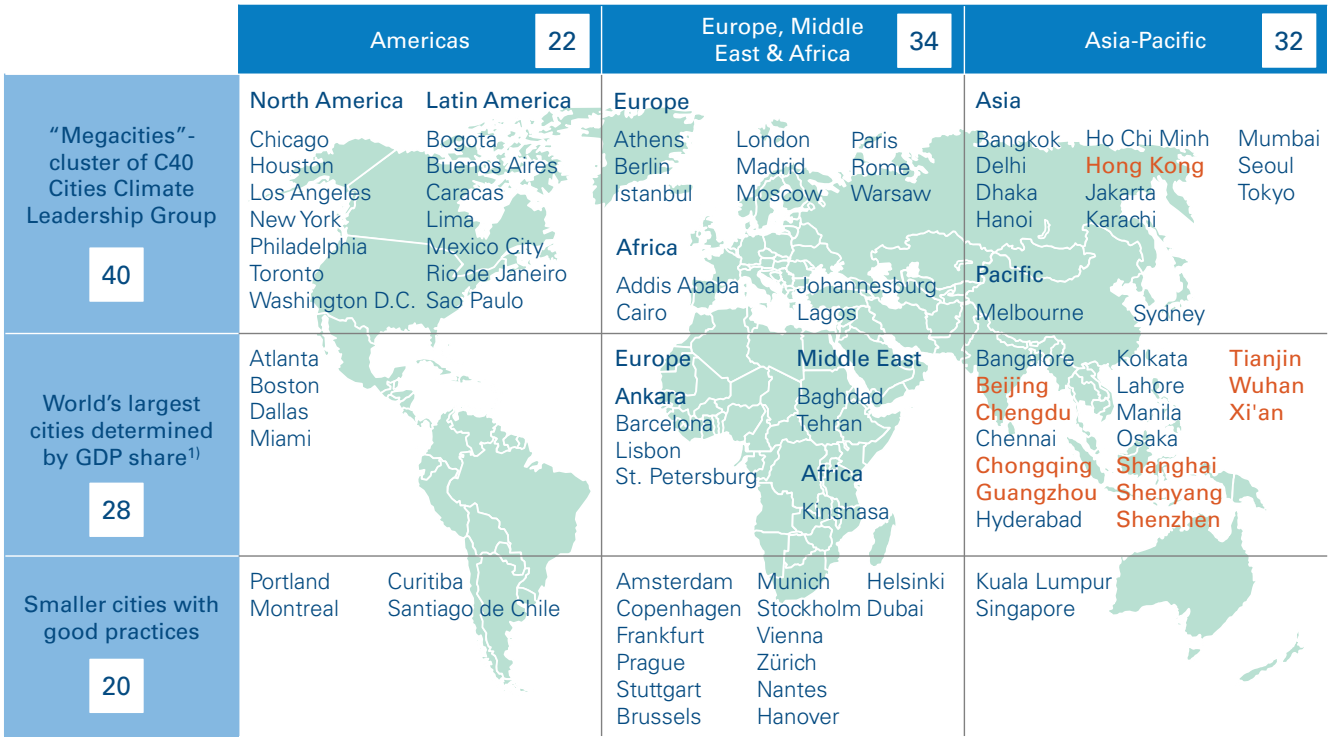
Introduction – Arthur D. Little Future of Urban Mobility Index

Given the complexity and comprehensiveness of urban mobility, evaluating urban mobility performance across cities is not an easy task and requires a commensurately ambitious approach. In January 2014, with the release of the second edition of the "Future of Urban Mobility" study, Arthur D. Little assessed the mobility maturity and performance of 84 cities worldwide, including 7 cities in Greater China as well as Hong Kong. For this report for Michelin Challenge Bibendum, we updated data on Chinese cities and extended the scope of the index to include four additional Chinese cities.

The Urban Mobility Index presented in this report includes 88 cities (see Figure 3), of which the largest group is the Megacity group of the C40 Climate Leadership Group, a network of cities around the world that are committed to addressing climate change. The next-biggest was the 28-strong group of cities that are not members of the C40 group but representing the largest metropolises determined by GDP share of region and population. The final group is made up of smaller cities.

The Mobility Index assessed cities based on 19 criteria. Eleven of these were related to how mature the city under examination was in terms of its existing infrastructure, from its public transport's share of the modal split to smart card

Figure 3: Benchmark sample of Arthur D. Little Urban Mobility Index 2.1



Source: Arthur D. Little
1) not included into group 1 (C40 Megacities)

penetration. These indicators made up 58 possible points of the 100 available. The other 42 points were awarded on the basis of performance, with categories including the level of transport-related CO_2 emissions and the mean travel time to work.

The criteria used to measure the maturity and performance of the cities under examination were selected to cover the classical areas of mobility measurements – security, quality, accessibility, affordability, sustainability, innovativeness and convenience – while finding the right balance between the supply side and the demand side, as well as overall mobility policy initiatives. A limited number of criteria (e.g. measurement of accessibility by the number of public transport stops per square kilometer) were not included, as certain statistics are not collected in some regions of the world[2] (see figure 4.)

It must be noted that the urban mobility index is a snapshot of mobility performance based on available data at a specific point of time (data regarding Chinese cities was collected during the first semester of 2014). Given the rapidly evolving environment, especially in booming cities such as China, it does not take into account the impact of initiatives launched more recently.

Comparative ranking of Chinese Urban Mobility Systems

The results of the Urban Mobility Index made grim reading, as it found that most cities were badly equipped to cope with the challenges ahead. The global average score (with the inclusion of the additional four cities in Mainland China) was 43.8 points, which meant that, on average, the 88 cities achieved less than half of the potential that could be reached when applying best practice across all operations.

Only 11 cities, or 13% of the sample of cities, scored above 52 points (the top 20% of the score range). Seventeen cities fell into the "below-average performance" cluster, which was the lowest 20% of the score range. The highest score (58.1 points) went to Hong Kong, followed closely by Stockholm (57.4 points) and Amsterdam (57.2 points), which still indicated potential for improvement, as the maximum obtainable score was 100. On average, Europe had the highest score of regions analyzed, with an average score of 51.5 points.

Except for Hong Kong (the best-ranked city in China as well as overall), Chinese cities fell within the "average performance" cluster (defined by 30% of the score range on both sides of the average score of 43.8 point). Shanghai was the challenger occupying place, followed closely by Wuhan. Both cities

2 For further information on Arthur D. Little's Urban Mobility Index (including a full description of the measurement criteria), please refer to the Arthur D. Little and UITP study "The Future of Urban Mobility 2.0 – Imperatives to shape extended mobility ecosystems of tomorrow", January 2014.

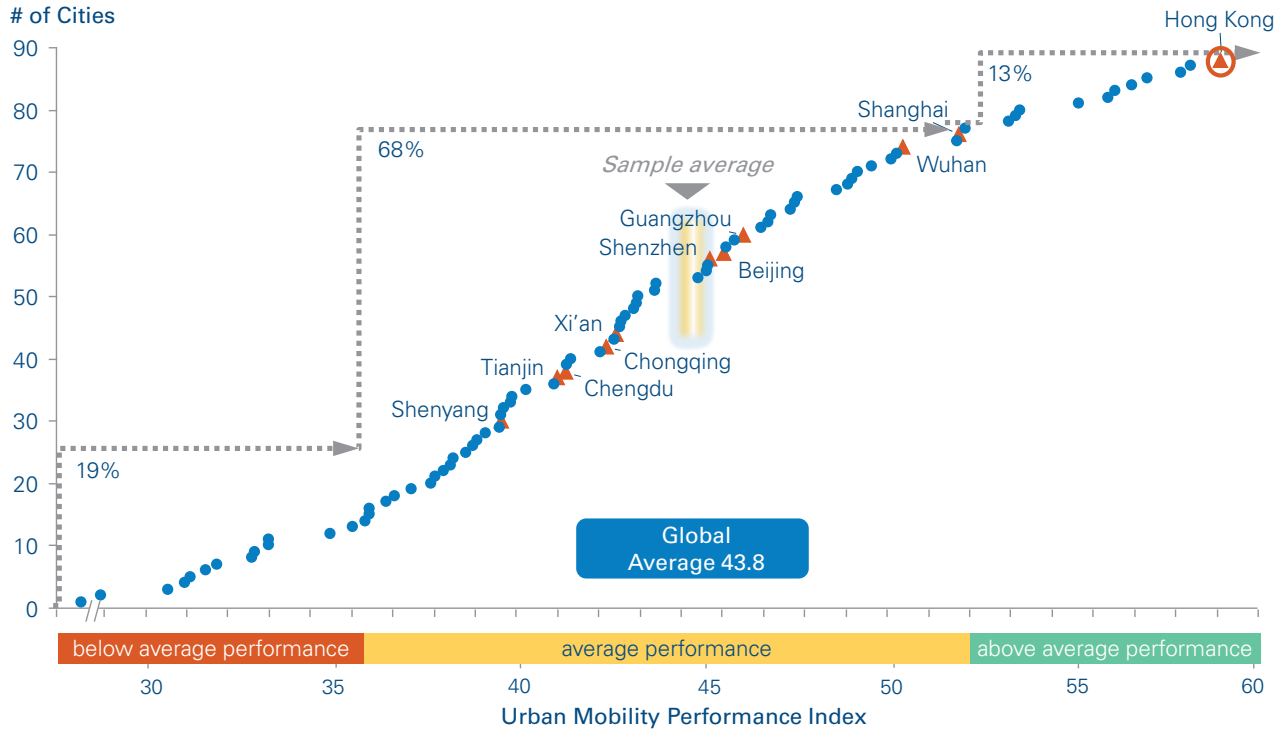
Figure 4: Arthur D. Little Urban Mobility Index assessment criteria

Arthur D. Little Urban Mobility Index 2.0 – Assessment criteria			
Maturity [max. 58 points]		Performance [max. 42 points]	
Criteria	Weight[1]	Criteria	Weight[1]
1. Financial attractiveness of public transport	4	12. Transport-related CO_2 emissions	4
2. Share of public transport in modal split	6	13. NO_2 concentration	4
3. Share of zero-emission modes in modal split	6	14. PM_{10} concentration	4
4. Roads density	4	15. Traffic-related fatalities	6
5. Cycle path network density	6	16. Increase of share public transport in modal split	6
6. Urban agglomeration density	2	17. Increase of share of zero-emission modes	6
7. Smart card penetration	6	18. Mean travel time to work	6
8. Bike-sharing performance	6	19. Density of vehicles registered	6
9. Car-sharing performance	6		
10. Public transport frequency	6		
11. Initiatives of public sector	6		

Source: Arthur D. Little Urban Mobility Index 2.0
1) The maximum of 100 points is defined by any city in the sample for each criteria

scored on the top end of the "average performance" cluster. Guangzhou, Beijing and Shenzhen all score above the global average performance, while Xi'an, Chongqing, Chengdu, Tianjin and Shenyang all scored below the global average. Shenyang had the lowest score of all the Chinese cities in scope. This ranking is a picture as of today, but may evolve quickly with the

Figure 5: Ranking of urban mobility systems in Greater China



Source: Arthur D. Little Mobility Index; xx% : share of cities in this performance cluster; 100 index points for city that would achieve best performance which is achieved today on each performance criteria

ongoing large investment from Chinese cities and the speed of transformation already observed.

Taking a closer look at the individual scores of cities in Greater China in the scope of the Arthur D. Little Urban Mobility Index (see figure 6 as well as High-level profiling of each city provided in appendix), a number of conclusions for China can be put forward:

- Public Transport is more affordable for citizens in China compared to other countries and continents. As such, it is no surprise that the share of public transport in the modal split is at 34% – the highest compared to other continents' average share. Smart card penetration is also the highest of all regions studied, with Hong Kong taking the lead with 3.3 cards per person.
- In comparison with other continents, China also has the highest share of zero-emission modes in the modal split. Although bike-sharing performance is the highest of all regions studied[3], cycle path networks are less developed than in Europe and Australia.
- Car sharing in China is underdeveloped: only the city of Hangzhou (not included in our index) has had a car-sharing scheme installed since August 2013. One of the underlying reasons for this might be the relatively low price of taxis.
- Overall, at 180 vehicles per 1,000 citizens, car ownership is still below levels seen in Europe (440 per 1,000 citizens) and the Americas (430), but this number is growing.
- As already highlighted, China's air quality is in a dire condition. Chinese cities have the highest NO_2 concentrations of all regions studied, and their PM10 concentrations are the second highest in the world after African cities included into the Urban Mobility Index sample. On the other hand, transport-related CO_2 emissions per capita are lower

3 This performance is mainly driven by the city of Wuhan, which officially reports to have 90,000 shared bikes. However, this figure couldn't be verified in the course of this study.

Figure 6: Ranking of urban mobility systems in Greater China – Detailed assessment

		Maturity indicators												Performance indicators								
		Fin. attract. of PT (cost of 5 km PT/ cost of 5 km car)	Share of PT in modal split [%]	Share of zero-emission modes in modal split [%]	Roads density (deviation from optimum) [km/km^2]	Cycle path network density [km/ths km^2]	Urban agglomeration density [citizens/km^2]	Smart card penetration [cards/capita]	Bike-sharing performance [shared bikes/ million citizens]	Car-sharing performance [shared cars/million citizens]	Density of vehicles registered [vehicles/capita]	Frequency of the busiest PT line [times/ day]	Initiatives of public sector (0 to 10 scale)	Transport-related CO_2 emissions [kg/capita]	Annual average NO_2 concentration [mcg/m^3]	Annual average PM10 concentration [mcg/m^3]	Traffic-related fatalities per 1 million citizens	Dynamics of share PT in modal split [%]	Dynamics zero-emission modes in modal split [%]	Mean travel time to work [minutes]	OVERALL SCORE
1	Hong Kong	1.41	55%	38%	2.0	188	6.5	3.3	0	0	0.09	322	10	776	50	50	18.2	+20%	0%	37	58.1
13	Shanghai	1.03	33%	47%	2.3	1,424	2.9	2.4	1,343	0	0.11	237	9	950	53	81	38.5	+18%	-19%	47	51.8
15	Wuhan	0.68	24%	58%	2.2	1,519	1.0	1.1	9,552	0	0.15	193	8	733	54	105	42.9	+9%	-12%	31	50.4
29	Guangzhou	0.94	32%	47%	2.6	1,130	1.1	1.8	446	0	0.24	320	10	952	56	70	109.1	+39%	-19%	48	46.5
32	Beijing	0.68	39%	34%	2.1	1,553	1.3	1.9	1,019	0	0.25	283	10	1,147	53	121	44.4	+24%	-24%	52	46.1
33	Shenzhen	0.94	38%	38%	3.0	642	5.3	1.4	1,152	0	0.19	188	10	1,042	73	46	44.4	+36%	-32%	46	45.7
39	Xi'an	0.68	31%	39%	2.9	865	0.8	1.0	1,556	0	0.22	133	7	702	42	113	66.5	+7%	-30%	29	43.4
47	Chongqing	0.67	35%	48%	2.3	1,442	0.4	0.7	127	0	0.13	215	7	1,134	70	105	33.3	+25%	-24%	35	43.2
51	Chengdu	0.65	23%	54%	2.3	1,456	1.0	0.6	1,154	0	0.26	143	7	1,094	74	111	51.0	+53%	-17%	31	42.2
52	Tianjin	0.66	29%	48%	2.5	1,180	1.2	0.9	45	0	0.17	124	8	803	50	101	60.0	+89%	-33%	40	42.0
59	Shenyang	0.66	33%	49%	2.9	851	0.6	0.7	26	0	0.16	129	8	1099	73	110	74.5	+74%	-28%	34	40.7
	Average China	0.82	34%	45%	2.46	1,114	2.0	1.4	1,493	0	0.18	208	9	948	59	92	53.0	+31%	-22%	39	46.4

than in other regions of the world (except for Africa), which can be explained by the lower number of vehicles per capita.

- With 53 traffic-related fatalities per million citizens, and despite a lower concentration of cars, Chinese traffic is less safe than in Europe (33 per million citizens) and the Americas (37 per million citizens), but below Asian averages (67 per million citizens).
- The average travel time to work in Chinese cities, 39.1 minutes, is only a few minutes higher than travel times in the Middle East (33.9), the Americas (33.8) and Europe (32.5), and just below Asia-Pacific (39.4).

Some trends are noticeable for the seven cities that were examined in both versions of Arthur D. little's Urban Mobility Index, released in 2011 and 2014, respectively: Hong Kong, Shanghai, Beijing, Guangzhou, Shenzhen, Tianjin and Wuhan)

- Walking and cycling modes are most commonly used in China than in many other regions due to necessity and habits – as no real alternatives exist for the last mile. However, with growing income revenue, individual motorized transportation modes tend to substitute public transport and zero-emission modes of transport, which have decreased for all cities in scope, except for Hong Kong, where it has remained equal. A comparatively low number of motorized individual vehicles as well as higher rates of walking and cycling in comparison with developed countries, constitute unique opportunities for Chinese cities for constructing fair, economically and resource efficient cities.
- In terms of traffic safety, Chinese cities have made great progress: transport-related fatalities have decreased for all examined cities. Shenzhen, for example, saw its number of traffic-related fatalities decrease from 68 per million citizens in 2009 to 44 in 2013.
- Transport-related CO_2 emissions per capita, on the other hand, increased drastically for all cities except for Wuhan and Tianjin. In Shanghai, for example, emissions per capita nearly quadrupled between 2003 and 2011.
- Except for Hong Kong, where the mean travel time to work decreased by two minutes in the FUM 2.0 index compared to the FUM 1.0 index, the mean travel time to work remained constant (or increased slightly) between the two indexes. The increase was the largest for the city of Tianjin, where the mean travel time to work increased from 30 to 40 minutes.

As a best-practice example, **Hong Kong** stands at the very pinnacle. Despite – or perhaps because of – being one of the most densely populated areas in the world, with more than 7 million people packed into a land mass of just 1,100 sq km, Hong Kong has developed the most advanced urban mobility system in the world. Public transport represents no less than 55% of the modal split, the number of vehicles registered per capita is among the lowest worldwide, and smart card penetration stands at 3.3 cards per person. This latter point can be explained by the fact that some people have two cards, one personalized and one anonymous; some cardholders work in Hong Kong but live in China; and others belong to tourists. Hong Kong fares even better when it comes to performance factors, including a moderate level of transport-related emissions per capita, a low rate of traffic-related deaths, and a respectable mean travel time to work given its population density.

Shanghai, with a FUM score of 51.8 points, has the second-best mobility system after Hong Kong in the Chinese sample, and serves as a role model for other mainland cities. As the first city to introduce a vehicle purchase restriction policy in 2004, Shanghai has the second lowest vehicle ownership rate after Hong Kong as of 2013. With a 47% share of zero-emission modes in modal split and 28,000 shared bikes (1,343 per million citizens), the city scores relatively high with regard to non-motorized transport. Like Hong Kong, Shanghai's smart card penetration rate is at saturation level, and it boasts dynamic and efficient public transport service delivery: 49 million transit smart cards in Shanghai means a penetration level of 2.4 cards per capita. Shanghai also aims to have 30,000 electric vehicles and 5,000 charging stations on its streets by 2015 to become a showcase for e-mobility for the whole country. Challenges for the city lie in the areas of air quality, further promotion of public transport in the modal split, and stabilization of current motorization level.

Please refer to the Appendix of this report for a high level profiling of other Greater China cities in scope of Arthur D. Little's Urban Mobility Index.

Figure 7: Urban Mobility profile of Hong Kong

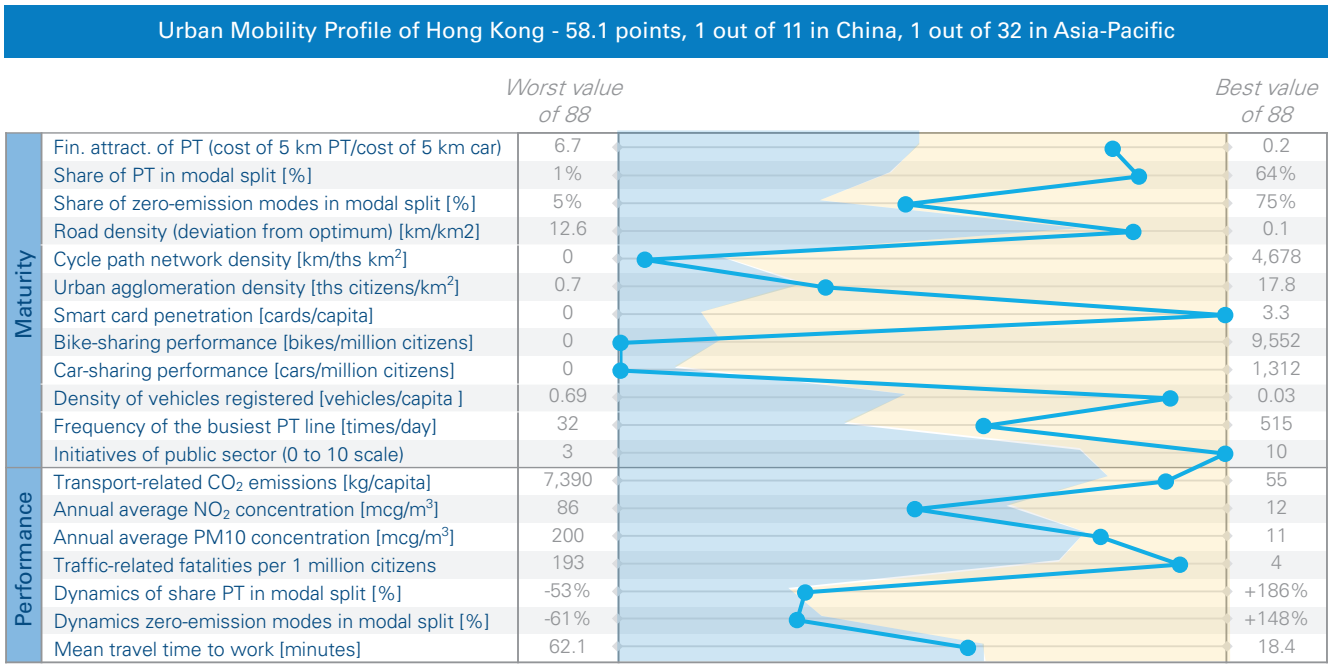
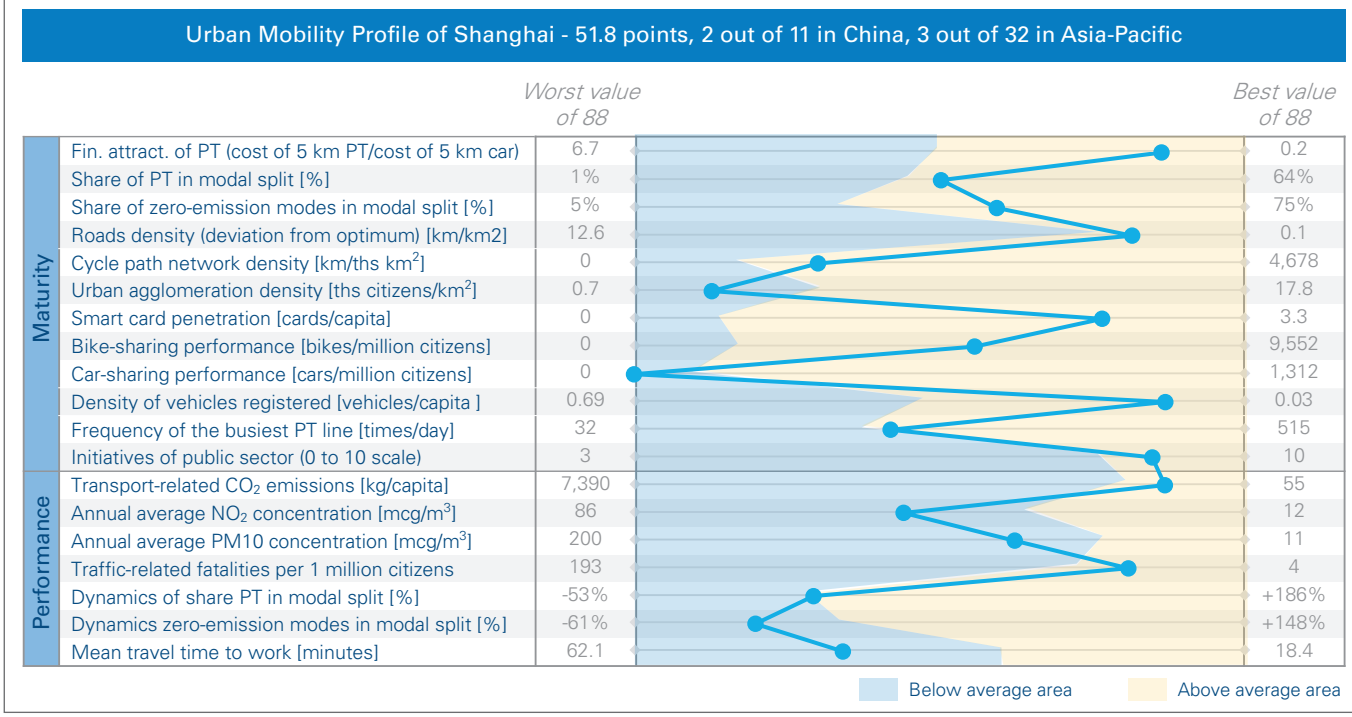


Figure 8: Urban Mobility profile of Shanghai



1.4 Conclusions – Urgent needs for urban mobility transformation

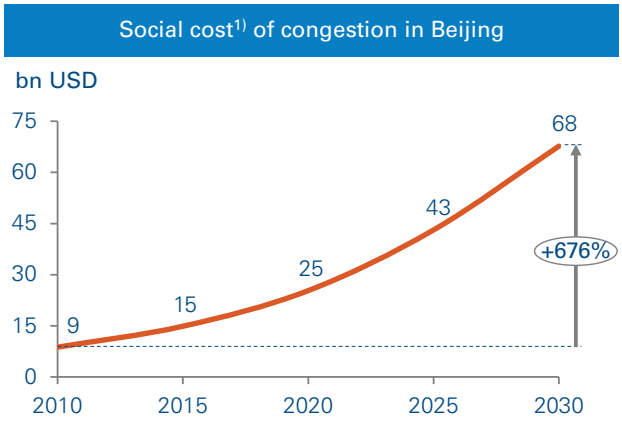
In summary of the analysis, it is not putting it too strongly to say that most Chinese mobility systems are standing on a burning platform, and if action is not taken in the very near future, they will play a major role in slowing the growth and development of their nation. If current trends continue and initiatives undertaken by mobility stakeholders at national and local levels are not able to reverse this course, urban mobility systems in China will break down spectacularly and the so-called triple bottom line – people, planet, profit – could suffer a serious blow.

The need for urgent action is becoming more and more obvious to the Chinese government and local cities, as economic and urbanization pressure is increasing. If nothing is done by 2020, issues linked to pollution and congestion will pull most Chinese cities back into the status of less-developed cities around the world with slow growth. On top of that, health and well-being issues could lead China into social unrest, civil disorder and political instability.

As an illustration, if no action is taken, the social cost of congestion in Beijing – loss of time, energy, accidents, vehicle damage and environmental pollution – is estimated to increase almost sevenfold from 2010 to 2030 (see figure 9), putting tremendous pressure on the city's economy and the citizens' well-being.

An analysis by Arthur D. Little of urban mobility systems around the world revealed sufficient availability of technologies and solutions to address the mobility challenges. The two main barriers to superior mobility performance relate to inadequacy of urban mobility strategies and the fragmented structure of urban mobility systems.

Figure 9: Social cost of congestion of Beijing



Source: CAERC, Energy Foundation China, Mao et. al. 2012, Arthur D. Little
1) Time, energy, accident, vehicle loss and environmental pollution cost

Urban mobility strategies do not fulfill expected requirements and lack integration:

- **Lack of clear vision and strategy:** A lot of mature cities do not yet have clear visions and strategies for how their mobility systems should look in the future. In all too many cases, urban mobility plans include long lists of initiatives with no sufficient reflection on the synergies and incompatibilities between the initiatives, limited integration between the different modes of transportation and no convincing explanations of how desired results should be achieved by allotting responsibilities, setting deadlines, and instituting monitoring procedures.
- **Poor interlinking with other strategies:** There is also often a poor interlinking of urban mobility strategy and other urban strategies. For example, if a city is committed in its environmental strategy to reduce CO_2 emissions, it should ask what contribution transport should make to achieve this goal.
- **Limited region-to-region integration:** At a different level, integration between regional mobility systems remains very low in comparison to other parts of the economy. Urban transport infrastructures were historically designed to serve regional rather than supra-regional goals.
- **Lack of private sector engagement:** Strategies are often mainly based on "public sector actions", and do not sufficiently address interfaces with the private sector and how business models could be established to better harness private sector capabilities and resources.

Urban mobility systems are too fragmented, not allowing for system-level innovation and collaboration:

- **Innovation hostility:** Urban mobility systems operate in an environment that is too fragmented and can sometimes be hostile to innovation, as it does not allow market players to compete and establish business models that bring demand and supply into a natural balance.
- **Lack of integration and agility:** Current mobility systems adapt poorly to changing demands, are weak in combining single steps of the travel chain into an integrated offering, and do not sufficiently bring together key players to work jointly on innovative mobility solutions.

The success will depend on the development of future innovative mobility services that will need to be driven less by improvements in single transport modes than by integration of different transportation modes. What is needed is system-level collaboration between all stakeholders of the Chinese mobility ecosystem in order to come up with innovative and integrated business models and solutions.

The economic and political stakes of urban mobility are so large in China that they could only call for decisions and actions. This sense of urgency might constitute a unique opportunity for China to leap forward in terms of mobility performance and, if it takes the right actions now, China could become the test bed and breeding ground of tomorrow's superior urban mobility systems. Also given the current economic growth rate, expansion of most Chinese cities constitutes a window of opportunity for major transformation.

Moreover, top-down planning and the thirteenth five-year plan also offer unique opportunities for China's central government to enable encouragement and support for an ambitious transformation plan and for city governments to drive delivery of superior mobility performance.

2. Vision and solutions for China to set the foundations of superior urban mobility systems

2.1. Which strategic directions for Chinese cities?

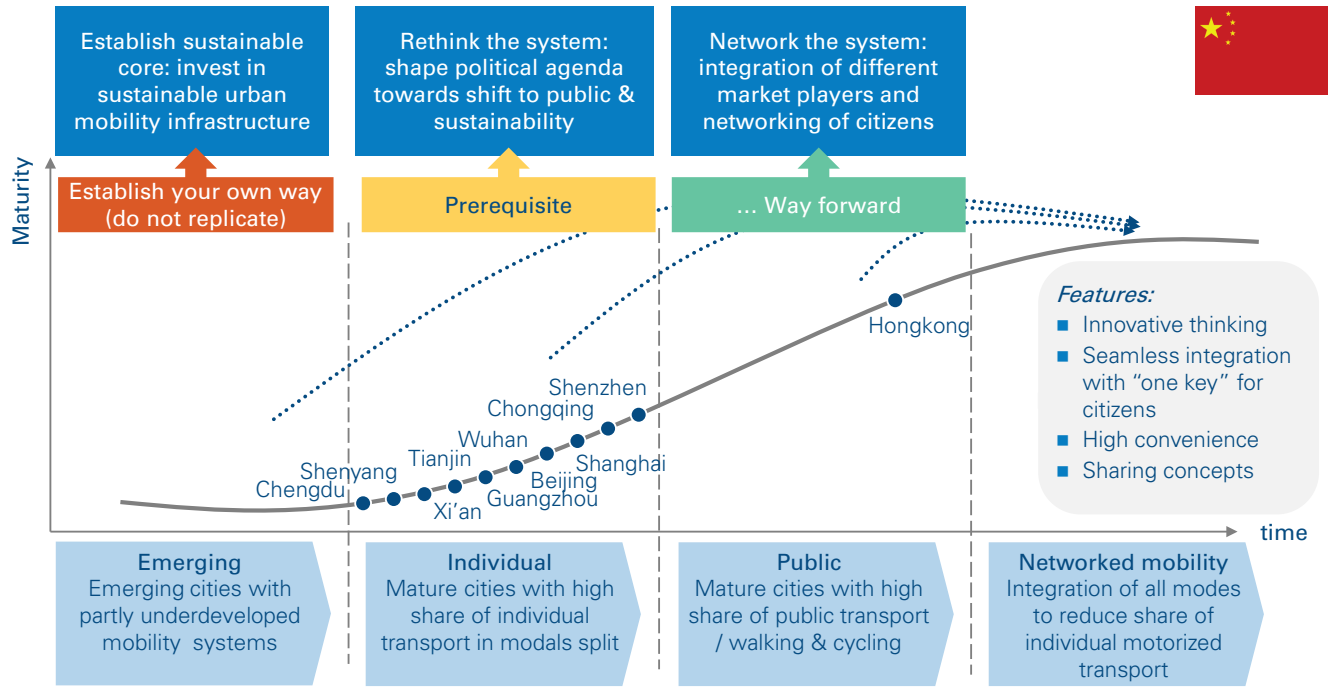
Which strategic directions should Chinese cities take to drive better mobility performance and develop themselves towards superior urban mobility systems?

In our Arthur D. Little Urban Mobility Lab, we tried to put the Urban Mobility Index results in perspective and derive conclusions in terms of orientations to drive better mobility performance. To that effect, we looked at city characteristics and analyzed correlation with scores on the Urban Mobility Index. The analysis revealed wildly divergent performances, but allowed for a number of interesting conclusions:

- **Mature cities are not necessarily a model** – Cities in emerging regions should not necessarily aspire to emulate their counterparts in mature regions. If cities in emerging regions replicate the pathway that cities in mature regions have followed, they run the risk of introducing the same problems of poor modal split, high carbon emissions and low travel speed.
- **Cities' size Cities' size does not influence mobility performances** – However, **city prosperity** and the **prevalence of sustainable transport modes** (public transport, walking and cycling) **in the modal split** do have significant influence on mobility performance. The richer the city and the lower the share of individual motorized transport, the higher the score.
- **Innovation is key** – One thing all cities have in common is that they need innovation at system level to improve their performance.

Globally, we can distinguish **three city clusters** in terms of **strategic directions** – "emerging", "individual" and "public" cities – each with specific opportunities and challenges that they need to address in order to become fit for the future (see figure 10) and move toward "networked mobility":

Figure 10: Strategic directions for Chinese cities



Source : Arthur D. Little FUM 2.0

- **Emerging cities – Establish Sustainable Core:** Cities in this cluster must establish a sustainable mobility core that can satisfy demand at a reasonable cost without replicating mistakes from developed countries. With the availability of emerging transport infrastructure and technologies, these cities have the opportunity to become the test bed and breeding ground for tomorrow's urban mobility systems.
- **Individual cities – Rethink the System:** With a high share of individual motorized transport, those cities need to (re-) shape their political agendas to fundamentally redesign their mobility systems so that they become more oriented towards public transport and sustainability. All 10 of the cities of Mainland China within our benchmark sample belong to this group, as they have well-developed transportation infrastructures but an insufficient share of sustainable transportation modes.
- **Public cities – Network the System:** For mature cities with large shares of sustainable transport modes, the next step must be to fully integrate the travel value chain to foster seamless, multimodal mobility and increase the overall attractiveness of public transport by extending services. Hong Kong is part of this city cluster.

However, different strategic directions should be combined. In addition to rethinking their mobility systems, cities in the "individual" cluster should initiate action today to network their systems (i.e. the integration of different market players and the networking of citizens) today. But these initiatives will only bring significant benefits if sustainable modes of transport make up a sufficient percentage of the modal split. Hence, "rethinking the system" is a prerequisite for obtaining the full benefits of "networking the system". Similarly, cities in the "emerging" city cluster should undertake the right set of actions in order to not be forced to rethink the system in a second stage, and once the foundations of a sustainable mobility systems are in place, they should start introducing initiatives to network the system.

From those analyses, we can conclude that for most Chinese cities, development of superior mobility systems will typically combine two strategic directions:

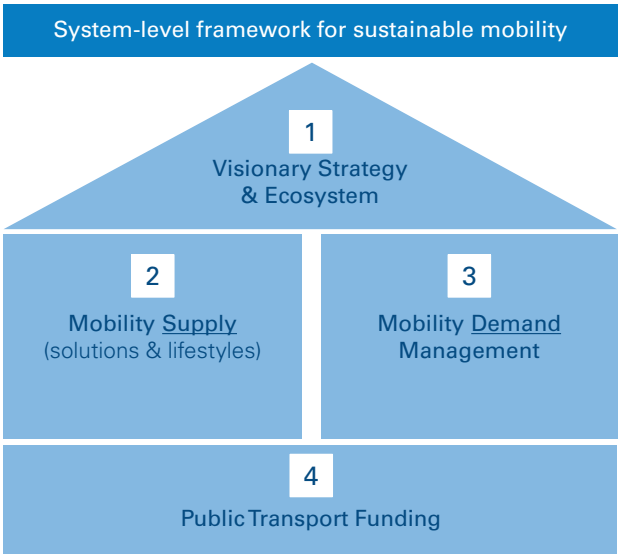
- **Rethinking the system** via development of long-term urban mobility vision and (re-)enforcement of sustainable urban mobility policies and strategies
- **Networking the system** via set-up of multi-stakeholders mobility ecosystems to deliver innovative, integrated and seamless mobility solutions to Chinese citizens

In the following sections, we take a closer look and provide some recommendations on how Chinese cities, in collaboration with other stakeholders of the (extended) mobility ecosystems, can move forward on those two strategic directions.

2.2. "Rethink the system" by developing a sustainable urban mobility vision, strategy and policies

Improving urban mobility is a challenge of epic proportions. As urban populations grow and economic prosperity increases, cities are under more pressure to deliver fast, safe and environmentally friendly transport to citizens and businesses. Arthur D. Little's research into good practices in the world's cities, in collaboration with the UITP (the International Association of Public Transport) showed that four key dimensions needed to be addressed to put sustainable urban mobility systems in place, as illustrated on figure 11[4].

Figure 11: System-level framework for sustainable urban mobility system



Source: Arthur D. Little & UITP FUM 2.0

A system-level approach across these four dimensions is critical: sustainable progression of a city's mobility performance require simultaneous improvement in each of the four dimensions, as the weakest link will influence overall mobility performance.

Dimension 1: Visionary strategy and ecosystem

Firstly, city authorities need to develop a **visionary strategy and ecosystem:** a political vision and clear urban mobility objectives, in order to communicate strategic priorities and investments. This needs to ensure the right balance between stretch and achievability, and be integrated with other urban policies, such as land planning, economic development,

4 For further information on each of those four dimensions, along with a detailed description of underlying strategic imperatives for cities, please refer to Arthur D. Little and UITP's study, "The Future of Urban Mobility 2.0 – Imperatives to shape extended mobility ecosystems of tomorrow", January 2014. Available at www.adl.com/FUM2.0

environmental and social policies, and housing. Transport authorities also need to consult, engage and win support from other (public and private) mobility stakeholders, including the public at large, to ensure broad backing from all parties involved.

Improving integration of transport planning with other urban policies should be one of the priority imperatives for China, particularly when it comes to the health and well-being of citizens. A key reason as to why China's larger cities suffer from extreme congestion and air pollution, even though the level of motorization is comparatively low, is the comprehensive disconnect between transport, environment and land use planning and management[5].

For instance, enforcing air quality standards for commercial vehicles is one of the fastest ways to reduce the environmental impact of transport. In Beijing and Shanghai, diesel trucks are the main contributors to $PM_{2.5}$ emissions (more than 90% of all motor vehicles) and amount to about 20% of the overall city $PM_{2.5}$ emissions, among other sources such as coal burning, dust and industrial sources. Implementing standards such as the National V emission standard (expected in 2018, and would imply a reduction by 99% of the amount of $PM_{2.5}$ generated by trucks) in China would be extremely challenging, looking at the difficulties already faced today with the National IV emission standard. Besides a strict monitoring of the implementation, such a measure would require development of an ecosystem with policy makers, commercial vehicle OEMs and suppliers, energy providers and logistics companies. This said, it would be of critical importance for Chinese stakeholders to align on an ambitious roadmap, having anticipated all requirements and roadblocks along the way.

The establishment of a visionary and well-grounded urban mobility vision and strategy involves a rigorous, multi-stakeholder approach that takes into account consultations between government and local authorities, public transport operators, other mobility solutions providers and businesses. The blue box provides some guidelines.

Dimensions to consider when defining an urban mobility vision and strategy

The headline goal of any effective urban mobility strategy is to satisfy the travel needs of both people and businesses in such a way that it improves quality of life for the citizens and increases the competitiveness of a country or region.

To ensure that this goal is achieved, a successful urban mobility strategy needs to consider the interests of both public and private transport, passenger mobility and goods mobility, motorized and non-motorized transport, and vehicles that are parked as well as those on the move.

The establishment of a visionary and well-grounded urban mobility strategy requires careful consideration of a number of dimensions, as illustrated in figure 12.

The first step is to set the scene by gaining an understanding of the current level of mobility performance (and its shortcomings) in order to create the required sense of urgency. Alongside this, the key stakeholders need to be identified and their needs examined and understood. Finally, a thorough assessment of the existing public and private mobility initiatives is of critical importance in order to understand everyone's agendas and avoid "throwing out the baby with the bath water".

These findings should form the basis of a political vision and lead to the formulation of urban mobility objectives based on a strategic alignment between all key stakeholders. This will serve as input to establish the urban mobility strategy, its priorities and the investments required to bring it to fruition. The geographical, functional and modal scope should also be clearly defined beforehand.

Although the selection of the appropriate mobility measures should be systematically assessed against local contexts, examining other mobility strategies and initiatives allows for the identification of good/bad practices and the discovery of lessons learned elsewhere, which can be inspirational.

5 This was one of the key conclusions of the recent study "Promoting Urban Green Travel-to Reduce Air Pollution and Congestion in Chinese Cities" by China Urban Sustainable Transport Research Centre (CUSTReC), 2013

Potentially relevant mobility measures should be identified, discussed and assessed with all the (public and private) stakeholders involved. Following this process, the most suitable measures can be selected and synergies/conflicts among them identified. On this basis, strategic options, in the form of integrated packages of measures, should be developed, resulting in a final selection of priority measures to implement.

The development of a master plan with a long-term horizon, which lays out responsibilities and allocates resources, together with the introduction of clear governance mechanisms for monitoring and updating, is also a must. Meanwhile, a budget plan will ensure that the investment undertaken synchronizes with existing funding streams.

Last but not least is the necessity of an energetic marketing and PR campaign to communicate the aims and objectives of the strategy and ensure the maximum involvement of all stakeholders (including the public at large) in its implementation.

Figure 12: Dimensions to be considered when defining a sustainable urban mobility vision and strategy

1 Sense of urgency	■ Understand patterns to reach shared understanding of mobility issues ■ Objectivize current mobility performance & gaps with best practices	Setting the Scene
2 Accountabilities	■ Identify key stakeholders and clarify "grey zones" of accountabilities ■ Understand current (public and private) mobility initiatives	
3 Stakeholders' views	■ Understand needs and agendas of each stakeholder group ■ Understand needs of different customer groups (individual, businesses)	
4 Scope	■ Define geographical scope: city, region, nation ■ Define functional (mobility, sustainability) & modal scope (persons, goods)	Vision & Objectives
5 Vision & Objectives	■ Develop a political vision and set priorities and targets ■ Ensure alignment between stakeholders on priorities (non normative)	
6 Good practices	■ Synthesis of experience from other mobility strategies and initiatives ■ Identify Good/Bad Practices and lessons learned	Strategy Formalization
7 Measures	■ Identify relevant mobility measures for set priorities and assess synergies ■ Select strategic options in form of integrated package of measures	
8 Roadmap	■ Develop master plan with responsibilities and resources allocation ■ Develop budget plan and synchronize with funding streams	Strategy Execution & Monitoring
9 Governance & Marketing	■ Set up clear governance mechanisms for monitoring and update ■ Marketing of mobility strategy, PR work with other stakeholder groups	

Source: Arthur D. Little

Dimension 2: Mobility supply (solutions and lifestyle)

Secondly, cities need to further extend their **mobility offerings** (the supply side of mobility), in terms of both capacity and quality of services, and adapt it from "delivering transport" to "delivering solutions". At the same time they must improve the quality of the customer experience and extend their service offerings to respond to evolving mobility needs through partnerships and alliances with third parties.

In this service-conscious age, mobility solution providers need to evolve toward a more customer-focused culture and improve public transport attractiveness so that all social classes are willing to use it. This evolution should be achieved by putting the interests of the customer at the heart of decision-making, which will lead to quality enhancement of service offering characteristics, such as:

- Improving quality and reliability of the core service offering characteristics – for example, punctuality, safety and security (and the perception thereof)
- Improving quality of information, for instance, through the introduction of Digital Multimodal Mobility Assistants with online booking and real-time travel information, to ease seamless travel across the various public and private transport modes
- Building a superior customer experience by eliminating major drivers of customer dissatisfaction, ensuring a consistent approach towards passengers across the whole journey, and exceeding expectations at selected touch points to create the moments of truth that turn customers into fans.

Enhancing service-offering quality and improving customer experience while getting costs under control requires the authorities to prioritize their actions and make the required trade-offs according to their expected impacts. Improvement can be achieved through a combination of smart actions of different natures that do not always need to be expensive. Alongside hard measures (mostly infrastructure-related, involving high capital expenditure) and measures related to the introduction of new technologies, the role of management measures (e.g. adapting processes toward increased customer centricity) as well as soft measures (e.g. training to increase staff empathy) should not be underestimated.

Among the most relevant urban mobility solutions to improve the supply side of Chinese urban mobility systems, one can mention:

- **Core public transport offering:** Investing in bus rapid transit (BRT) and personal rapid transit (PRT) solutions, and promoting car sharing and carpooling as well as a non-motorized taxis. Promising car-sharing (e.g. CC Club (**车纷享**) and carpooling initiatives (e.g. Haha Pinche (**哈哈拼车**) with advanced digital technologies exist in China. Yet these new emerging services need to be supported by clear regulations in order to secure further investment and expansion plans.
- **Additional "green" mobility solutions:** Further development and promotion of sustainable mobility solutions is of critical importance to improve door-to-door mobility for Chinese citizens. Chinese cities must provide a safer and more convenient environment for citizens to walk and cycle, including the development of cycle lanes and the introduction of bike-sharing schemes. Moreover, convenient links to public transport should be ensured to maximize integration of sustainable transport modes.
- **Offering characteristics:** Deploying leading-edge technologies based on Big Data analytics to improve safety, decreasing congestion via "smart" steering of transport flows, and enabling better decision-making for passengers with integrated and higher-quality real-time information. For example, every day Shanghai metro transports 7 million passengers on 14 lines to more than 300 stations; sound data analytics is a must to optimize flows, guide passengers to their most relevant routes and intermodal interchange points and prepare future infrastructure developments.
- **Value-added services:** Embedding of urban transportation into holistic smart-city concepts, leading to integration of customer services in mobility with other areas (e.g. retail, location-based services, healthcare, security, tourism and other governmental services).
- **Integrated mobility:** building-up of physical multimodal interchange points and offering smartphone-based multimodal mobility assistants (DMMA, see box on page 25). These are clear customer needs, as Chinese passengers are already heavy users of digital platforms to manage their last miles with, for instance, taxi-ordering tools. The are two players Kuaidi and Didi each claiming to have 100 million registered users: users are ready to employ DMMAs to prepare, book, and pay for their overall journeys.

Dimension 3: Mobility demand management

Thirdly, cities must determine which means will encourage changes in mobility behaviors: although the supply of infra-structure, vehicles/rolling stock and services will always have a key role in the provision of any urban mobility system, the management of the demand side is equally important and should be an integral part of any mobility master plan. Given the limited capacity of current mobility systems and the level of investment required to expand them, this issue is particularly vital for

Figure 13: Set of measures to consider when defining the right Mobility Demand Management mix

1 Commu-nication campaign	■ Campaign in schools & business community ■ Welcome packs for new residents ■ Multimodal contextual journey planners	4 Parking policy	■ Reduce supply ■ Fee sophistication ■ Electronic guidance ■ Access-contingent parking model
2 Traffic calming measures	■ Street design: vertical and horizontal deflection ■ Speed limits; Green zones ■ Shared spaces	5 Land-use measures	■ Mobility impact analysis & mitigation ■ Transit-oriented development ■ (Re)location of companies
3 Pricing measures	■ Congestion charge ■ Smart fares ■ Usage-based taxes and insurances ■ Fuel price	6 Corporate policies	■ Mobility plan; Mobility manager ■ Salary incentive ■ Telecommuting ■ Encouragement of carpooling ■ Urban logistics schemes

Acceptance of measures to be assessed based on existence of viable alternatives to motorized-individual transport modes and dialogue with key stakeholders (citizens and businesses). Adaptation to local context is a must.

Source: Arthur D. Little & UITP FUM 2.0

transport authorities of cities that belong to the "individual" city clusters – as is the case for most Chinese cities.

Mobility demand management (MDM) strategy typically includes a cocktail of incentives and penalties aimed at encouraging durable changes in mobility behavior, for mobility of both passengers and goods. This makes it a delicate discipline, which can easily meet strong resistance if not properly managed and executed. Moreover, the relevance and acceptability of each individual measure must be assessed against local contexts and based on the existence of viable alternatives. A range of MDM measures exists, many of which have already derived clear benefits, as illustrated in figure 13, and could be applied in China.

Transit-oriented development (TOD) and freight last-mile delivery (LMD) management are two examples of scalable solutions that can be particularly relevant for China, given its population and urban density, and that could trigger the necessary transformation of the Chinese mobility landscape.

Spotlight 1: Transit-oriented development (TOD)

A TOD is a mixed residential and commercial area designed to maximize access to public transport, and often incorporates features to encourage transit ridership. A TOD neighborhood typically has a center with a transit station or stop (train station, metro station, tram stop, or bus stop), surrounded by relatively high-density developments, with progressively lower-density developments spreading outward from the center. TODs are generally located within a radius of a quarter to half a kilometer from a transit stop, as this is considered to be an appropriate scale for pedestrians, thus solving the last mile problem.

A key concept around TOD is the "transit corridor". A transit corridor is a route aligned with public transport infrastructure (highway, BRT, railway, metro, etc.) with main urban functions planned around it, within a walkable distance from each station. Corridor planning presents an enormous opportunity to engage all decision-makers and stakeholders early in the process. Another key concept of TOD is "pedestrian priority", meaning, out of each station, most buildings should be accessible by walking to deter the usage of private vehicles, which requires careful land planning.

TOD initiatives could bring many benefits to Chinese cities; such as:

- Mobility-related benefits around reduced transportation costs, enhanced access to the transportation network, and thus improvement of the last mile issue, which, at the end, tends to reduce the usage of automobiles.
- Economic and social-related benefits, as it develops a sense of community and place, with improved access to economic activity and jobs and improved public health due to increased walking and cycling.

Hong Kong is a well-known example for its "public transport-oriented development" approach in China. According to the Hong Kong Planning Standards and Guidelines, such standards should be followed in planning for new development areas:

- The population and employment centers should be located in close proximity to railway stations.
- Adequate pedestrian facilities and connections with other transport means should be provided.
- Development of railway stations and surrounding land use should be synchronized.

As a result of applying a transit corridor approach, currently about 42% of households, 43% of the employment population and 75% of the commercial and office floor areas in Hong Kong are located within 500 meters of railway stations.

Spotlight 2: Last-mile Delivery (LMD) solutions for freight delivery

As mentioned in chapter 1, the global goods mobility demand in China is expected to quadruple by 2050, compared to 2010, reaching a total of 2.9 trillion ton-km by 2050.

This boom of the demand for urban logistics (exacerbated by online shopping growth), along with the growing sensitivity of the general public to the negative environmental and societal impact of fuel-driven deliveries in saturated urban centers, is triggering a call for action in this field.

A comprehensive urban logistics strategy can contribute to several goals: reduction of urban congestion and of the number of trucks in the city, reduction of air pollution (i.e. CO_2/NOX and PM), noise reduction, development of the local economy and contribution to housing policy objectives. However, urban logistics is a difficult issue to implement, as it encompasses several levels of complexity: next to the heterogeneity of the goods transported and the means of transportation, urban logistics encompasses a multiplicity of stakeholders (public transport authorities and other local authorities, transportation companies, shippers), each of which may have diverging interests. Most of these will lack a shared understanding of the status quo, priorities and most appropriate action levers.

Several LMD levers have been implemented in China. For example, Shanghai has adopted restrictions on polluting vehicles in the city center. Other levers have already been introduced, but only on a small scale or in pilot test versions. DHL is partnering with a number of Chinese tier-2 cities, such as Nanjing and Wuhan, to implement urban distribution centers in town. Measures such as congestion pricing were the subject of heavy debate in Beijing in 2011, but have been postponed for now. Other levers, such as Intelligent Traffic Systems (ITS) for freight, also promise effective results, and the necessary technology is available, but there are no significant implementation cases known at this stage – not in China or anywhere else in the world. In 2012, The Ministry of Commerce launched a logistics technology pilot project in nine cities, including Guangzhou, Wuhan and Lanzhou, aiming to increase maturity of Chinese logistics operators.

When selecting appropriate levers to solve the last-mile delivery problem, the specific situation for China needs to be taken into account:

- China has a large number of megacities whose urban densities are higher than those of Western cities. This provides both opportunities and challenges, as higher urban density possibly allows for more efficient routing schedules (drop-off locations are closer together), but also increases the cost per delivery (due to increased complexity).
- China's logistics sector is not very developed compared to other regions, as it lacks an integrated logistics infrastructure, and has a high level of informal transport into the city and a very fragmented logistics industry.

The key stake for last-mile Delivery is careful prioritization and alignment between stakeholders to define shared objectives as a prerequisite for crafting a last-mile delivery strategy. Among the most relevant LMD levers for Chinese cities are urban distribution centers (UDCs) and low-emission zones (LEZs). However, potential benefits of such levers should be carefully assessed against the local contexts and require development of sound business cases.

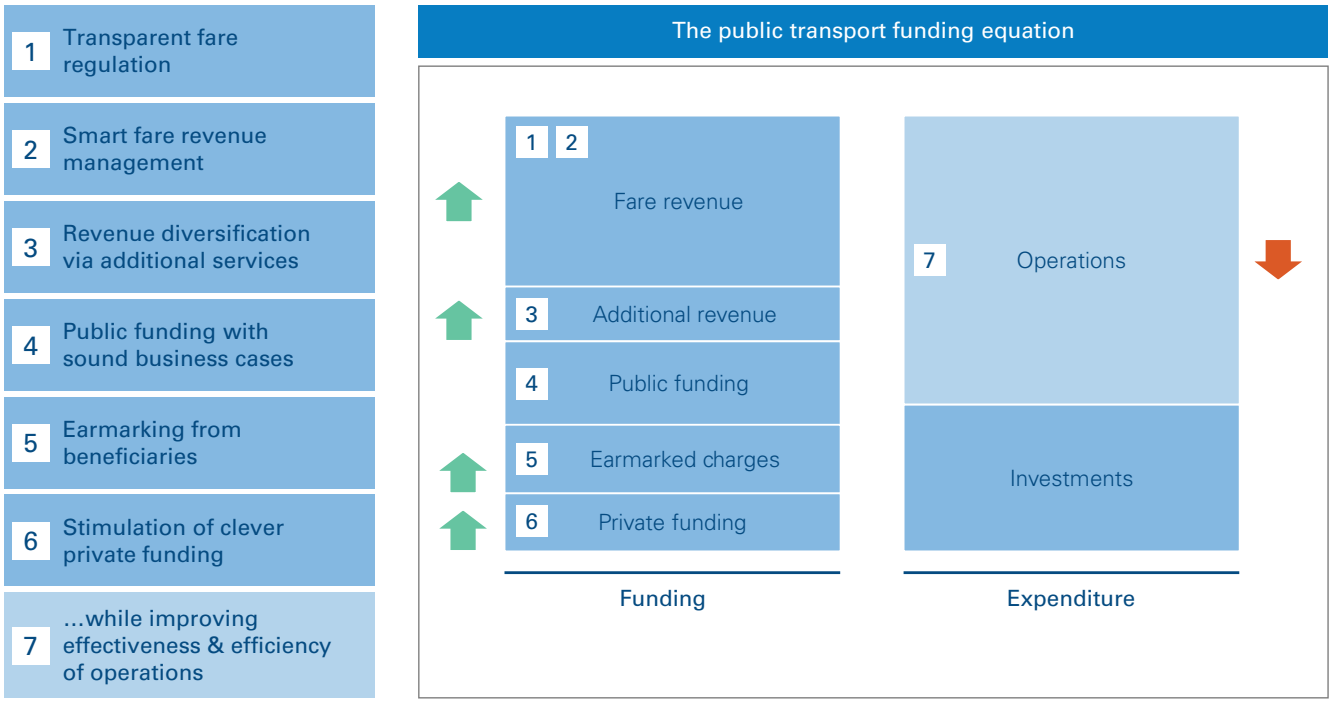
Dimension 4: Public transport financing

Some of China's local public transport infrastructure, construction and public transport companies are severely underfinanced. In this context, devising the right funding mix is a critical priority, and securing adequate funding under budgetary pressure means thinking outside of the box, particularly given that funding needs are increasing significantly due to growing supply, rising quality expectations and the increased cost of production factors. As fare revenues do not always evolve in line with the costs of production factors and the public debt crisis is increasing the pressure on public resources, transport authorities and operators need to devise alternative funding streams.

Various financing schemes for public transport currently exist in Greater China. In Hong Kong, MTRC is driving a substantial share of its revenue from non-core transport activities (such as retail and real estate), and transport operators in Mainland China are striving to identify alternative funding sources to complement public funding. There is, however, no silver bullet for the funding of public transport. Apart from improving the efficiency and effectiveness of operations to keep operational expenditures under control, the public transport funding equation involves (as illustrated in figure 14):

- Maximizing fare revenues by driving demand for public transport and smart fare revenue management through product differentiation
- Exploring opportunities to derive additional revenues from value-added services
- Exploring opportunities for Chinese cities to raise additional funds locally by receiving taxes from indirect beneficiaries of public transport
- Ensuring the right prioritization of public funding for capital investments while exploring opportunities for partnership with private investors.

Figure 14: The public transport funding equation



Source: Arthur D. Little & UITP FUM 2.0

2.3. "Network the system" by setting up innovative mobility ecosystems

Due to the complex nature of the problems at hand, separate optimization at sub-system level has limitations and will generally not impact overall urban mobility performance. System-level collaboration between multiple stakeholders is thus required: Chinese public transport authorities and operators will need to open their minds and take a much more holistic view of mobility than they have done up to now. They will need to work closely with each other and with other key public and private actors (such as automotive, financial services, telecoms, and other providers of solutions to the mobility industry) and set up the required ecosystems to deliver innovative mobility solutions in order to answer China's future urban mobility needs.

Ultimately, the success of any urban mobility strategy depends on how well ecosystems can be shaped to encourage innovative business models and integrated solutions. In an effective mobility ecosystem, it is clear for all groups involved what their roles are and how value will be created. This implies mapping financial streams (e.g. sales revenues and concession fees) between the ecosystem's core members, as well as assessing the value creation on environmental and social levels. Clearly defining the allocation of roles and responsibilities between groups and setting up the right governance mechanisms is of paramount importance, given the complexity of the system. For public agencies and businesses looking to identify opportunities to reap the benefits of urban mobility ecosystem development, it is helpful to consider these roles and what sort of rewards can be expected:

Figure 15: Contributions and rewards for partners of urban mobility ecosystems

Actors	Contributions	Rewards
Public Transport Authorities and Operators	Integration Leadership	Better mobility performance
Other mobility providers (incl. OEM)	New mobility solutions	Increased revenues
Goods mobility providers (transporters, postal op.)	Optimized urban logistics	Increased revenues
ICT integrators and energy providers	Harmonization of technologies and platforms	Competitive advantage
Telecom and payment providers	Smartphone-based urban mobility	New revenues and competitive advantage
Internet businesses	New applications	New revenues
Retailers and other value added services providers	Increased customer experience	Access to customers
NGO, think-thank and academia	Innovation partners and awareness builders	Recognition and R&D funding

Public transport authorities (PTAs) and public transport operators (PTOs)

- Role: Integration leadership. PTAs/PTOs are the natural choice to take a leading role in mobility ecosystems. If an ecosystem is to be created around the development of an integrated mobility offering at regional or city level, PTAs/PTOs are likely to assume the position of an "integrated mobility platform operator" (see the illustration box on DMMAs on page 25).
- Rewards: Better performance. By opening their minds and taking a much more holistic view of public transport, and working together with each other and new market players, PTOs/PTAs can achieve high-performing, sustainable, transport-oriented mobility systems, with public transport as a backbone.

Other passenger mobility providers (automotive OEMs, providers of innovative mobility solutions)

- Role: New mobility solutions. Mobility providers can introduce new modes of transport, such as bike sharing, car sharing or automated car fleets, in order to increase the attractiveness of mobility in cities without the need to own a car, and thus shift the modal split towards sustainable modes of transport. By taking an active role in the ecosystem, mobility providers can better establish integrated solutions and provide "door-to-door" rather than "station-to-station" solutions.
- Rewards: Increased revenues. There is a substantial opportunity for passenger mobility providers to take a leading role, along with others, in integrating transportation modes. By doing this, they expand usage of their services, increasing revenue volumes and positioning themselves as "sustainable companies".

Goods mobility providers (logistics companies, postal operators, etc.)

- Role: Optimize urban logistics. Logistics providers have an important role to play in influencing overall urban logistics strategy and contributing, in close collaboration with retailers, to the set-up of innovative urban logistics schemes in order to optimize the "last-mile delivery" of goods. Technological advancements in real-time location, scheduling and routing open up opportunities to positively impact urban congestion and air pollution. One example of this is urban distribution centers at the edges of cities.
- Rewards: Increased revenues. Logistics providers that take leading roles in setting up innovative urban logistics schemes can benefit from additional revenue sources (such as by providing services to third parties).

ICT integrators and energy providers

- Role: Harmonization of technologies and platforms. These groups are suppliers to the extended urban mobility ecosystem, offering technologies, products and services that are of paramount importance. They can play an important role in terms of harmonizing the deployment of technologies and integrated platforms at a local/regional level, as well as at a supra-regional level, leading to economies of scale.
- Rewards: Competitive advantage. By taking a leading role in devising components of the urban mobility systems of tomorrow, these companies can position their technologies and further tailor them to future requirements. This maintains or reinforces their competitive advantage in the market. As investments in emerging technologies that may not succeed can be very costly, participation in multi-stakeholder ecosystems also offers opportunities for collaborative de-risking of technology investments.

Telecom and payment providers

- Role: Smartphone-based urban mobility. Connectivity and payment providers can contribute to implementing the concept of "smartphone-based urban mobility", which would enable innovative routing, buying (ticketing) and payment technologies (e.g. e-wallets and intermodal ticketing). This contributes to the convenience and user-friendliness of public transport, while increasing efficiency.
- Rewards: New revenues and competitive advantage. There is a major opportunity for these groups to become part of the ecosystem and create additional revenues on a per-usage basis, as well as develop technology leadership to create competitive advantage on an (inter)national scale.

Internet businesses

- Role: New applications. Using travel information, internet business can create additional applications that increase convenience for travelers (such as multimodal mobility applications) and aggregate third-party mobility services, in the same way that Amazon has created its internet platform.
- Rewards: New revenues. Depending on their business models, internet businesses can create revenues from registration and annual fees for mobility providers, loyalty program-related revenues, booking fees, or advertising.

Retailers and other value-added service providers

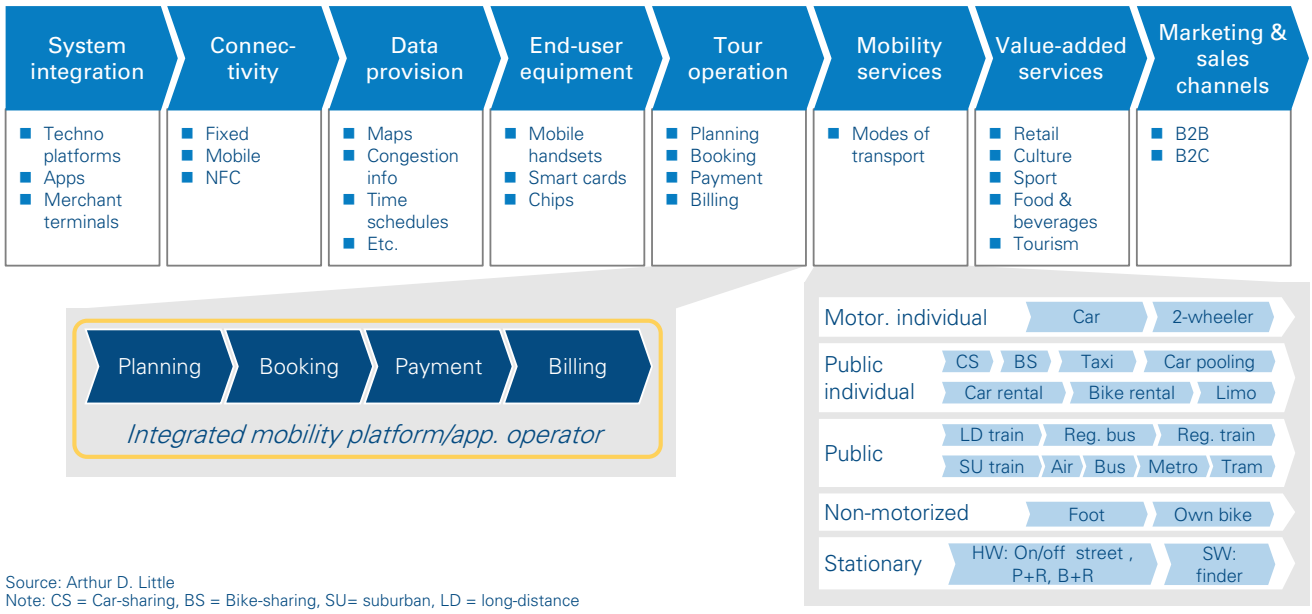
- Role: Enhance customer experience. Retailers and other value-added service providers (such as entertainment, business or convenience services) can contribute to the development of a coherent and engaging experience within and around metro and subway stations, transforming them from purely transport centers to destination locations. This can significantly improve the customer experience and the attractiveness of public transport while maximizing revenues from existing infrastructure assets.
- Rewards: Access to customers. These providers have the opportunity to further embed their activities into the mobility infrastructure, which creates important exposure to large passenger traffic flows, generating additional revenue streams and increased visibility.

NGOs, think tanks, consultants and academia

- Role: Innovation partners and awareness builders. NGOs, think tanks and academia contribute by conducting studies, carrying out collaborative R&D with suppliers, and developing scientific models. They contribute to creating awareness of the "need for change" within the public at large, and help to disseminate best practice.
- Rewards: Influence and access to R&D funding. The urban mobility area is fertile ground for R&D, and the amount of public funding available is increasing. Active participation in the ecosystem will help organizations leverage funding and enhance public recognition and profile, as well as helping to drive innovation.

Illustration of an urban mobility ecosystem: Integrated mobility platform and digital multimodal mobility assistant (DMMA) for personal mobility

Figure 16: Illustration of stakeholders involved in urban mobility ecosystem integrated mobility platform and DMMA



Source: Arthur D. Little
Note: CS = Car-sharing, BS = Bike-sharing, SU= suburban, LD = long-distance

Development of integrated mobility platforms for personal mobility typically requires negotiation of a complex web of relationships with a wide mix of public and private stakeholders, as illustrated in figure 16.

In this integrated ecosystem, a critical role is the one of "integrated mobility manager", which is responsible for planning, booking, payment and billing, thereby ensuring "one face to the traveler".

The integrated mobility manager should be able to:

- Act as a single point of contact for travelers and as a full-service provider, which involves bundling third-party services while taking overall delivery responsibility.
- Aggregate services of all mobility providers across all modes of transport, which requires the management of a partner ecosystem.
- Offer tailored solutions that consider customer preferences, lifestyle and budget, applying customer profiling (Big Data) while achieving a balance between data security and need for transparency.

From a business point of view, integrating different transport modes while ensuring real-time interactions with customers requires:

- The creation and running of a platform that, via application programming interfaces, integrates routing, booking and payment services of different mobility providers.
- Operations of a smartphone application (Digital Multimodal Mobility Assistant, DMMA) to enable end users to access the platform and thus plan, book and buy their multimodal journeys with one click.

Key success factors for setting up integrated mobility platforms and apps include:

- **Extended ecosystem stakeholder management:** Finding roles and allocating them to the right set of partners to close all competency gaps along the value chain, while ensuring a positive business case for each partner.

- **Devising a profitable business case:** If kept at regional level, given the significant investments required to set up and manage such integrated platforms, an extension of the revenue pool through the introduction of value-added services (such as retail) is an important part of arriving at a balanced business case.
- **Technology integration:** While the necessary technologies to address the needs of integrated mobility platforms are generally available, the ability to seamlessly integrate technologies (and accompanying management mechanisms) is critical for success.

There is no fully functional example of a full-fledged integrated mobility platform today. What we see on the market are pilots and trials aimed at gathering experience and trying out different variations of this business model. The most prominent examples are focused on German-speaking area. Some of the initiatives worth mentioning are:

- **SMILE** (Vienna Utility Company and Austrian Federal Railway) – pilot started in January 2014. The SMILE platform and app enable integrated planning, booking and payment for public transit, taxis, (e-)cars and (e-)bike sharing, parking and charging in the whole country of Austria.
- **moovel** (Daimler Mobility Services) – launched in July 2012. Currently covering five regions in Germany (Stuttgart, Berlin, Munich, Nuremberg and Rhine-Ruhr), as well as long-distance rail country-wide. Since July 2014, offers services in other countries: Austria, Canada, the UK, Italy, the Netherlands and the US.
- **Qixxit** (German Railway) – launched in October 2013. Integrates numerous country-wide mobility services: local and long-distance public transport, car rental, car and bike sharing, taxis, long-distance buses, airlines.
- **Stuttgart Services** (Stuttgarter Straßenbahnen with 13 consortium partners) – currently in beta-version, launch expected in early 2015. The appeal of the approach lies in the integration of multimodal mobility with city services (libraries, museums, baths) and retail (gastronomy, shops & stores).
- **Waymate /Allryder** (start-up) – long-haul version (Waymate) launched in December 2010, short-haul version (Allryder) in February 2014. Mobility providers on platforms are railways, airlines, long-distance buses, ride sharing, car sharing, taxis and local public transit.

Typically, one or several stakeholders takes the lead in a given ecosystem, managing the relationships between the different parties. When the mobility solution requires having "one face to the customer", the ecosystem leader typically takes overall accountability for the combined services offered to users, including services offered by third parties and shares the financial and operational risks of the undertaking with a selected group of core ecosystem members.

Finally, successful mobility ecosystems typically have a "common motivational factor" across all stakeholders. Even when these stakeholders might have different objectives (e.g. profit vs. congestion reduction), the common motivational factor ensures that stakeholders are aligned. New business models, such as data monetization, return by usage, and low-asset initial public investment will allow for different (public and private) parties to be aligned around a common motivational factor.

Insights for the executive

Addressing the current and future needs of urban mobility is one of the greatest challenges facing the world today. Although good progress has already been made in some cities, there is still a long way to go, even among the leaders. In many cases, the technological solutions are already available, but there are still significant barriers relating to lack of mobility vision and strategy and system fragmentation and complexity:

- Mobility visions and policies do not cover requirements: A lot of mature cities do not have clear visions and strategies on how their mobility systems should look in the future. Moreover, the lack of integration between different transport modes, across different urban policies (environment, land planning, energy, social policy) and across regions is leading to a sub-optimal outcome in terms of mobility performance.
- Lack of system-level collaboration and innovation: Current mobility systems do not sufficiently adapt to changing demands, instead combining single steps of the mobility value chain into an integrated system. In addition, actors of the mobility ecosystem do not collaborate sufficiently to foster lateral learning and jointly develop innovative mobility solutions.

Looking more specifically into urban mobility challenges and opportunities for China, it is not putting it too strongly to say that most Chinese mobility systems are standing on a burning platform. Also, the economic and political stakes of urban mobility are so high in China that they could only call for decisions and actions. This sense of urgency might offer a unique opportunity for China to leap forward in terms of mobility performance and, if it takes the right orientations now, the country could become the test bed and breeding ground for tomorrow's superior urban mobility systems.

From the analysis performed by Arthur D. Little's Urban Mobility lab on Chinese cities, we can conclude that for most Chinese cities, development of superior mobility systems will typically involve a combination of two strategic directions:

- Rethinking the system via the development of a long-term urban mobility vision and the (re-)enforcement of sustainable urban mobility policies and strategies, which will involve finding the right balance between "supply" and "demand management" solutions, while securing the most appropriate funding streams.
- Networking the system via set-up of multi-stakeholder ecosystems to deliver innovative mobility solutions to Chinese citizens and organizations. This will require careful consideration of the roles and responsibilities of each actor and setting up the right governance mechanisms.

For Chinese cities to overcome existing barriers and develop superior mobility systems, it will take vision, creativity, courage, and entrepreneurship to move urban mobility systems towards full integration. Those players that are willing to take up the challenge, leading or participating actively in urban mobility ecosystems and jointly implementing innovative urban mobility solutions, will be the ones that stand to reap the tremendous political and commercial benefits.

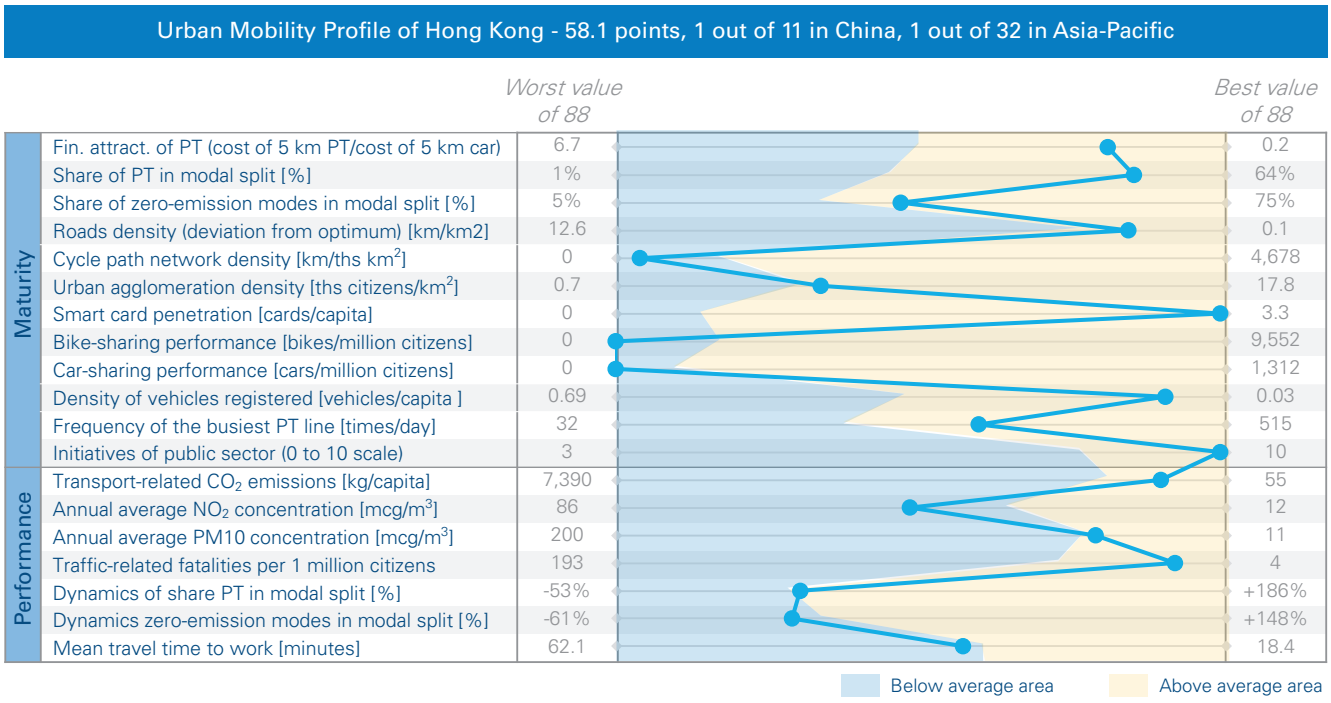
Appendix – High-level profiling of Greater Chinese cities in the scope of the Arthur D. Little Urban Mobility Index

Urban Mobility Profile 1 – Hong Kong

As a best-practice example, Hong Kong stands at the very pinnacle. Despite – or perhaps because of – being one of the most densely populated areas in the world, with more than 7 million people packed into a land mass of just 1,100 sq km, Hong Kong has developed the most advanced urban mobility system in the world. Public transport represents no less than 55% of the modal split, the number of vehicles registered per capita is among the lowest worldwide, and smart card penetration stands at 3.3 cards per person. This latter point can be explained by the fact that some people have two cards, one personalized and one anonymous; some cardholders work in Hong Kong but live in China; and others belong to tourists.

Hong Kong fares even better when it comes to performance factors, as it has a moderate level of transport-related emissions per capita, a low rate of traffic-related deaths, and a respectable mean travel time to work given its population density.

Figure 17: Urban Mobility profile of Hong Kong



Urban Mobility Profile 2 – Shanghai

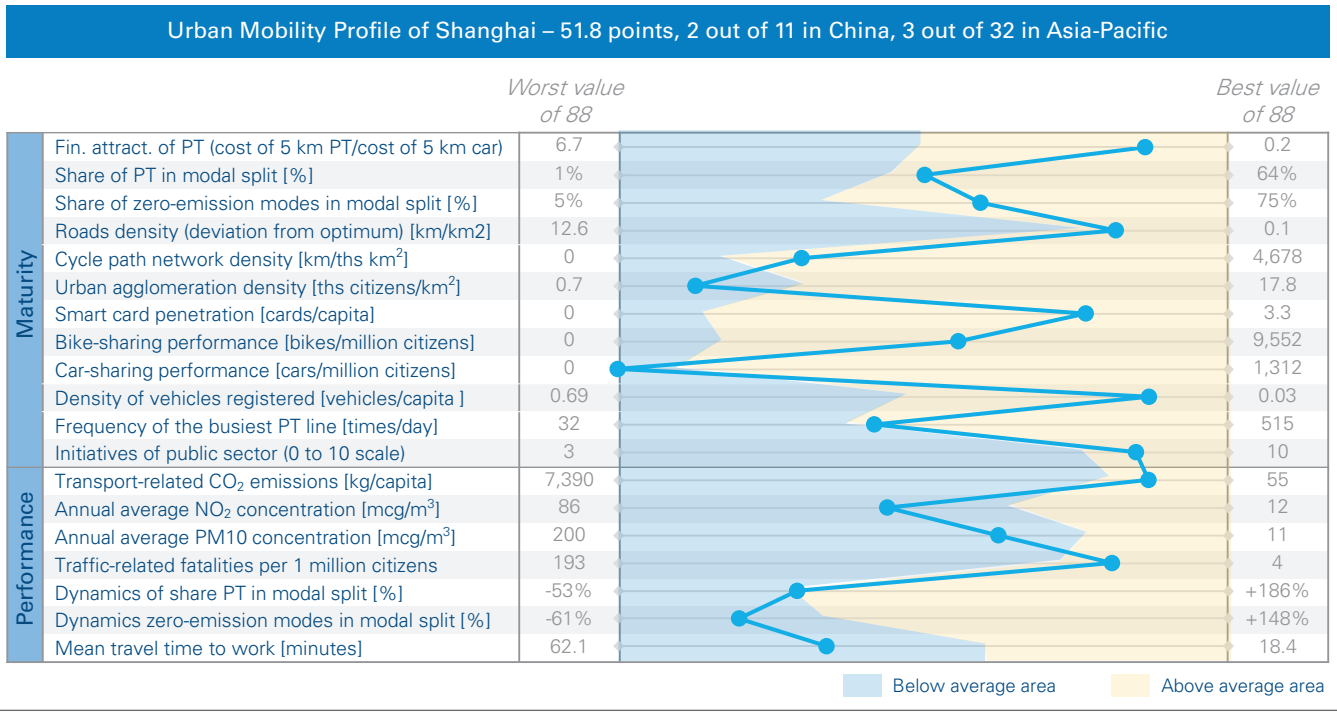
Shanghai, with a FUM score of 51.8 points, has the second-best mobility system after Hong Kong in the Chinese sample that serves as a role model for other mainland cities. As the first city to introduce a vehicle-purchase restriction policy in 2004, Shanghai has second-lowest vehicle ownership rate after Hong Kong as of 2013.

With a 47% share of zero-emission modes in modal split and 28,000 shared bikes (1,343 per million citizens), the city scores relatively high with regard to non-motorized transport. Like Hong Kong, Shanghai's smart card penetration rate is at saturation level, and it boasts dynamic and efficient public transport service delivery: 49 million transit smart cards in Shanghai means a penetration level of 2.4 cards per capita.

Shanghai also aims to have 30,000 electric vehicles and 5,000 charging stations on its streets in 2015 to become a showcase for e-mobility for the whole country.

Challenges for Shanghai lie in the areas of air quality, further promotion of public transport in the modal split and stabilization of its current motorization level.

Figure 18: Urban Mobility profile of Shanghai



Urban Mobility Profile 3 – Wuhan

Wuhan claims to have the largest bike-sharing fleet worldwide, consisting of 90,000 units. This leads to an incredibly strong bike-sharing performance, with 9,552 shared bikes per million citizens.

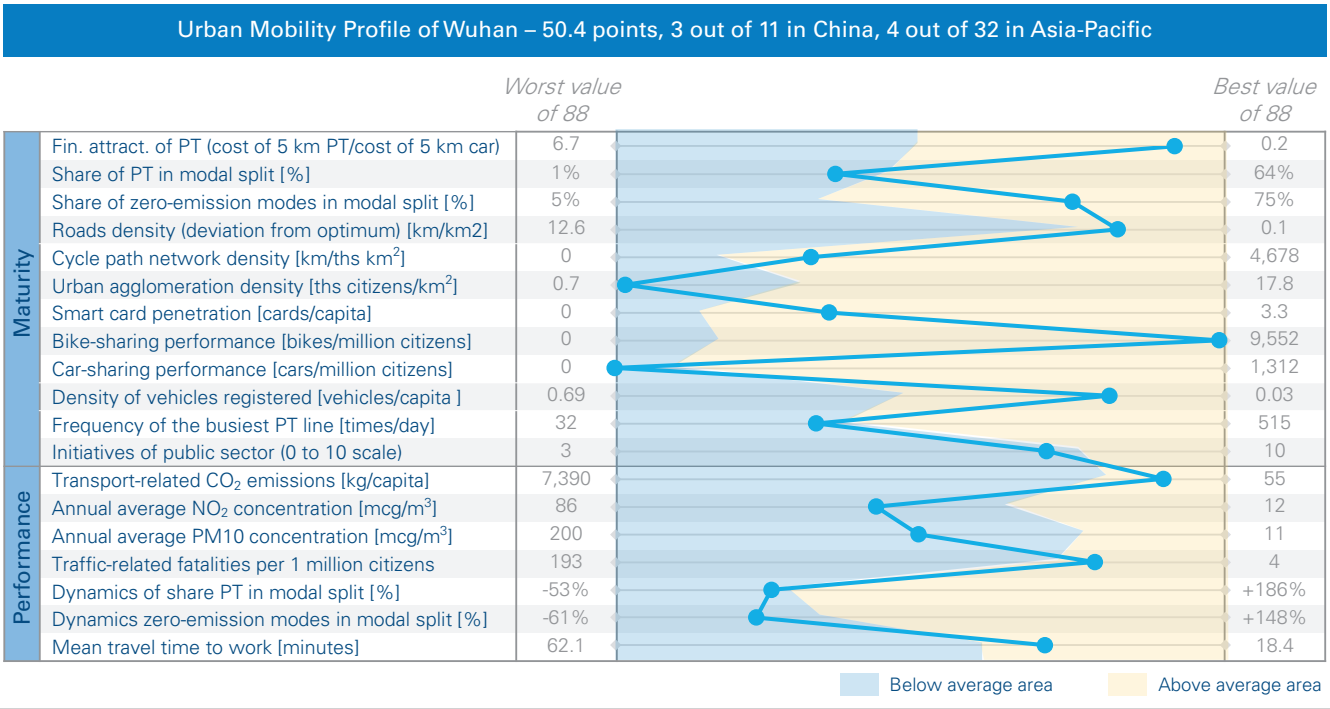
Alongside Hong Kong, Wuhan has the lowest level of transport-related CO_2 emissions, with 733 kg emitted per capita per year. It also has a below-average number of private cars per capita and encourages cycling. The combined effect of all this is relatively low travel time to work of only 31 minutes.

Wuhan also plans to put into operation a bus rapid transit system in 2015 to increase the traveling speed for citizens. The investment cost of the system is expected to reach 12 m USD/km for a 16 km system. By 2020 the mileage of the system is expected to increase to 123 km.

However, the city falls down badly when it comes to car sharing, where it has zero penetration, the same as all other Chinese cities. Annual average concentration of PM10 is another area that needs improvement, as Wuhan, like half of all Chinese cities surveyed, has a high level of this pollutant – 105 mcg/m2.

Strategic development priorities for Wuhan's urban mobility system include improving the modal split share of PT and further implementation of green mobility initiatives.

Figure 19: Urban Mobility profile of Wuhan



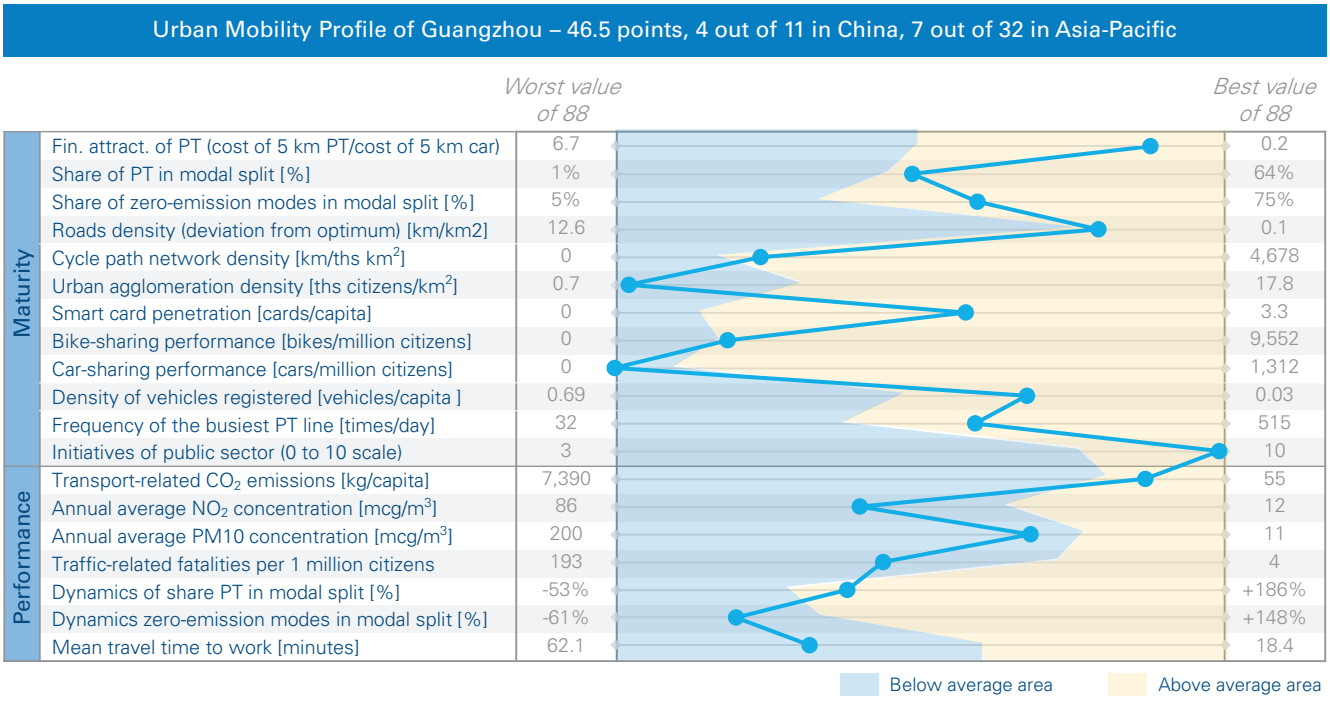
Urban Mobility Profile 4 – Guangzhou

Guangzhou. Guangzhou stands out for having the most frequent metro service in mainland China, going up to 320 times a day in one direction. But although it has frequent services on public transport, its mean travel time to work is below average. Still, the city has a high rate of public sector initiatives, and its multi-modal smart card, "Yang Cheng Tong", has a penetration of 1.78 cards per capita. Meanwhile, Guangzhou's transport-related fatalities level is the highest one in China – 109 per million – six times the level of Hong Kong.

Having recently introduced a policy of high taxes and duties, the city aims to curb the trend of increasing car ownership, which in 2013 reached 238 vehicles per 1,000 citizens, having totaled 136 only as of 2008. Guangzhou's new cycling paths, called "Greenways", are being considered a benchmark for sustainable transport infrastructure in China. So far 2,500 km of Greenways have been built, with a plan to add another 5,500 km by 2020.

Strategic imperatives for Guangzhou would be to focus on expansion of bike sharing and the introduction of a car-sharing service, as well as heavy promotion of vehicles with alternative engines.

Figure 20: Urban Mobility profile of Guangzhou

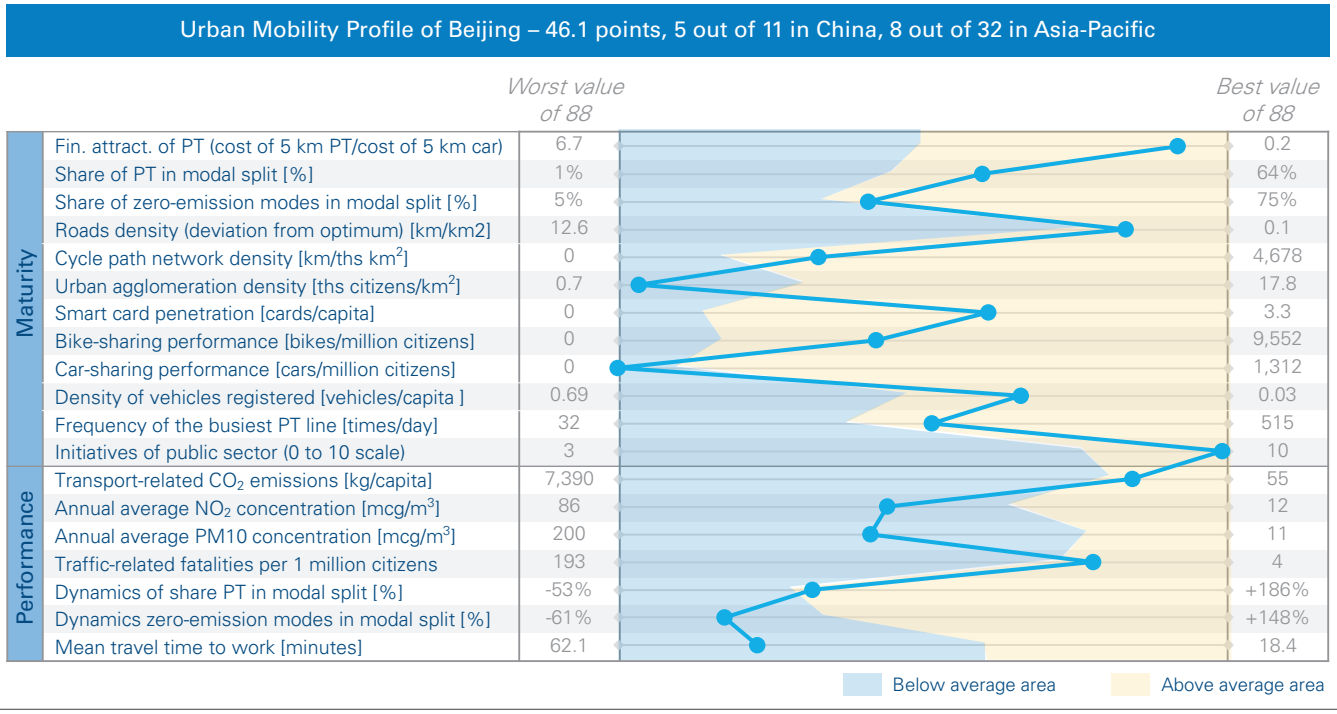


Urban Mobility Profile 5 – Beijing

Beijing – Traffic congestion is endemic in the Chinese capital as car registrations proceed apace. Indeed, car ownership is growing at a compound annual growth rate (CAGR) of no less than 11%: the motorization level reached 251 cars per 1,000 citizens in 2013, and is the second largest after Chengdu out of all 11 cities surveyed. Two of the effects of this are a mean travel time to work of 52 minutes, almost twice that of Xi'an, and 44 transport-related deaths per million, 2.5 times the rate in Hong Kong.

Beijing also has the weakest performance with regard to transport-related CO_2 emissions: 1,147 kg were emitted per Beijing citizen in 2013 compared to only 300 km in 1995. In these circumstances there is a pressing need for draconian restrictions on car use, including limitations on car registrations, car-free days, and banning cars in rush hour. Beijing's strength is its extensive, low-cost public transport system standing for 39% of modal split.

Figure 21: Urban Mobility profile of Beijing

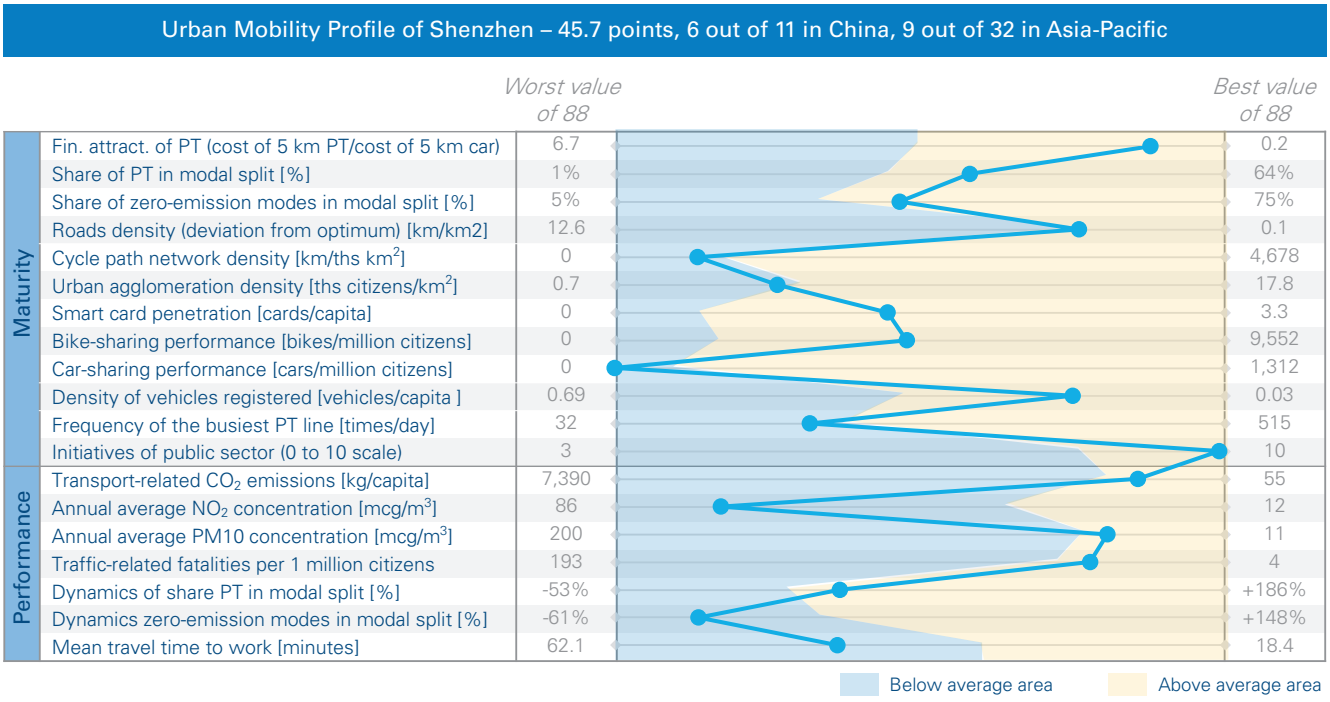


Urban Mobility Profile 6 – Shenzhen

Shenzhen – With a population density of 5,300 inhabitants per square kilometer – the highest of the 10 mainland cities surveyed – Shenzhen's public transport is well developed, accounting for no less than 38% of the modal split, and mobility card penetration is at 1.4 cards per capita. There is a car for one in five citizens in Shenzhen, which makes it on the average of all 11 cities surveyed. Add to this its second-poorest bike-sharing performance after Hong Kong (642 shared bikes per million citizens) and it's no surprise to hear that zero-emission modes are decreasing drastically (-32% since the last modal split measurement).

Despite having a far-from-optimum level of road density, Shenzhen's rate of traffic-related fatalities is below average and its level of harmful emissions is above average. Its "good-practice" urban mobility strategy has led to implementation of a leading-edge ITS system, as well as comparably large fleets of electric taxis and electric buses. The city is about to launch a large-scale subsidy for private buyers of electric vehicles.

Figure 22: Urban Mobility profile of Shenzhen



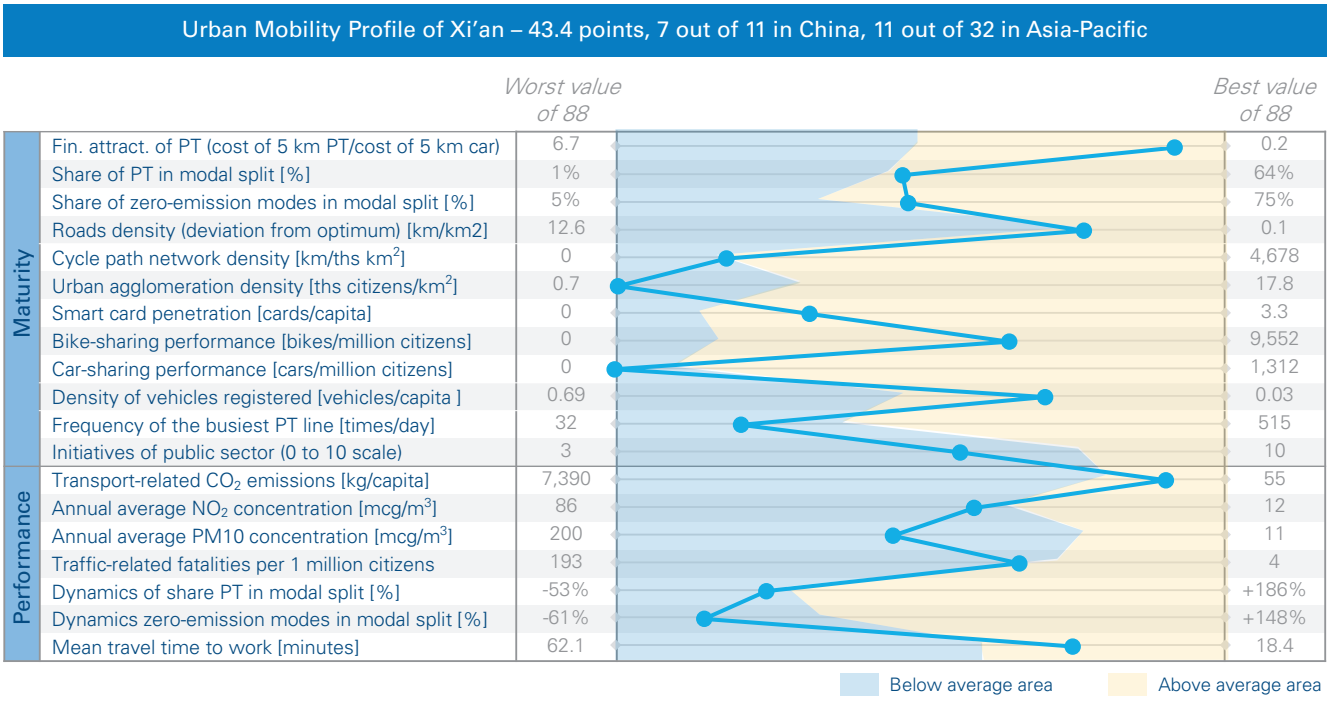
Urban Mobility Profile 7 – Xi'an

Xi'an is a car-loving city, where individual motorized transport accounts for 30% of all journeys, representing the highest value of all Chinese cities surveyed. Existing journey-to-work times are comparably low, at 29 minutes, which represents the best value of all 11 cities.

The capital of Shaanxi Province also comes top for transport-related CO_2 emissions and its bike-sharing performance (after Wuhan). But it has low frequency of metro and a rapidly falling share of zero-emission modes in the modal split: -30% since the last measurement.

Development priorities for Xi'an include an increase of PT infrastructure supply and an investment in reduction of transport-related emissions.

Figure 23: Urban Mobility profile of Xi'an

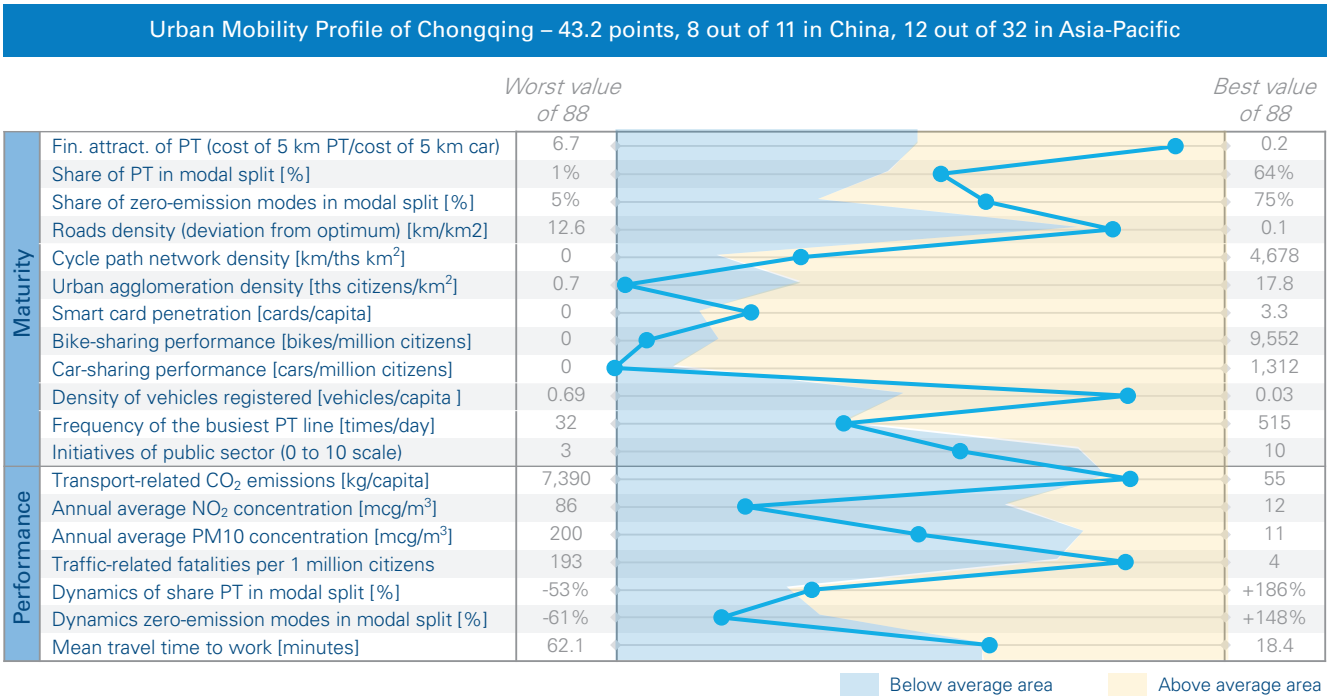


Urban Mobility Profile 8 – Chongqing

Chongqing. As a result of its forward-thinking approach, the city of Chongqing ranks above average for transport-related fatalities, has a low motorization rate – 132 private vehicles per 1,000 citizens – and has reasonable travel time to work despite the challenge that Chongqing is a mountainous municipality.

Share of motorized individual transport is the lowest out of all mainland cities surveyed (17%). The level of zero-emission modes in Chongqing is slightly above average. Chongqing's CO_2 emissions are high at 1,134 kg per capita, compared with, e.g., 702 tons in Xi'an. In order to cope with growing vehicle density, one of the challenges for Chongqing will be the introduction of traffic-calming measures.

Figure 24: Urban Mobility profile of Chongqing

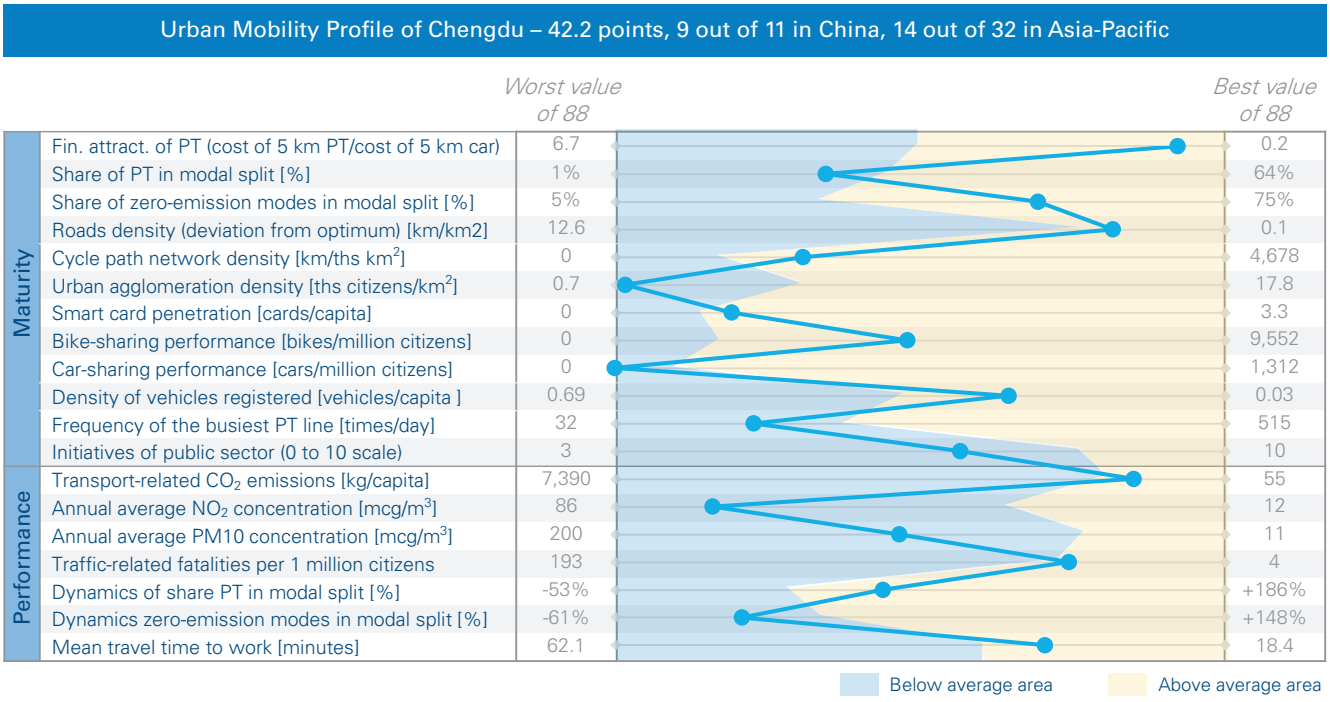


Urban Mobility Profile 9 – Chengdu

Chengdu – the Sichuan Province's capital – has improvement potential on its mobility strategy's side. The city has the highest level of vehicle ownership out of all Chinese cities surveyed, and thus suffers from traffic congestion. The city's mobility card, "Tianfu Tong", has the lowest penetration in the study sample at 0.58 cards per capita. This goes in line with the lowest share of public transport observed in the modal split (23%).

Still, it should be mentioned that Chengdu's bike-sharing project has had considerable positive impact on the modal choice of citizens. The city needs to increase the maturity of its public transport and urban planning in order to achieve a sustainable mobility system.

Figure 25: Urban Mobility profile of Chengdu

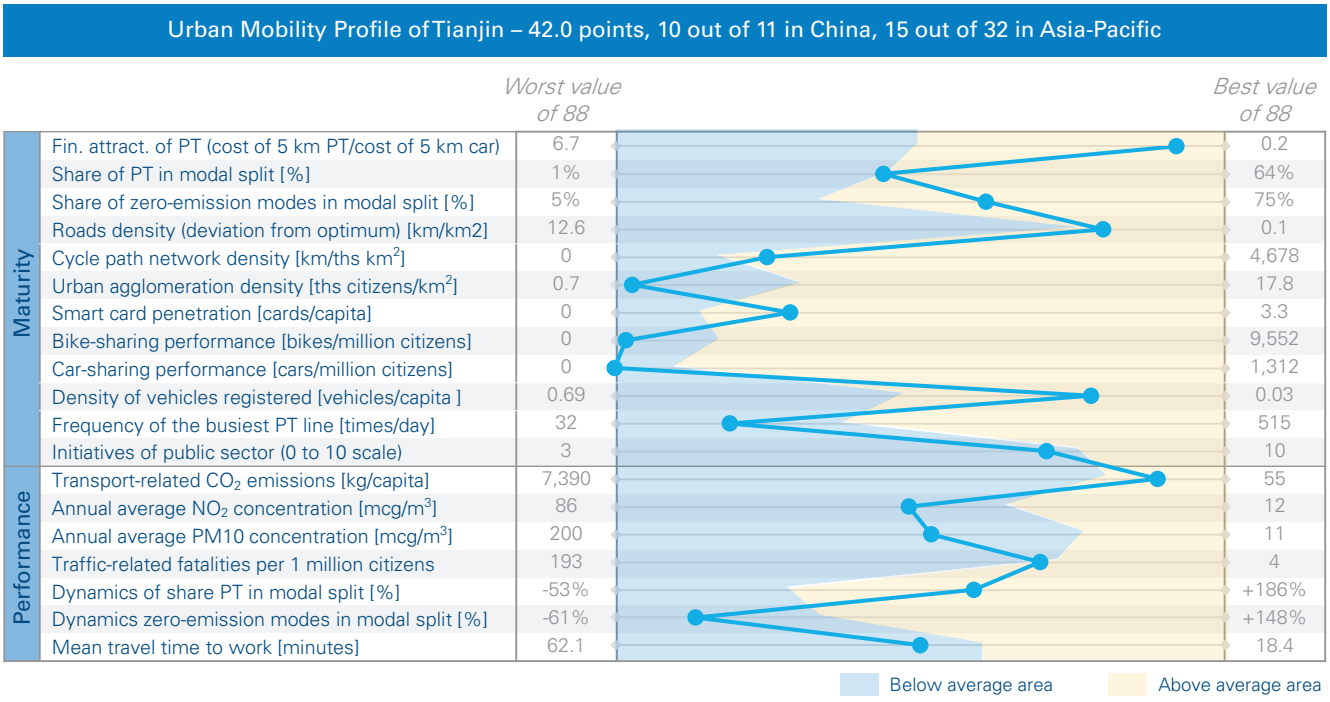


Urban Mobility Profile 10 – Tianjin

42.0 points, 10 out of 11 in China, 15 out of 32 in Asia-Pacific

Tianjin. In addition to the least-frequent metro system, this metropolis in northern China has a poor bike-sharing performance, offering only 400 shared bikes to its citizens (penetration level of 45 shared bikes per million citizens). Its public transport network is advancing, which is reflected by an extraordinary growth of PT share in the modal split: +89% since the last measurement. But that is from a low basis: from 15% in 2005 to 29% as of now. The city also plans to extend its public transport system aggressively by, e.g., investing 8 bn USD until 2020 to extend metro lines by 100 km.

Figure 26: Urban Mobility profile of Tianjin



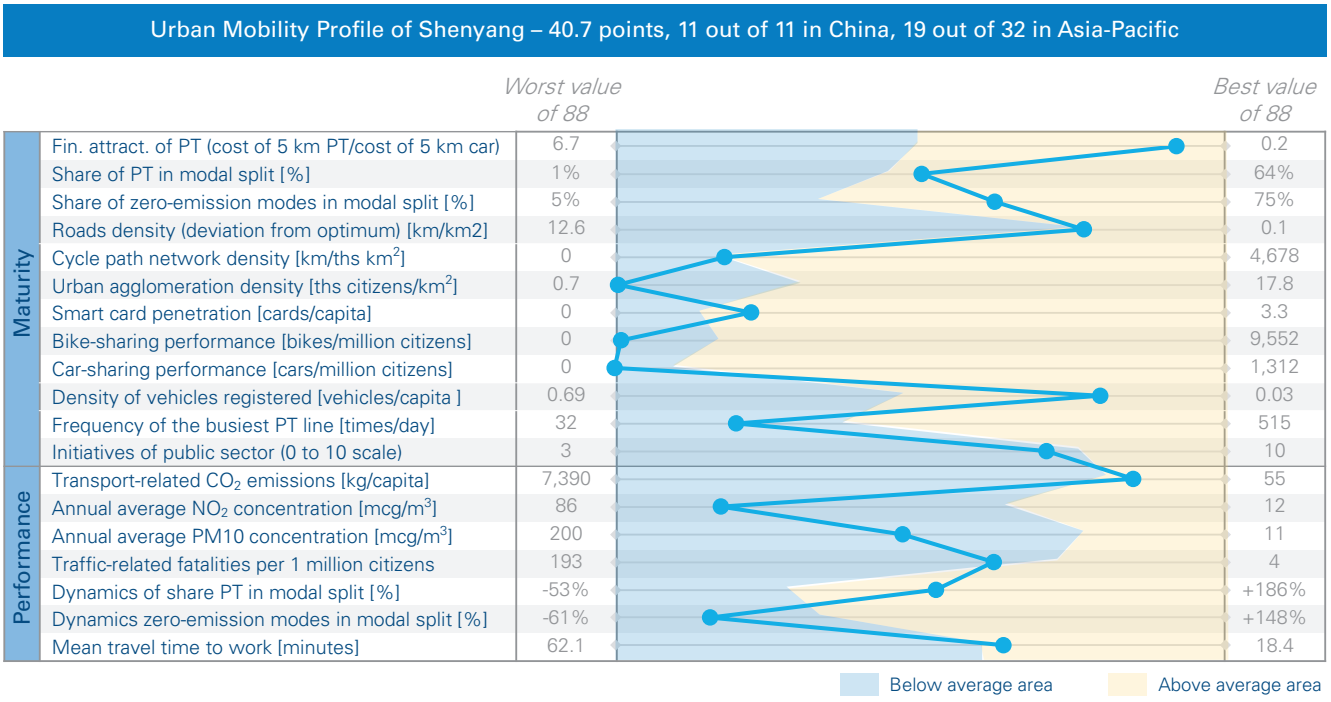
Urban Mobility Profile 11 – Shenyang

Shenyang. The capital of Liaoning Province has the second-least safe urban mobility system out of 11 cities, with 74.5 traffic deaths per million citizens.

It also has the second-lowest penetration rate of smart cards after Chengdu, at 0.7 per capita, and the use of individual transport is on the increase. This, coupled with the fact that it has only 150 shared bikes as of March 2014 (the time of measurement), a penetration of 26 bikes per million citizens, helps explain why the city ranks at the bottom of the sample.

However, this famous Chinese heavy-industry center saw public transport's share of the modal mix increase by 14 percentage points between 2005 and 2012 to 33%, putting Shenyang alongside Tianjin as the city with the most dynamic development of public transport usage out of 11 cities surveyed.

Figure 27: Urban Mobility profile of Shenyang



Authors

François-Joseph Van Audenhove
Partner, Arthur D. Little, Brussels
Mobile: +32 473 998 358
vanaudenhove.f@adlittle.com

Antoine Doyon
Head of Arthur D. Little China, Shanghai
Mobile: +86 18 121 106 226
doyon.antoine@adlittle.com

Oleksii Korniichuk
Manager, Arthur D. Little, Frankfurt
Mobile: +49 175 5806 132
korniichuk.oleksii@adlittle.com

Jeff Hou
Manager, Arthur D. Little China, Shanghai
Mobile: +86 18 603 512 392
hou.jeff@adlittle.com

Contacts

If you would like more information or to arrange an informal discussion on the issues raised here and how they affect your business, please contact:

Argentina
Micaela Carlino
carlino.micaela@adlittle.com

Austria
Karim Taga
taga.karim@adlittle.com

Belgium / Luxemburg
Francois-Joseph VanAudenhove
vanaudenhove.f@adlittle.com

Brazil
Rodolfo Guzman
guzman.rodolfo@adlittle.com

China
Antoine Doyon
doyon.antoine@adlittle.com

Czech Republic
Dean Brabec
brabec.dean@adlittle.com

France
Aurelia Bettati
bettati.aurelia@adlittle.com

Germany
Ralf Baron
baron.ralf@adlittle.com

India
Srini Srinivasan
srinivasan.srini@adlittle.com

Italy
Saverio Caldani
caldani.saverio@adlittle.com

Japan
Akitake Fujita
fujita.akitake@adlittle.com

Korea
Kevin Lee
lee.kevin@adlittle.com

Middle East
Thomas Kuruvilla
kuruvilla.thomas@adlittle.com

The Netherlands
Martijn Eikelenboom
eikelenboom.martijn@adlittle.com

Spain
Salman Ali
ali.salman@adlittle.com

South East Asia
Piyush Mehra
mehra.piyush@adlittle.com

Singapore
Akitake Fujita
akitake.fujita@adlittle.com

Sweden / Russia
Klas Anderlind
anderlind.klas@adlittle.com

Switzerland
Ralf Baron
baron.ralf@adlittle.com

UK
James Catmur
catmur.james@adlittle.com

USA
John Brennan
brennan.john@adlittle.com

Arthur D. Little

As the world's first consultancy, Arthur D. Little has been at the forefront of innovation for more than 125 years. We are acknowledged as a thought leader in linking strategy, innovation and transformation. Our consultants consistently develop enduring next generation solutions to master our clients' business complexity and to deliver sustainable results suited to the economic reality of each of our clients. Arthur D. Little has offices in the most important business cities around the world. We are proud to serve many of the Fortune 500 companies globally, in addition to other leading firms and public sector organizations. For further information please visit **www.adl.com**

www.adl.com/FUM2.0