The Future of Urban Mobility

Towards networked, multimodal cities of 2050

Arthur D Little 125 years

Content

Authors:

Wilhelm Lerner
Director Germany
Strategy and Organization Practice

Additional author is the
Global Future of Urban Mobility Lab Team
Salman Ali, Ralf Baron, Antoine Doyon, Boris Herzog, Daniel Koob, Oleksii Korniichuk, Stefan Lippautz, Kiyoung Song, Michael Zintel

1. Executive summary

Management consultancy Arthur D. Little's (ADL) new global study of urban mobility assesses the mobility maturity and performance of 66 cities worldwide and finds most not just falling well short of best practice but in a state of crisis. Indeed it is not putting it too strongly to say that many cities' 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 host nations.

What is needed is innovative change. This report highlights what is holding them back, showcases best practice and identifies three strategic imperatives for cities and three clusters of future business models for mobility suppliers that will enable cities to meet the urban mobility challenge.

Methodology

Arthur D. Little assessed the mobility maturity and performance of 66 cities worldwide using 11 criteria ranging from public transport's share of the modal mix and the number of cars per capita to average travel speed and transport-related CO_2 emissions. The mobility score per city ranges from 0 to 100 index points; the maximum of 100 points is defined by the best performance of any city in the sample for each criteria. In addition the study reviewed and analysed 39 key urban mobility technologies and 36 potential urban mobility business models.

Plotting the trend

The world's population is increasingly city-based; 51% or 3.5 billion people currently live in urban areas and by 2050 this is expected to reach 70% of the population or 6.3 billion people. Urban mobility is one of the toughest challenges that cities face; accordingly, we will see massive investment in the future. Today, 64% of all travel kilometres made are urban and the amount of travel within urban areas is expected to triple by 2050. Being able to get around urban areas quickly, conveniently and with little environmental impact is critical to their success.

Existing mobility systems are close to breakdown. By 2050, the average time an urban dweller spends in traffic jams will be 106 hours per year, three times more than today. Delivering urban mobility will require more and more resources. In 2050 urban mobility will:

- Cost €829bn per year across the globe, more than four times higher than in 1990.
- Use 17.3% of the planet's biocapacities, which is five times more than in 1990.

Where are we now?

Rated on a scale of 1-100 (with 100 representing the top performance) the average score was close to 65 (64.4 points). Which means that, on average, the 66 cities achieve just two thirds of the level of performance that could potentially be reached today by applying best practice across all operations. Only two cities (Hong Kong and Amsterdam) scored above 80 points, with just 15% of cities scoring above 75 points. There are big differences between the top and low-end performers in the various regions.

- **Western Europe:** Overall best regional performance with an average of 71.4 points, with seven out of the 18 analysed cities scoring above 75 points. Amsterdam (81.2) and London (78.5 points) lead the way, while Rome (57.9 points) and Athens (53.3) are the worst performing cities.
- **Eastern / Southeastern Europe:** Most cities performed close to the regional average of 64.0 points. Only Istanbul (70.2) comes close to the top performance cluster and St. Petersburg (56.9 points) is the worst performing city in Eastern / Southeastern Europe.
- **North America:** A slightly below average performance – but way below Western Europe – with 62.0 points. Just Boston, with 76.2 points scores highly, while Atlanta has only 46.2 points, making it the worst performing city surveyed.
- **South America:** Average performance, just ahead of North America with 63.6 points. Mexico City leads the way with 65.7 index points closely followed by Buenos Aires (65.3) and São Paulo (59.7).
- **Asia / Pacific:** The broadest range in performance – from Hong Kong, which with 81.9 points tops the global table, down to Manila with 48.4 points. This gives an average of 62.5 points.

- **Middle East / Africa:** The lowest performing region with an average of 54.4 points. Dubai (58.0) comes top and Tehran bottom with 47.7 points.

What is holding back change?

There are clearly sufficient available solutions to meet today's urban mobility challenges. Arthur D. Little identified 39 key technologies and 36 potential urban mobility business models. However, these solutions are not being applied comprehensively.

Why has the innovation potential not been unleashed? There is one key reason: the management of urban mobility operates globally in an environment that is hostile to innovation. Our urban management systems are overregulated, they do not allow market players to compete and they do not establish business models that bring demand and supply into a natural balance.

Some will say this is easier said than done but we need only look at the performance of other sectors of the global economy to see that transformative change is possible in a relatively short space of time. No example is more vivid than that of the communications sector. In just two decades, hardware and software innovation coupled with the

rise of the internet has brought about what is nothing short of a communications revolution. What we need now is a mobility revolution.

Showcasing success – Hong Kong

Successful cities, such as Hong Kong, have a well-balanced split between different forms of transport that move people away from individual motorised transport. In Hong Kong, travel is integrated through multimodal mobility cards that are owned by 95% of citizens, part of a clear, well-articulated mobility strategy that combines low transport-related emissions with a short average travel time to work.

Three strategic imperatives for cities

To meet the urban mobility challenge, cities need to implement one of the following three strategies dependent on their location and maturity:

- **Network the system:** For high performing cities the next step must be to fully integrate the travel value chain, increasing convenience by aggressively extending public transport, implementing advanced traffic management systems and further reducing individual transport through greater taxation and road tolls.

- **Rethink the system:** Cities in mature countries with a high proportion of motorised individual transport need to fundamentally redesign their mobility systems so that they become more consumer and sustainability orientated. This group contains the majority of cities in North America along with those in Southwestern Europe.

- **Establish a sustainable core:** For cities in emerging countries the aim must be to establish a sustainable mobility core that can satisfy short-term demand at a reasonable cost without creating motorised systems that need to be redesigned later. With access to new and emerging transport infrastructure and technologies these cities have the opportunity to become the test bed and breeding ground for tomorrow's urban mobility systems.

Three future business models for mobility suppliers

Having grasped the scale of the looming crisis in the urban mobility sector, Arthur D. Little set about researching a solution. Following rigorous analysis of other systems that have adopted open and innovative approaches to change, we have identified three long-term sustainable business models for the evolving urban mobility ecosystem.

- **The Google of urban mobility:** Built on a core asset of a user-friendly customer interface, it provides a single point of access for multimodal mobility and supplementary services to end consumers on a large scale to drive uptake.

- **The Apple of urban mobility:** At the core of this business model are integrated mobility services and solutions to the end consumer or cities. Integrated mobility services for end consumers provide a seamless, multimodal journey experience such as public transport interlinked with car and bike sharing. Suppliers that target cities provide integrated, multimodal mobility solutions on a turnkey basis.

- **The Dell of urban mobility:** This is a basic offering such as cars or bike sharing, without integration or networking. It can also include disruptive technological solutions such as transponders that make the Google and Apple models feasible.

Arthur D. Little's contribution to shaping the future of urban mobility

The current disparate nature of urban mobility systems means that none of the individual stakeholders can create these models alone. Arthur D. Little specialises in linking strategy, technology and innovation, and aims to use its Future Lab as the platform to enable and facilitate an open dialogue between urban mobility stakeholders.

2. Study design: comprehensive scope and approach

The reform of urban mobility systems is one of the biggest challenges confronting policymakers, stakeholders and users today and to do it justice the study required a commensurately ambitious approach. Our researchers worked on six of the seven continents to study the status quo, from Atlanta to Lagos, Lahore to Zurich. A vast amount of data was accumulated to enable us to divide the cities under scrutiny into clusters and thus propose different ways forward for cities at different stages of development. In addition, we reviewed in depth a vast number of business models and technologies that are required to enable the way towards high performance urban mobility systems.

2.1 Urban mobility clusters

The urban mobility study was conducted in 66 cities around the globe, a sample consisting of the 50 largest cities in the world as measured by population and by regional GDP share as well as another 16 Arthur D. Little focus cities (see figure 1).

Figure 1: Study scope

Region	Americas	Europe, Middle East & Africa	Asia
World's largest cities determined by GDP share of region and population	**North America** New York, Los Angeles, Chicago, Miami, Philadelphia, Washington, D.C., Dallas, Atlanta, Houston, Boston, Toronto **Latin America** Mexico City, Buenos Aires, São Paulo	**Europe** Istanbul, Moscow, Paris, London, Madrid, Saint Petersburg, Barcelona, Ankara, Berlin, Athens, Lisbon **Africa** Kinshasa, Lagos **Middle East** Tehran, Baghdad	**Asia** Tokyo, Mumbai, Delhi, Dhaka, Kolkata, Shanghai, Karachi, Manila, Beijing, Jakarta, Guangzhou, Osaka, Lahore, Shenzhen, Chennai, Seoul, Bangalore, Wuhan, Tianjin, Hyderabad, Bangkok
Additional Arthur D. Little focus cities		Amsterdam, Brussels, Stockholm, Vienna, Zurich, Rome, Dubai, Frankfurt, Cambridge, Goteborg, Milan, Prague, Munich	Hong Kong, Kuala Lumpur, Singapore

Source: Arthur D. Little

These were then split into clusters based on their level of prosperity, modal split of total number of journies in them and their population.

Prosperity – This was determined by the GDP per capita as of 2008, with those having a GDP per capita of more than US$25,000 defined as 'mature' and those below that level defined as 'emerging'.

Modal split – This indicator was applied by assessing the respective shares of individual motorised mobility, public transport and walking/cycling. Cities with less than 50% of individual travel were categorised as 'public mobility oriented cities' and those with more classed as 'individual mobility cities'.

City size – This was determined by the population of the city agglomerations as of 2010. Cities with more than 5 million residents were defined as 'large' and those below, 'small'.

These indicators led to the categorisation of eight different clusters divided into two broad groups, membership of which was allocated on the basis of whether their modality split was 'public' or 'individual'.

Thus 1A was 'Public, small and mature', while 1D was 'Public, large and emerging'. In the same way, 2A was 'Individual, small and mature' and 2D was 'Individual, large and emerging'.

The Public cluster (see figure 2) totalled 48 cities and the Individual one just 18. Each city's profile was further refined with the addition of information relating to population growth and density. Cities were identified as having more or less than 0.5% population growth and a density of more or less than 7,000 people per square km.

ADL's analysis revealed wildly divergent performances but one thing all clusters have in common is that they need to innovate to improve their performance.

1A – Public, small, mature – Vienna-type

Cities in this category had the fewest transport-related fatalities and the shortest mean travel time to work as a relatively high take-up of safe public transport options such as buses and trains meant there were fewer cars on the road and so the rate of accidents and congestion was reduced. They performed poorly, however, in terms of the number of shared bikes and need to increase the proportion of people who walk or cycle.

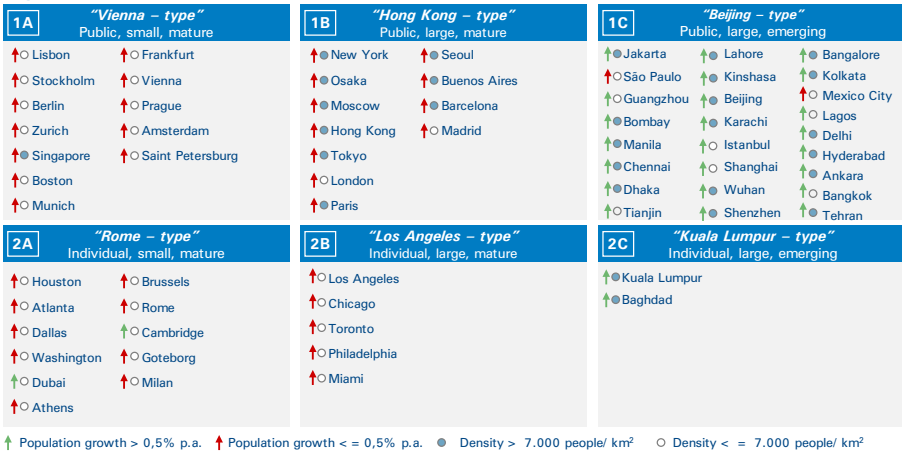
Case study

Vienna – The Austrian capital has one of the highest uses of public transport in Europe and a high level of mobility satisfaction among its citizens. However, it falls down badly when it comes to multimodal mobility cards, where it has zero penetration. Car and bike sharing are other areas that need improvement as Vienna has a very low rate of car sharing and 703 shared bikes per million citizens.

1B – Public, large, mature – Hong Kong-type

Transport-related CO_2 emissions and fatalities are the areas where this cluster performs well but it did badly when it came to innovative mobility sharing practices such as car sharing.

Figure 2: City clusters



Case study

Hong Kong – stands at the very pinnacle. Despite – or perhaps because of – being one of the most densely populated areas in the world, with a land mass of just 1,100 sq km, Hong Kong has developed a highly networked, multimodal mobility system. Smart card penetrations stands at a remarkable 2.9 cards per citizen, while car registrations, transport-related fatalities and CO_2 emissions are all among the lowest in the survey.

1C – Public, large, emerging – Beijing-type

This category includes both Indian and African cities with underdeveloped mobility dominated by walking and three-wheelers to others with fast-increasing levels of income and car ownership such as Beijing and Shanghai. Both groups need to be more innovative in their approach to a growing crisis by promoting sharing and multimodal concepts.

Case study

Bejing – 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 12%. Two of the effects of this are a mean travel time to work of 52 minutes, almost twice that of Vienna, and 68 transport-related deaths per million, more than eight times the rate in the Austrian capital. In these circumstances there is a pressing need for draconian restrictions on car use, including limitations on car registrations, car-free days, and banning car commuters in the rush hour.

2A – Individual, small, mature – Rome-type

While this cluster performed best in terms of mean travel time to work, this was achieved at some cost to the environment and there is a pressing need for its member cities to reduce the number of cars registered per citizen and the level of transport-related CO_2 emissions.

Case study

Atlanta – In a nation of car lovers, the capital of the southern US state of Georgia bows to no one in its enthusiasm for the automobile. In the modal split, the car accounts for an extraordinary 95% of journeys. This means that Atlanta's CO_2 emissions are off the scale at 7.5 tonnes per capita, compared with 0.5 tonnes in Asia and 1.1 tonnes in Europe. Meanwhile its transport-related fatalities level is even higher than Beijing's at 83 per million. It has an urgent need to fund and promote public transport if it is to achieve a sustainable mobility system. As existing journey-to-work times are extremely low at 26.6 minutes, this will be a major challenge for policy makers.

2B – Individual, large, mature – Los Angeles-type

Citizens profess a high degree of satisfaction with their transport options in this cluster and can point to a good record on fatalities and CO_2 emissions. But, again, there is more to be done, particularly involving mobility innovations such as sharing options and the penetration of smart cards.

Case study

Toronto – The Canadian capital comes top of its cluster for 'Satisfaction with transport' and its level of transport-related fatalities. But it has negligible penetration of smart cards, high carbon emissions and cycling and walking account for just 6% of the modal split.

2C – Individual, large, emerging – Kuala Lumpur-type

Carbon emissions are where this cluster performs best but it also has the highest rate of transport-related fatalities of all the clusters and performs poorly when it comes to sharing options.

Case study

Baghdad –The capital of Iraq – has no clear mobility strategy, no car and bike sharing systems as well as no smart transit cards. The city has enormously high transport related CO2 emissions per capita compared to other cities in Africa and Middle East: About 1.55 tones. It is caused by a very high number of vehicles registered (0.55 per capita) and low ecological standards in the city.

2.2 Urban mobility demand, business models and supporting technologies

ADL analysed all three areas in depth: Demand – We selected use cases for mature markets and emerging markets and identified general characteristics, mobility demand and implications for solution providers in each case.

Business Models – The study identified business models in four sectors: Transport, Infrastructure, Traffic Management and Information, Planning and Payment, plus Integration, which straddles these. These were then assessed for their level of maturity: introduction, growth, maturity or decline and allocated to clusters.

Technologies – We looked at four sectors (as above) and identified the most suitable technologies for each sector before assessing them for their level of maturity and identified as being at one of four stages

2.3 Urban Mobility Index

The Arthur D. Little Urban Mobility Index (see figure 3) aggregates the position of a city on 11 indicators. The first five indicators measure mobility maturity: vision and strategy for future mobility, number of shared cars per capita, number of shared bikes per capita, penetration rate of smartcards and share of public transport and walking and cycling in the modal split.

The second range of indicators measures mobility performance, i.e. the degree to which mobility-related goals are fulfilled in an effective and efficient manner: average travel speed in the city with all modes of transport, mean travel time to work, number of fatalities per inhabitant, transport-related CO_2 emissions per capita, number of vehicles registered per citizen and inhabitant satisfaction with mobility in the city. For each indicator we defined a point scale, with the maximum and minimum end of the scale being defined by the best and worst performance of the 66 cities. The point scales add up to a maximum of 100 points on all indicators combined (i.e. if a city achieves the maximum score on each of the 11 indicators, it will have an index score of 100).

Next we did desk and field research to score each of the 66 cities on the Urban Mobility Index. We used the scoring results to identify common characteristics and factors explaining differences in performance for each of the six clusters.

Figure 3: Definition of urban mobility index indicators

Urban Mobility Index Indicator Definition	
Mobility maturity max 32.5 points	
Share of public transport, walking/cycling in modal split [%] *MAX 7.5 POINTS*	■ Best (7.5) ■ Worst (0)
Mobility strategy/ vision *MAX 10 POINTS*	*cumulative* ■ Alternative engines 2 ■ Sustainability 2 ■ Multimodality 2 ■ Infrastructure 2 ■ Restrictions 2
Car sharing performance *MAX 5 POINTS*	■ No sharing system (0) ■ Introduction planned for 2011 (1) ■ < 50 vehicles/ million citizens (2) ■ 51-100 vehicles/ million citizens (3) ■ 101-200 vehicles/ million citizens (4) ■ > 201 vehicles/ million citizens (5)
Number of shared bikes per million citizens *MAX 5 POINTS*	■ 0 = no sharing system ■ 1 = < = 100 bikes/ million citizens ■ 2 = 101-500 bikes/ million citizens ■ 3 = 501-1000 bikes/ million citizens ■ 4 = 1001-5000 bikes/ million citizens ■ 5 = > 5001 bikes/ million citizens
Penetration of smart cards *MAX 5 POINTS*	■ 0 = no smart transit card ■ 1 = < 0.1cards/ capita ■ 2 = 0.1-0.25 cards/ capita ■ 3 = 0.25-0.5 cards/ capita ■ 4 = 0.5-1 cards/ capita ■ 5 = > 1 cards /capita
Mobility performance max 67.5 points	
Transport related fatalities per million citizens *MAX 15 POINTS*	■ Lowest (15) ■ Highest (0)
Transport related CO_2 emissions [kg per capita] *MAX 15 POINTS*	■ Lowest (7.5) ■ Highest (0)
Vehicles registered per citizen *MAX 7.5 POINTS*	■ Lowest (7.5) ■ Highest (0)
Average travel speed [km/h] *MAX 7.5 POINTS*	■ Best (7.5) ■ Worst (0)
Satisfaction with transport [points] *MAX 15 POINTS*	■ Average of 3 ADL intern expert opinions ■ Additional interviews for verification
Mean travel time to work [minutes] *MAX 7.5 POINTS*	■ Shortest (7.5) ■ Longest (0)

3. Urban mobility systems on their way to breakdown

Some storms that beset the global economy are wholly unexpected but the end game in the looming crisis over urban mobility is eminently predictable. At its root is our old friend the Malthusian Devil. With the Earth's population set to grow by just under a third in the next 40 years, already creaking transport systems in our mushrooming cities will come under intolerable strain. In such a context innovation is crucial and yet our researches show that, instead of being championed, innovative approaches are all too often stifled.

3.1 Relevance of urban mobility

The population of the world is set to grow from 7 billion today to 9.2 billion by 2050 and this presents intimidating challenges in a range of diverse spheres, from food production 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 more thorny than the provision of urban transport. Indeed, the proportion of the global population living in cities is expected to rise from 51% in 2010 to 70% by 2050 (see figure 4). As existing urban mobility systems are already facing breakdown in many regions, this presents a problem of crisis proportions for policymakers worldwide.

The problem is exacerbated by the fact that city workers are responsible for creating a disproportionate amount of global GDP. By 2025, their contribution is expected to total 86%. In such a context, it is vital that urban residents are in a position to move around freely. And yet – while urban mobility currently accounts for 64% of overall mobility – it is expected to almost triple between now and 2050, with the result that the average time a citizen will spend trapped in traffic congestion could also triple – to 106 hours a year.

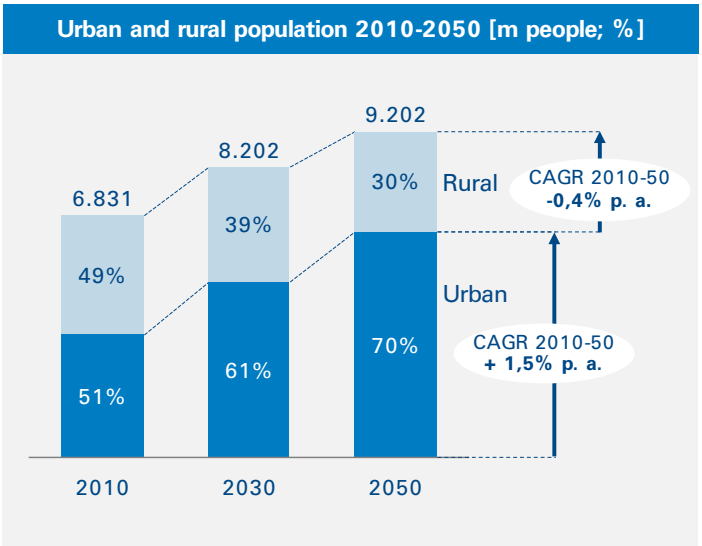


Figure 4: Development of urban and rural population

Source: UN Population Division, Arthur D. Little Lab

3.2 Triple bottom line impact of urban mobility systems

If current trends continue, urban mobility systems are going to break down spectacularly and exact a heavy toll. The so-called triple bottom line – people, planet, profit – could suffer a serious blow. For example, a US citizen by 2050 will on average suffer some 100 hours of congestion-related delays a year, which is triple the number in 1990. 17.3% of the planet's bio-capacities will be needed to make urban mobility possible in 2050, which is five times more than in 1990. And annual investment in urban mobility will have to quadruple to some €829bn worldwide by 2050.

Hand-in-hand (see figure 5) with this change will come a massively increased demand for energy and raw materials. Given this, sustainability will become an increasingly key factor in the way the urban mobility systems of the future are desig-ned – and that means environmentally friendly mass transit must win out over individual motorised transport.

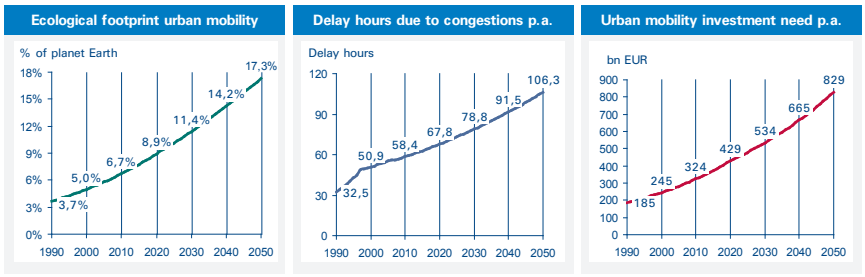
This is why, when it comes to performance, the study focuses on the three dimensions of sustainability: people, planet and profit.

Planet – We have a duty as citizens not to compromise the next generation's opportunities to make their living on planet Earth and yet, without careful planning, mobility systems will remain major generators of greenhouse gases and thus significant contributors to climate change. In addition they will deprive other sectors of energy supplies and cause air and noise pollution.

People – Our systems and technologies have to serve people to a broad extent. As the world's population grows and more and more people migrate to the cities, urban mobility systems will come under growing strain, with congestion increasing and travel speeds declining. Unless the modality split can be shifted in favour of public transport and walking/cycling accidents and fatalities will increase.

Profit – Whatever we propose must match the principles of good management. It is forecast that annual spending

Figure 5: Triple bottom line impact of urban mobility



Source: Stockholm Environment Institute, US Census Bureau, UN Population Division, Schäfer/ Victor 2000, Siemens, Bureau of Transport Statistics, Arthur D. Little

on urban mobility – including infrastructure – will have to rise to €829bn per annum by 2050, more than four times the figure in 1990. And yet its services must remain affordable for all citizens.

These dimensions work together to construct a triple bottom line of benefits:

- Environmentally compatible business
- Sustainable communities and a high quality of life
- Social investments and an equitable economic system

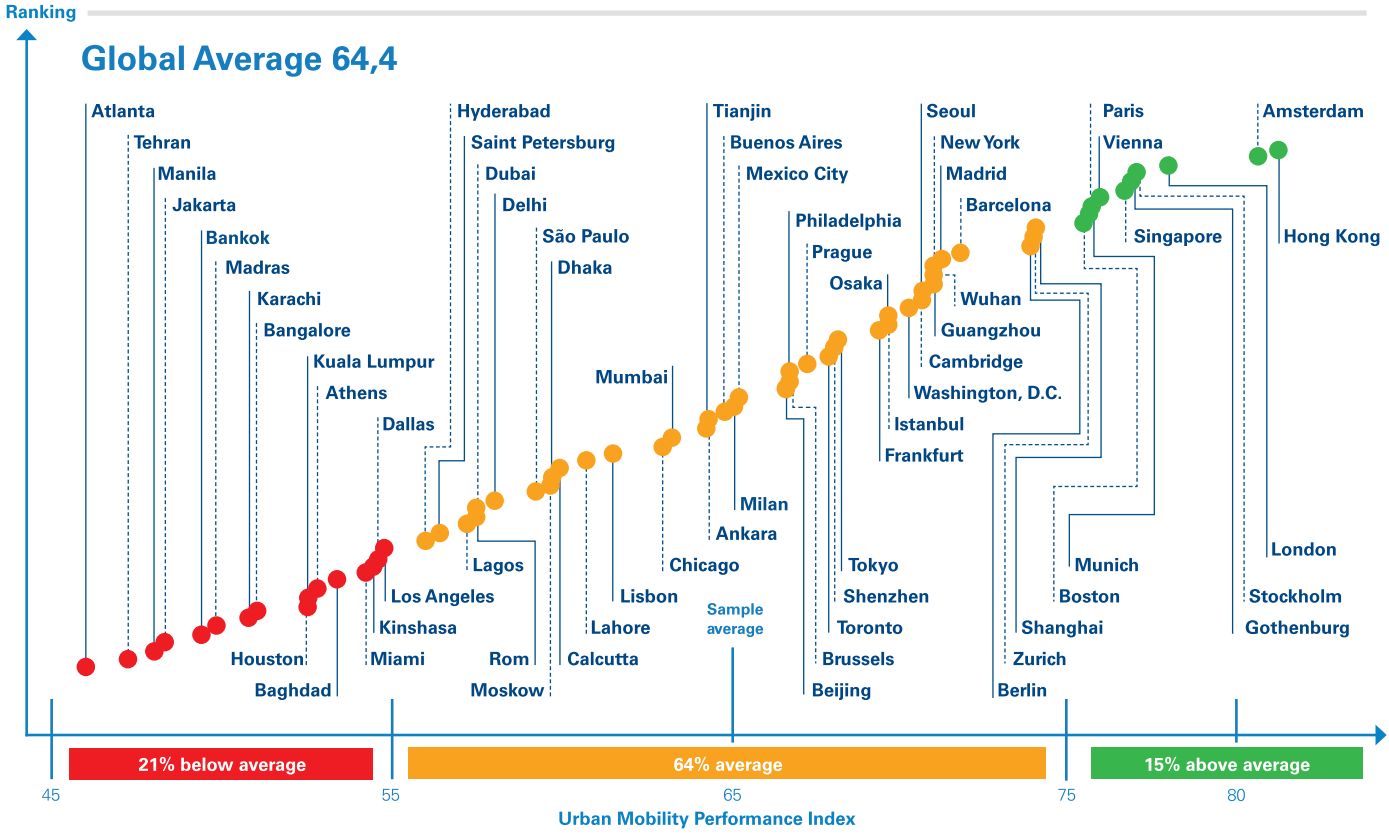
3.3 Overal-Performance of urban mobility systems

Rated on a scale of 1-100 (with 100 representing the top performance) the average score of the cities surveyed was close to 65 (64.4 points). This means that, on average, the 66 cities achieve just two thirds of the level of performance that could potentially be reached today by applying best practice across all operations.

Only two cities (Hong Kong and Amsterdam) scored above 80 points, with just 15% of cities scoring above 75 points (see figure 6).

The analysis reveals a number of remarkable results. First, there is a clear correlation between the use of innovative mobility concepts on the one hand and

Figure 6: Urban mobility ranking



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

mobility effectiveness and efficiency on the other hand. Cities that promote walking, cycling, bike sharing, car sharing and smart mobility cards as part of an integrated mobility vision and strategy do reduce travel times, fatal accidents and carbon emissions. All of the top ten performing cities have a strong focus on public transport, walking and cycling, with individual motorised mobility usually commanding less than half of the modal split.

As the following chart shows, cities that are above average in terms of mobile maturity are characterised by high levels of public transport use and walking and cycling; car and bike sharing; and penetration of smart cards. They also have a coherent mobility strategy.

Second, the average score achieved by the 66 cities in the sample is 65 points (64.4) and only 15% of the cities score above 75 points. In other words, the average city achieves only two thirds of what is possible today by applying best practice across all operations and only ten cities perform in the highest quartile possible today. This analysis indicates the significant performance-improvement potential cities have and highlights the urgent need for cities to address the urban mobility challenge proactively.

Third, even for cities that score highest, namely Hong Kong (81.9) and Amsterdam (81.2), the scope for improving toward the maximum score of 100 is still significant. Hong Kong, for example, scores very high in terms of smartcard penetration – allowing people to use one and the same contactless payment card across transport modes – but lags in terms of car and bike sharing. In other words, a near-perfect mobility system does not yet exist in the world today and full satisfaction with urban transport is not observed in any of the cities studied (see figure 7).

Fourth, city size does not have a significant influence on the mobility score. For example, the small cities of Rome and Athens have much lower scores (57.9 and 53.3 respectively) than the large cities of London and Madrid (78.5 and 71.8 respectively). However, the two other city characteristics that we studied, namely city prosperity and the prevalence of public transport ('modal split'), do have a significant influence on the mobility score. The richer the

Figure 7: Top ten city index performance

City	Share pubic transp. + walking/ cycl. in modal split [%]	Mobility strategy/ vision [points]	Car sharing performance [points]	Number of shared bikes per million citizens	Penetration of smart cards [cards / capita]	Transport related fatalities per million citizens	Transport related CO_2 emissions [kg per capita]	Vehicles registered per citizen	Average travel speed [km/h]	Satisfaction with transport [points]	Mean travel time to work [minutes]
1 Hong Kong	84%	10	1	0.0	2.9	23.0	378	0.08	25,1	12	39,0
2 Amsterdam	56%	10	5	305.1	1.0	27.0	1100	0.40	34,0	13	22,0
3 London	62%	10	5	695.1	2.3	39.0	1050	0.40	17,7	14	44,1
4 Stockholm	54%	10	4	1944.9	0.2	21.0	1430	0.40	28,6	13	29,1
5 Goteborg	48%	9	5	1220.4	0.6	48.0	1800	0.41	24,0	13	18,7
6 Singapore	55%	9	5	0.0	2.0	47.0	900	0.10	26,9	8	36,0
7 Vienna	69%	9	3	703.6	0.0	16.0	1250	0.39	26,7	13	27,6
8 Paris	56%	10	5	1964.7	0.2	91.0	950	0.39	31,0	14	35,0
9 Munich	63%	8	5	926.4	0.0	22.2	1390	0.42	32,0	14	30,2
10 Boston	55%	8	4	132.8	1.4	23.0	1028	0.63	29,0	12	30,4

Source: Arthur D. Little Mobility Index

city and the lower the share of individual transport, the higher the score.

Fifth, cities in mature regions are not necessarily a model that cities in emerging regions should aspire to emulate. Many of the former, such as Tokyo, Prague, Moscow, Atlanta and Miami, still do not appear to have a vision and documented strategies that clearly articulate what they want their future mobility systems to look like. Furthermore, if cities in emerging regions replicate the pathway that cities in mature regions have followed, they run the risk of introducing the very same problems of poor modal split, high carbon emissions and low travel speed. US cities in particular tend to score low, as their modal split is heavily biased toward cars and their carbon emissions are a multiple of those in Europe (see figure 8).

Regional performance

- There are big differences between the top and low-end performers in various regions (see figure 9).

- **Western Europe:** Overall best regional performance with average of 71.4 points and seven out of the 18 analysed cities scoring above 75 points. Amsterdam (81.2) and London (78.5 points) lead the way – while Rome (57.9 points) and Athens (53.3) are the worst performing cities.

- **Eastern / Southeastern Europe:** An average performance from all cities in the region with an average of 64.0 points. Only Istanbul (70.2) comes close to the top performance cluster and St. Petersburg (56.9 points) is the worst performing city in Eastern / Southeastern Europe.

- **North America:** A slightly below average performance, way below Western Europe with 62.0 points. Just Boston, with 76.2 points scores highly, while Atlanta has only 46.2 points, making it the worst performing city surveyed.

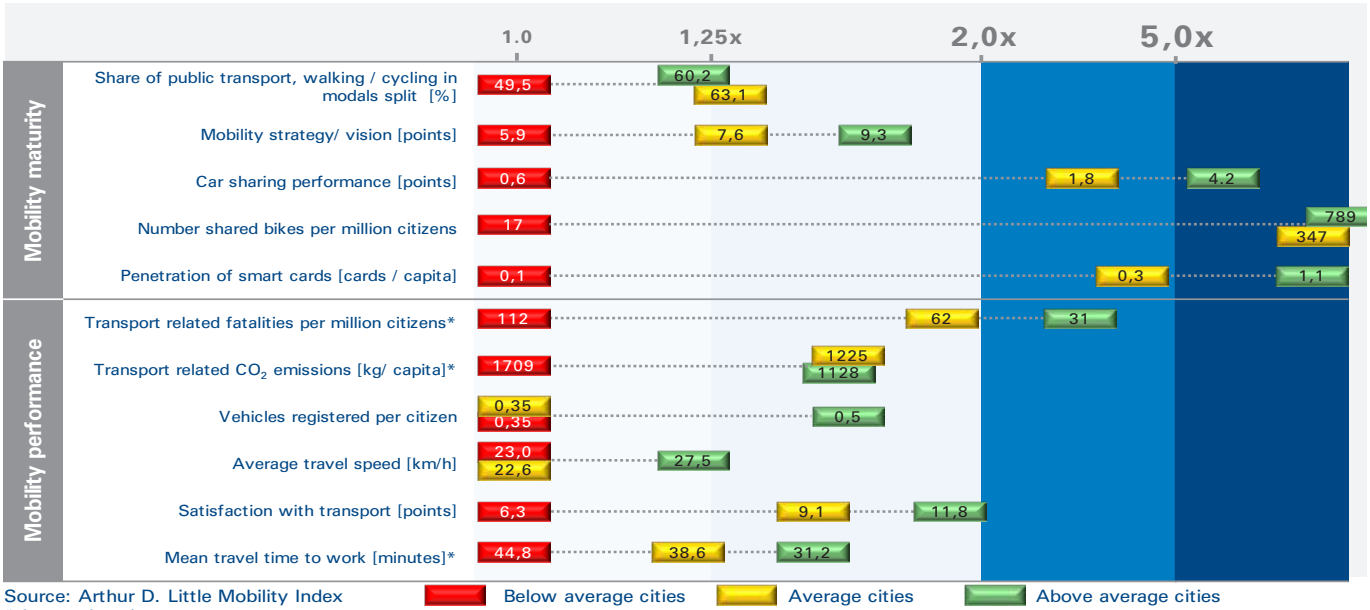
- **South America:** Average performance, just ahead of North America with 63.6 points. Mexico City leads the way with 65.7 index points closely followed by Buenos Aires (65.3) and São Paulo (59.7).

- **Asia / Pacific:** The broadest range in performance – from Hong Kong, which with 81.9 points tops the global table down to Manila with 48.4 points. This gives an average of 62.5 points.

- **Middle East / Africa:** The lowest performing region with an average of 54.4 points. Dubai (58.0) comes top and Teheran bottom with 47.7 points.

3.4 Innovation hostility of urban mobility systems

While poor, let alone deteriorating, urban mobility is a source of daily frustration to citizens, businesses and governments alike, many people are resigned to see it as an inescapable consequence of economic development and wealth creation.



Source: Arthur D. Little Mobility Index
* inverted scale

But urban mobility need not be an intractable problem. Solutions to address the pressing mobility challenges are widely available. This appears clearly from the progress the top-performing cities such as Hong Kong, Amsterdam and London are making. It also appears from our comprehensive review of 39 technologies and 36 urban mobility business models. Some of these technologies are fairly mature (think of electronic tolling, advanced parking systems, the automatic monorail, the Segway…), while others are still in the embryonic phase (think of access to the CAN communication network in a car, the automated car, the solar roadway, the straddling train…).

Likewise some business models are mature (e.g. bike rental), while others are embryonic (e.g. cargo pipelines).
If the availability of good-practice examples, technology and business models is not the bottleneck, what then is holding back resolution of the mobility challenge? Our study reveals that the root cause of the performance gap is the aversion to innovation within the urban mobility system. By 'system' we mean groups of stakeholders, the relationships between these, the rules and incentives that govern their behaviour, and the assets and capabilities through which they seek to achieve their objectives.

Current mobility systems adapt poorly to changing demands, are weak in combining single steps of the travel chain into an integrated offering, find it difficult to learn from other systems, and shun an open, competitive environment. Collaboration on solutions is rare. Rewards for investors are rather meagre.

This is a pretty damning verdict, but it also shows the road to redemption because it highlights four key shortcomings mobility stakeholders will need to address to enable the emergence of innovative and effective mobility concepts:

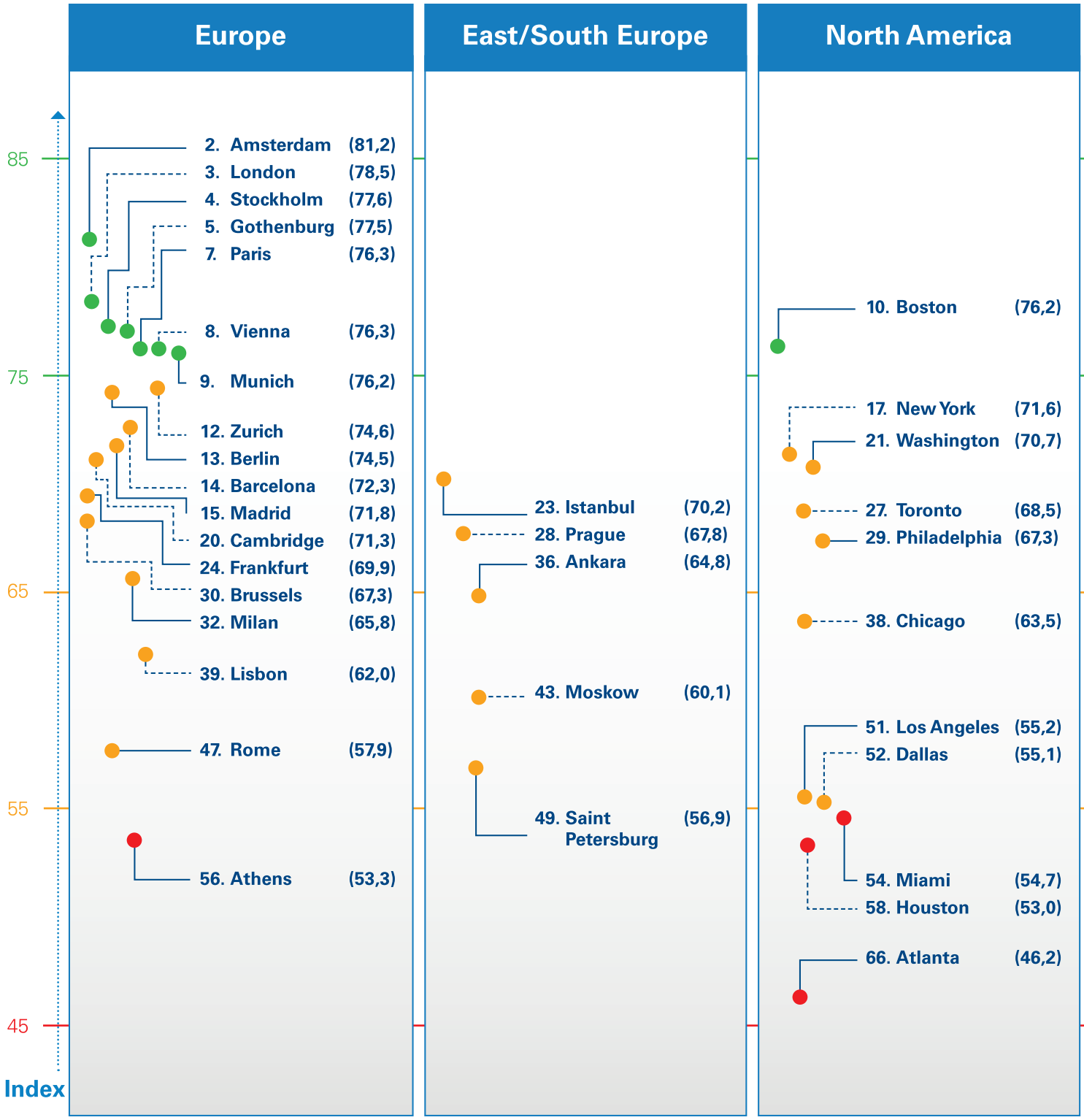
1. **Lack of a collaborative platform.** Diverse stakeholders are failing to work together.

2. **Absence of vision.** Leaders of the relevant stakeholder groups have not formulated a common vision for the mobility concept.

3. **Lack of focus on customer needs.** All too often mobility systems are run for the convenience of their operators rather than consumers.

4. **Inadequate competition.** Services have a tendency to decline unless there is meaningful competition between operators for the custom of travellers.

Figure 9: Urban mobility performance by regions



Source: Arthur D. Little


South America
33. Mexico City (65,7)
34. Buenos Aires (65,3)
44. São Paulo (59,7)
Asia Pacific
1. Hong Kong (81,9)
6. Singapore (77,3)
11. Shanghai (74,7)
16. Wuhan (71,7)
18. Guangzhou (71,6)
19. Seoul (71,5)
22. Osaka (70,2)
25. Tokyo (68,7)
26. Shenzen (68,5)
31. Beijing (67,2)
35. Tianjin (64,9)
37. Mumbai (63,7)
40. Lahore (61,2)
41. Calcutta (60,4)
42. Dhaka (60,3)
45. Delhi (58,5)
50. Hyderabad (56,4)
57. Kuala Lumpur (53,1)
59. Bangalore (51,3)
60. Karachi (51,0)
61. Madras (50,0)
62. Bankok (49,8)
63. Jakarta (48,6)
64. Manila (48,4)
Middle East / Africa
46. Dubai (58,0)
48. Lagos (57,7)
53. Kinshasa (54,9)
55. Baghdad (53,7)
65. Tehran (47,7)
Above average
Average
Below Average

4. Urban mobility futures: solutions and technologies waiting for deployment

Figure 10: Urban mobility demand pattern

Urban Mobility Lifestyle	"Vienna – 1A type"	"Hong Kong – 1B type"	"Beijing – 1C type"	"Rome – 2A type"	"Los Angeles – 2B type"	"Kuala Lumpur – 2C type"
Greenovator						
Family Cruiser						
Silver Driver						
High-frequency Commuter						
Jet Setter						
Sensation Seeker						
Low-end Mobility						
Basic						
Smart Basic						
Premium						

Source: Arthur D. Little

Knowing the nature and needs of your mobile population is a key first step to putting in place a networked solution which will suit all parties. Then it becomes a question of identifying and executing the appropriate modes of transport to avoid the onset of gridlock. One of the more surprising results of our study is that many solutions and technologies already exist but remain unexploited. What is needed is an informed openness to what is available and the flexibility and imagination to innovate as required.

4.1 Urban mobility demand patterns

One of the most difficult challenges facing policymakers in mature markets is satisfying the needs of a diverse array of users. While public transport may suit a single person commuting to and from work, it may be less convenient for a stay-at-home mother juggling the school run, shopping and visiting friends.

ADL identified 10 types of urban mobility users: Greenovators, Family Cruisers, Silver Drivers, High-Frequency Commuters, Global Jet Setters, Sensation Seekers and Low-end Mobility, Basic, Smart Basic an Premium (see figure 10). In the following we will describe selected lifestyles.

- **Greenovators** directly link environmental awareness and a sustainable lifestyle with their quality of life. Restraint in consumption and luxury constitutes an essential component of their understanding of culture and life – obviously with consequences for mobility consumption. Greenovators want integrated ecological mobility concepts that are oriented towards their own personal wellbeing and the good of society. This makes them a significant force in the 'Public, small, mature' cluster and to a slightly lesser extent in the 'Individual, small, mature' cluster epitomised by Rome.
- **The family life of Family Cruisers** takes place in an ever more fragmentary way. The new definition of the concept of family as a "network of many" involves an explosion of needs from everyone involved, resulting from the desire to balance career, partnerships, child rearing and individual personality development. This need for intensive family mobility makes Family Cruisers a significant factor for planners in clusters coping with large urban sprawl such as 'Individual, large, mature', where Los Angeles is a good example.
- **Silver Drivers** are a new generation of older people who will become increasingly important as a target group in the future mobility markets. Silver Drivers are not only well off; they are ready to spend their money rather than save it. Their battle cry is: "Anyone who saves is just starving themselves for their heirs". This makes them serious players in clusters incorporating mature cities but largely irrelevant in poorer parts of

the world where the shrinking older generation devotes much of its wealth to supporting the population explosion among the young.

■ **High-Frequency Commuters** are extremely mobile job nomads who are constantly on their way to visit customers, business partners and temporary projects. Network-type concepts, which combine several mobility services in an intelligent way, are required to meet High-Frequency Commuters' needs. With the help of modern digital networking possibilities, High-Frequency Commuters will be able to organise themselves in carpools more spontaneously and at shorter notice and develop a high affinity towards car sharing and short-term rental car offers. Not surprisingly, perhaps, this category of consumer is a significant user in the four Mature clusters, and only marginally less of a force in emerging markets.

■ **High-Frequency Global Jet Setters** are people who are regularly en route – quite frequently several times a week – between the major cities of the world. Being constantly in transit is not an exceptional situation for the Global Jet Setter; it's the general rule. As naturally as others travel to work in the morning by getting into their car or taking the subway, Global Jet Setters jump on planes. For suburban mobility, however, they too cannot get by without car solutions. Being in transit on an ongoing basis intensifies Global Jet Setters' wish to arrive somewhere, to feel at home and find tranquillity. Modes of transport have to satisfy what Global Jet Setters demand from a "third place": places where one feels at ease and can be productive, where one can connect the practical with the pleasing. Meeting people, keeping in touch with contacts, coming up with ideas, learning, and being creative – all this is becoming ever more important for Global Jet Setters when travelling. Therefore, means of transport must fulfil the functions of a personal workstation, as well as the desires for privacy, familiarity and intimacy. All this makes them most at home in the 'Public, large, mature' cluster exemplified by Hong Kong and least comfortable in emerging megacities.

■ **For Sensation Seekers**, cars are the ultimate objects of experience and in the future will link driving with attributes such as freedom, fun and pleasure. To fulfil Sensation Seekers' wishes and needs, future concepts should consider cars ever more strongly as third places: as refuges between job and home, in which the driver is happy to stay, feels good, enjoys life, but can also spend time sensibly. For Sensation Seekers, cars express their attitude towards life.

The individual demand patterns are of varying importance for the city clusters as can be seen from figure 10. The most striking features are the significant role played by the High-Frequency Commuter in all clusters, whether Mature or Emerging, Public or Individual, and how Greenovators, on the other hand, tend to be of meaningful relevance only in Mature clusters (although they are less significant in the Americas, where concern over petrol-based carbon emissions tends to be less marked).

4.2 Maturity of urban mobility business models

Confronting the challenges of the future will often require the adoption of new business models. The majority of urban mobility business models are at the growth or maturity stage. We have divided them into four categories: Transport, Infrastructure, Traffic Management and Information, Planning and Payment.

Transport – This naturally encompasses everything from buses and rail services to car and van rental and taxi services of all sorts but also includes car and bike sharing schemes.

Infrastructure – Business models here cover the operators of road and rail networks and the services that flow from them.

Traffic Management – Once the hardware has been installed, it has to be managed and there are operators in a wide range of sectors.

Information, Planning and Payment – This covers journey planning, navigation and location based services.

Integration – There is also scope for bodies that straddle two or more of these categories, such as operators of mobility cards (smart cards) and those involved in multimodal journey planning.

Despite the relative maturity of most of the models in use, there is scope for extending the scope of a number of the growth business models – such as car sharing and traffic management – and the introduction-level ones – notably Public Rapid Transit (PRT) and automated parking garages.

Examples of growth-level business models

Traffic management operator

In the absence of a reduction in road users, one partial solution is to manage their progress better (see figure 11). Traffic control systems rely on a network of detection and enforcement systems, which relay their findings to control rooms. Personnel there can then predict changes in demand and manage the load on the network to improve journey times. A more efficient use of the infrastructure is also like to lead to safer journeys and lower emissions.
Key partners in such schemes are likely to include the highway authority, city and/or national government, data provi-

ders, ICT providers and civil engineering companies. These would work in close cooperation with the emergency services, vehicle recovery organisations and enforcement agencies.

Revenue to cover the cost of the installation of detection and information provision systems, control rooms and enforcement would come mainly from infrastructure owners in the form of a periodical management fee and possible variable fees based on the amount of traffic handled or toll revenue raised. There might also be scope for selling on raw or processed data.

Smart transit card
A mass market, multimodal proposition, this offers the user a highly convenient, cash-free way of accessing a large transport network. It may also be made more attractive by extending its use to retail outlets and facilities such as car parks, libraries and cinemas, etc.

Car sharing (private end-user)
Car sharing services, whereby drivers hire a vehicle at will rather than invest in a car of their own, are seen as an economic and environmentally friendly complement to public transport. While they are already well established in many cities around the world, there remains considerable scope for growth.

Car sharing (business internal)
This variant on the genre operates as a closed system within a company. Instead of each employee making use of their own car, vehicles are shared among the staff, thus saving on parking spaces and contributing to a reduction in the company's carbon footprint.

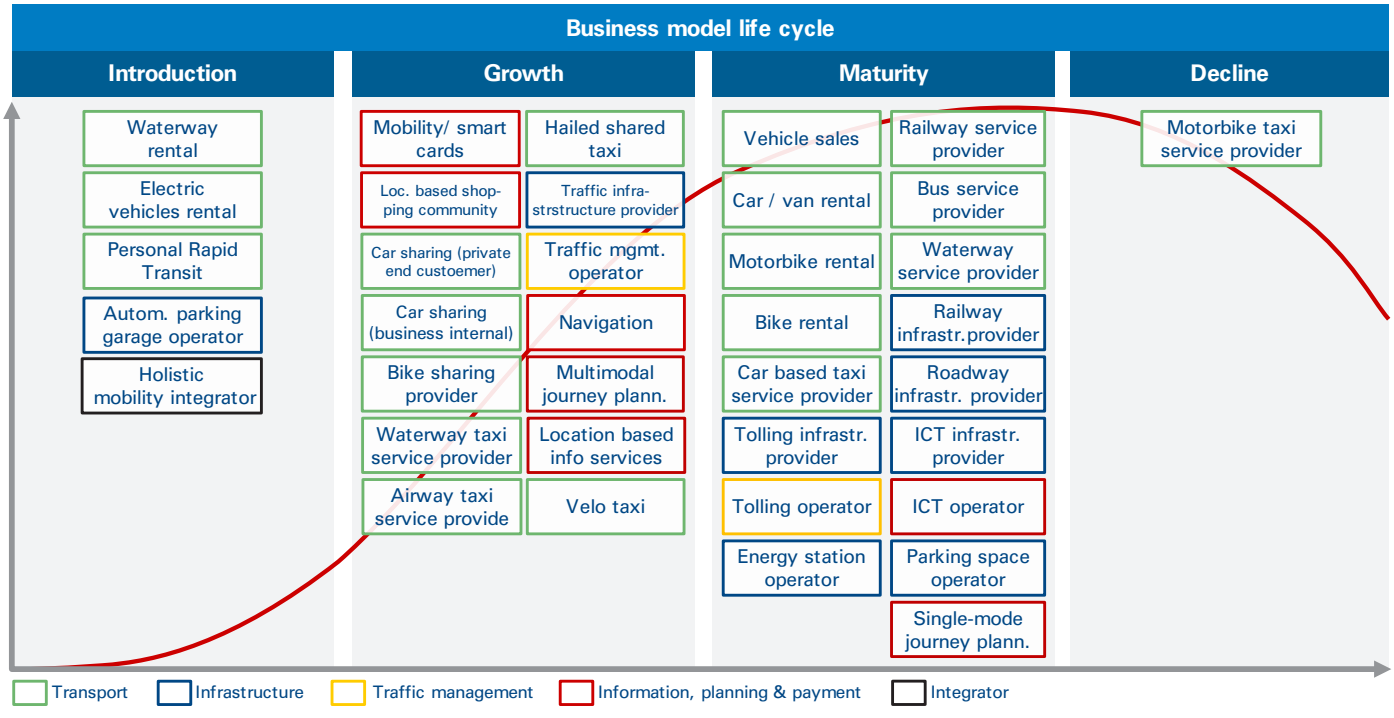
Examples of introduction-level business models

Personal Rapid Transit (PRT)
This mode of transport is in its infancy but is finding a growing constituency of customers among airports, business parks, college campuses and national parks.

It consists of individually hired electric pods carrying two to six passengers apiece that travel on fixed routes on guideways. Fully automated, they offer round-the-clock availability and no congestion or parking issues.

Aimed at the mass market, there is potential for expansion to city centres and suburbs and to business customers with large premises who have a demand for freight transportation.

Figure 11: Urban mobility business models



Source: Arthur D. Little

The key partners in the development of such networks are the organisation responsible for the hardware – infrastructure and vehicles – its maintenance and operation and public transport operators or governments.

The major costs of establishing such a network are the construction of the guideways and vehicles and running costs such as electricity and labour. Revenue streams will be passengers paying a fixed sum per journey or mileage fee, businesses buying freight transportation services and local governments offering subsidies for public transport.

Automated robotic parking

With land at a premium in our increasingly congested cities, this space-saving parking solution promises the same amount of parking as offered by existing operations in 50% of the land area. Customers leave their car on an automated 'lift', which then travels to the nearest available parking pod in the multi-storey structure. It also offers more security and a lower in-garage accident rate, a lower rate of carbon emissions and greater convenience as it obviates the need to search for a parking position.

A mass-market proposition, it will particularly appeal to Sensation Seekers, Silver Drivers and Jet Setters, and will be attractive to customers in urban areas where parking spaces are limited. Construction, operating and maintenance costs will be offset by parking fees and revenue from additional services, such as cleaning, and on-site advertising.

4.3 Maturity of urban mobility technologies

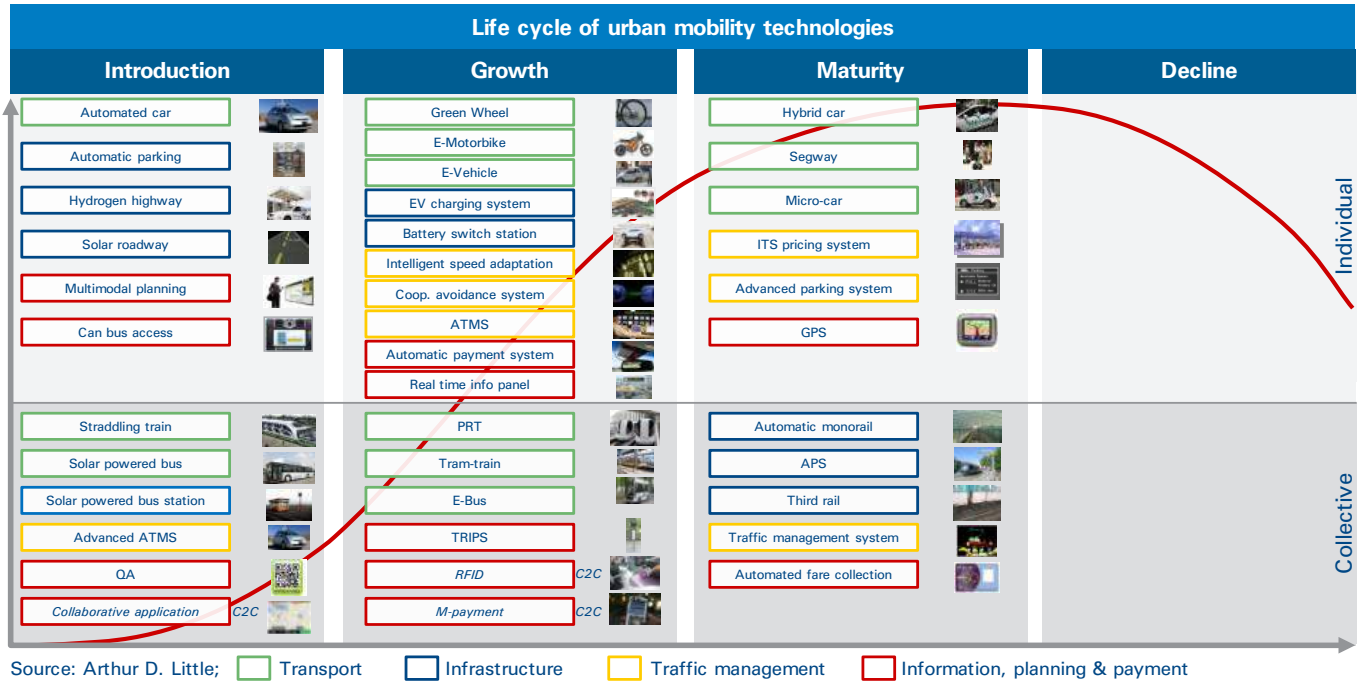
A wide range of technologies have been developed for both individual and collective transport which span the sectors of transport, infrastructure, and traffic management and information, planning and payment (see figure 12).

Transport

This embraces technologies developed for both individual modes of transport (the car and two and three-wheeled forms of transport) and collective modes such as bus, tram and train.

The future – Hybrid cars are already a well-accepted part of the landscape but may other radical new technologies have been launched or are under development that will revolutionise travel in the cities of the future. Solar-powered buses and trains that obviate the need to build new tracks by straddling existing highways are two of the more eye-catching projects in the pipeline.

Figure 12: Urban mobility technologies



Case study

Green Wheel – This is a low-cost electric propulsion system for bikes currently in development. It is designed to boost bicycle use in urban areas by taking some of the perspiration out of this form of travel. A motor and batteries are enclosed in a hub that can be installed on any standard bike wheel. The battery, designed to be charged overnight, can provide up to 25 miles of propulsion and – apart from being non-polluting – its carbon footprint is restricted to the emissions produced by the electricity production source. This will be a low-cost solution, which can be retrofitted to existing bikes.

Infrastructure

Conventional structures developed for the individual user include roads, parking facilities and energy supply stations (whether petrol stations or electric charging points), while collective transport is catered for by rail links, stations and energy supply centres.

The future – Electric vehicle (EV) charging systems are becoming increasingly ubiquitous in the developed world but they may, in time, be joined by hydrogen highways, chains of hydrogen-equipped filling stations along roads or motorways, which will enable cars powered by zero-emission hydrogen fuel cells to be used in large numbers for the first time. Other newcomers will include automatic robotic parking and solar-powered bus stations.

Case study

Sun Power Road – US scientists are already at work on prototypes of solar panels made of toughened glass so strong that they can be used instead of asphalt to pave the nation's highways.

Traffic Management

Road traffic management has come a long way since the invention of the traffic light. ATMS (Advanced Traffic Management Systems), which draw on real time traffic data from cameras and speed sensors, are already well established and have the power to reroute traffic and issue DMS (Dynamic Messaging System) messages to road users. ISA (Intelligent Speed Adaptation), meanwhile, can keep drivers informed of the speed limit operating in their area and even curtail the speed of the vehicle accordingly.

The future – A straddling train that saves space by running above motor highways is one of many ingenious solutions in development.

Case study

Automated Car – Perhaps the most radical development in this area is the advent of driverless cars that operate using a combination of sensors, video cameras and artificial intelligence software. Google has already successfully lobbied for a change in the law in the US state of Nevada to allow the passage of driverless cars on state roads as it develops its own proprietary system.

Endless possibilities

The results of this study show that there are the business models and technologies to offer a comprehensive toolbox to city planners wrestling with the problems of the future.

The public sector must seek to increase the role of public transport and walking/cycling in the modal split and improve individual motorised transport by traffic management measures and thus ensure sustainable mobility.

Operators in the private sector, on the other hand, are under pressure to retain their position in a changing environment, and innovate their business models.

5. Shaping the future: towards networked, multimodal urban mobility systems

Solving the problem of urban mobility does not require vision alone. Stakeholders involved in shaping the future must collaborate and compete as appropriate and never lose sight of their customers' needs. The highest scoring city in our mobility index, Hong Kong, relies on a highly integrated system with a smart card at its heart. It points the way to a highly networked, multimodal future but it is worth remembering that, while Hong Kong is far ahead of many other cities, its score of 81.9 is still well short of a perfect 100.

5.1 Key enabler innovation

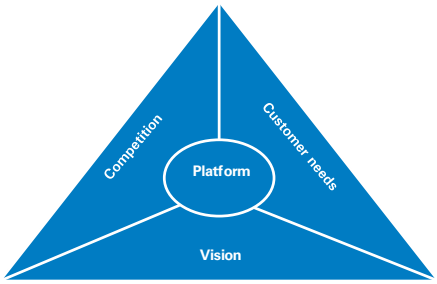
Mobility stakeholders should jointly work on four axes to enable the emergence of innovative and effective mobility concepts:

1. Establish a collaborative platform. A platform is an agreement between diverse stakeholders – infrastructure and service providers, technology suppliers, financiers, regulator, city government, users, etc. – leading to a structure that enables them to align their shared objectives and prioritise common initiatives.

2. Establish and execute a vision. The senior leaders of the stakeholder groups participating in the platform should formulate and support a common vision for the mobility concept. They should assign accountability to each player. They should institute the willingness and capabilities to improve the concept continuously.

3. Discover and respond to customer needs. The mobility concept should be able to adapt to changing demand volumes. It should allow flexible and peak-oriented pricing. And it should offer seamless multimodal services to users.

4. Initiate competition. Government should guard over the working of market mechanisms that ensure fair competition between different transport modes, business models and types of infrastructure. It should enable entry by new players. Where applicable, it should establish balanced public-private-partnerships within a reliable framework conducive to the provision of competitive services.



5.2 Strategic imperatives for city management

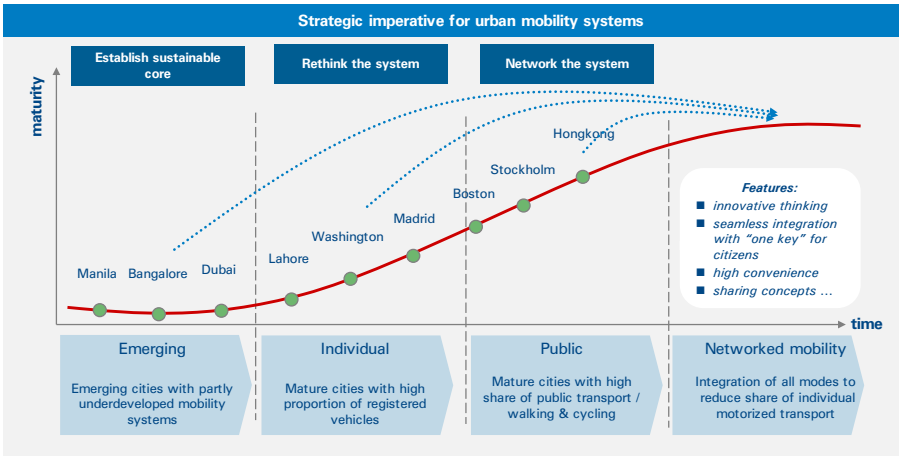
Broadly speaking, there are three typical models of urban mobility – public, individual and emerging. Each of them has specific challenges to solve and address (see figure 13).

Figure 13: Urban mobility challenges by city cluster

Cluster	Planet	People	Profit	Imperative
1A *Vienna - type*	Sustainability – often a goal of master plans; public transport less environmentally harmful	Sufficient infrastructure supply and convenient usage/ access	Mature cities with high mobility budgets; able to implement high-end technologies	**Further decrease share of individual transport in modal split – Be pioneers of future urban mobility!**
1B *Hong Kong - type*				
2A *Rome - type*	Often most dirtiest cities in the world (mobility related impact), e.g., 7 t CO2/ capita	High congestion and accident levels lead to lowering quality of life	Increasingly attractive markets for infrastructure providers, due to anticipated shift to public transport	**Change mobility culture and system – You are polluting strongly an environment and offer low quality of life!**
2B *Los Angeles - type*				
1C *Beijing - type*	Weak environmental impact due to partially underdeveloped of infrastructure	Low satisfaction with mobility supply esp. in Africa, South-East Asia	Often problems with financing of mobility infrastructure - affordability challenges	**Do not follow "Western" development path – Otherwise you will become unsustainable!**
2C *Kuala Lumpur - type*				

Source: Arthur D. Little Lab Note: performance level: ● good ○ bad

Figure 14: Urban mobility strategies



Source: Arthur D. Little Lab

Public – The key here is to improve in terms of sustainability and infrastructure. Both point to further efforts to reduce the role of individual transport solutions in the modal split.

Individual – Cities in this cluster tend to be among the dirtiest and most congested in the world thanks to a disproportionate reliance on car use. In the interests of both sustainability and quality of life there is a pressing need to change the mobility culture.

Emerging – The bad news is that infrastructure is underdeveloped and the resources to change this are scarce, but the good news is that there is an opportunity to create a mobility system that does not repeat the errors made in Mature markets.

Each of the groups requires a different approach to make them fit for the future – 'network', 'rethink' and 'establish a sustainable core' (see figure 14).

1. Network the system

This solution is best applied to the mature and top performing cities of Northwestern Europe (plus some selected centres in North America and Asia Pacific), which boast a high penetration of public transport. Given that they already have a relatively balanced modal split, the emphasis switches to integrating and extending the existing mass transit services, and continuing moves to deter commuters from using private cars via taxes and road tolls. Such cities will also benefit from the implementation of advanced traffic systems to steer and guide the traffic flow.

2. Rethink the system

Given the US citizen's love affair with the car, this strategy is most relevant to the majority of the North American cities analysed, as well as the cities in Southwestern Europe. In many ways, reform of such urban clusters is the most challenging of all as it requires the authorities to fundamentally redesign the mobility system and that can only be done by radically reshaping the political agenda to rally support for a public and sustainable mobility system. Once this has been done, as there are no universal solutions, each city will have to rigorously reassess all the building blocks of its system including modes of transport, traffic management, transport information and planning and payment systems.

3. Establish a sustainable core

This model is designed for cities in emerging markets that tend to have undeveloped and uncoordinated mobility systems. The temptation is to rely on a mainly individual motorised system but that will only have to be redesigned later. Forward-thinking planners have the chance to take advantage of new and emerging transport infrastructures and modes of transport which allow them to avoid the errors made in the developed world and transition straight to a modern and sustainable mobility model.

Case study

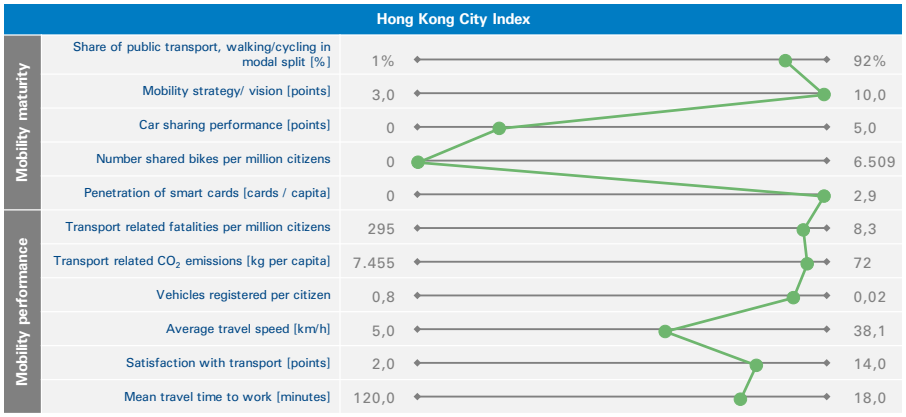
Zurich – To get a glimpse of what networked mobility could mean, let's consider the case of Zurich, which ranks number 12 in our Urban Mobility Index (score: 74.6). While public transport and walking and cycling in Zurich already accounts for a 65% share of the modal split – one of the highest values of Western Europe – it has set its sights on further increasing this share.

The idea is simple: rail and car sharing are for long distances, public transport and taxis are for in-city travel, and bicycle and walking are for short distances. The public transport provider and companies from diverse industries cooperate to develop new offerings, such as car sharing, mobility cards and shops.

For example, IG Velo is involved in the Bike-to-Work campaign. Swiss Federal Railways offer a rent-a-bike service. UGZ, the city's environment and health agency, is having a multi-mobility-day and supporting a "muscles instead of engines" campaign. While another city agency is offering a multi-mobile city map and a multimodal trip planner.

The success of these and other initiatives hinges on four factors. First, integrated traffic information enables travellers to choose flexibly between different means of transportation. Second, there are no barriers between different modes of transport. Third, a plethora of tools support multimodality: smartphone

Figure 15: Urban mobility performance Hong Kong



Source: Arthur D. Little's Urban Mobility Index

apps, dynamic pricing, advertisements, discounts, loyalty programs and shared spaces. Last but not least, multimodal mobility has full political support, evident in measures such as parking lot management, the creation of environmental areas, the raising of fuel prices and car taxes, and the implementation of automated fare collection systems.

Showcasing success

One of the few cities that has created a high performance and sustainable mobility system is Hong Kong. The highest-scoring city in Arthur D. Little's Urban Mobility Index, it has a well-balanced modal split, which is seamlessly integrated to ensure convenient journeys and reduce the incentive for citizens to travel by private car.

As figure 16 shows, the share of sustainable forms of mobility such as public transport and walking and cycling makes up no less than 84% of the modal split. Other standout statistics are the low level of vehicle registration per citizen and transport-related deaths and CO_2 emissions. Coupled with this are relatively high average travel speeds and consequently low travel-to-work times. Smart card penetration runs at 2.9 cards per citizen, which means that Hong Kong's multimodal mobility card enjoys the highest penetration of any product of its kind in the world. The Octopus contactless smartcard – which is carried by 95% of the population – can be used throughout the public transport system on everything from the subway and buses to trams and ferries, as well as high-speed and long-distance trains. It an also be used to pay for purchases at many of Hong Kong's public institutions such as school and hospitals as well as at selected retail outlets.

Thanks to this ease of use and the existence of such a comprehensive and highly integrated mobility system, 46% of travellers use public transport (see figure 15). The fact that a further 38% get about either on foot or by bike means that the rate of registered cars per citizen is very low and just 16% of journeys are taken by individual motorised transport. As a result, Hong Kong has an exemplary level of transport-related C02 emissions per capita, low mean travel times to work and a low rate of transport-related fatalities.

5.3 Business models for suppliers of mobility solutions

Having city leaders articulate a vision and strategy for their mobility system is one thing. Getting companies to contribute and commit to the development and subsequent realisation of the vision is quite another. Commercial enterprises will do so only if they can earn a fair return commensurate with the risks taken.

As we have noted before, solving the urban mobility challenge requires system-level innovations. These are notorious for "chicken or egg" situations: before a company invests in, say, charging stations for electrical vehicles, it needs reassurance that there will be a sufficient number of users buying electrical vehicles; but users will buy only when they are reassured there will be a sufficiently dense network of charging stations. So the question is: which business models can companies adopt when seeking to participate in urban mobility solutions profitably?

The Google, Apple and Dell of mobility

ADL has identified three long-term sustainable models for urban mobility suppliers that will help them adjust to the changing demand landscape. Named after a trio of iconic internet-age companies, they cater for very different contexts and scenarios (see figure 17).

Google of urban mobility

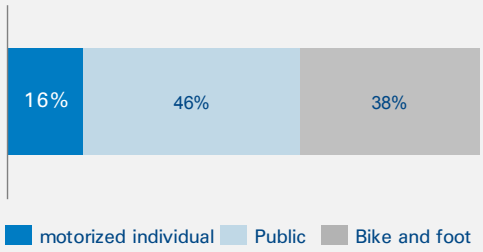
The key here is that there must be a single point of access for both mobility and supplementary services: identification, information, booking and payment. As well as policymakers and public transport operators, the introduction of such schemes requires the involvement of stakeholders such as banks and payment firms, telecommunications companies and technology suppliers as the focus is on the generation of data

Figure 16: Hong Kong urban mobility case study

Top 5 Challenges

1. **No geographic extension** potential
2. Drastic increase of **cross border traffic** (from 9,7 Mio. vehicles in 2003 to 29,2 Mio. vehicles in 2011P)
3. **Traffic accidents** (increase of 4% p.a.)
4. **Air pollution** (33% of PM_{10}- und 20% of NO_2-emissions from urban mobility)
5. **Jammed urban mobility infrastructure**

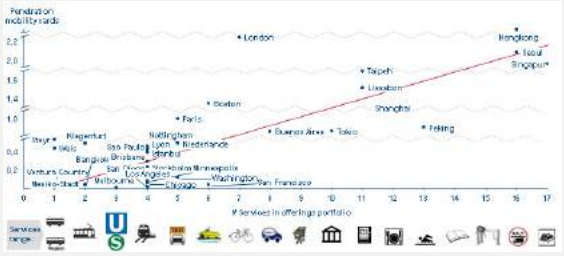
Modal Split



Top 5 Initiatives

1. **Octopus – multimodal mobility card** (penetration rate: 2,9 cards per inhabitant)
2. Extensive system of **free of charge escalators / people movers** in the city center
3. **Taxation of cars** (35-100% of car value)
4. High **taxation of gasoline**
5. Aggressive **extension of subway network**

Mobility Card Acceptance



Source: Census and Statistics Department Hong Kong, Arthur D. Little

volumes and penetration rates within the population.

Apple of urban mobility

This solution is centred on integration. The B2C version involves integrated mobility services for high-end consumers that provide a seamless multimodal journey experience. The B2B model calls for similarly integrated multimodal mobility solutions on a turnkey basis targeted at cities and mobility service providers.

Dell of urban mobility

The most basic of the three offerings, this model would concentrate on car and bike sharing, for example, rather than networking.

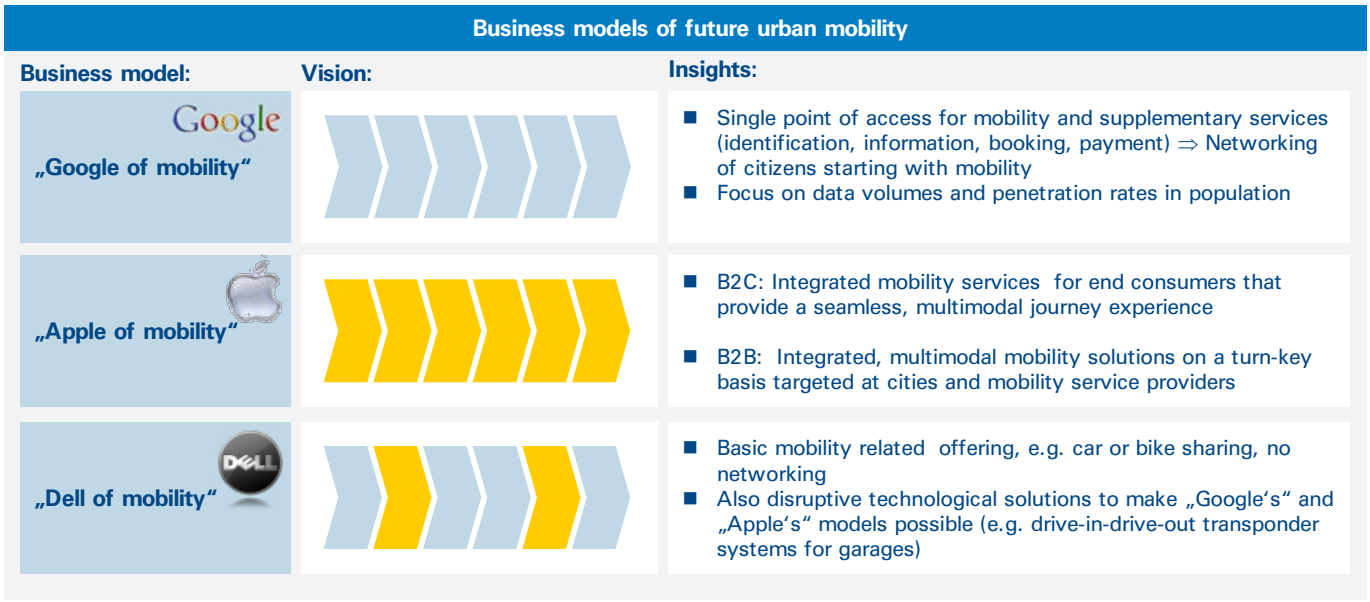
Through our research we have translated the three archetypes into four distinct business models. The differences between the three relate to customers targeted, products and services offered, assets and capabilities put to use, and revenue sources. The descriptions that we offer below are idealised archetypes, yet they could serve as a source of inspiration for more specific business concepts.

Model 1: The mobility services platform manager

A supplier adopting this business model offers any traveller a platform through which she can get travel information, plan a journey, make a booking and/or pay for the journey (see figure 18). The platform serves as a medium through which the supplier tries to reach as many users as possible in the traveller community that he is targeting. As he acts as an aggregator of underlying services offered by third parties (e.g. parking managers, bike sharing providers, point-of-interest search application developers), sourcing and contracting are critical capabilities. He gets his revenues through fees from partner transactions, fees from rent-a-place on the platform, advertising, interest income from the float on e-wallets, etc. We estimate that about one third of the 66 cities we studied lend themselves to this business model, that is mostly rich cities with already a large public share of the modal split.

Hong Kong Octopus Ltd is an example of a company that has adopted this business model. It supplies the Octopus smart card which can be used across public transport modes: bus, subway, high-speed train, tram, ferry and long-distance train. About 25% of transactions are not transport-related, as the card is also accepted at about 3,000 service providers. It can be used at close to 200 retail outlets (food, entertainment, leisure), for parking in all Hong Kong streets and at some 600 private parking lots, to get access to some 200 companies and other buildings, and at hospitals, schools, libraries and other public institutions. Ninety-five per cent of Hong Kong inhabitants own an Octopus card.

Figure 17: Business models for urban mobility suppliers



Source: Arthur D. Little Lab

Model 2: The mobility chain integrator

A supplier adopting this business model offers individual travellers a personalised seamless journey to get as fast as possible from A to B, whatever combination of transport modes it requires. Imagine a businessperson or celebrity flying into Moscow. The journey to his destination in heavily congested Moscow might take four and a half hours in total. With a premium personalised service, the journey time could be cut to 45 minutes. First he takes a branded flight in alliance with an airline; upon arrival a chauffeur takes him to a helicopter taxi; the taxi transfers him to the city centre; a limousine service takes care of the last mile to destination. The above description of course is a bit fanciful, but it brings the point home: there is a customer segment with strong purchasing power that is willing to pay a premium for speed, safety and convenience. This segment in principle exists across all 66 cities worldwide. Clearly it takes a strong brand and a dense service network (or at least trusted partners) to make and deliver on this promise.

This business model typically is the domain of premium car manufacturers such as Daimler. They are in a position, for instance, to provide small pickup cars (e.g. the Smart car), branded parking spaces where the pickup car can be left, and a branded first-class section in a suburban train.

Model 3: The city mobility solutions provider

A supplier adopting this business model targets cities instead of travellers. He offers cities tailored integrated multimodal mobility solutions on a turnkey basis. He acts as a system integrator and contractor for the various components of the solution. These could include parking infrastructure, charging infrastructure for electrical vehicles, automated fare collection, a bike sharing system, city buses, financial services, mobility planning, etc. This is an area where public-private partnerships and so-called BOOT (build-own-operate-transfer) schemes can play a very useful role. Clearly the market for this offering is global.

This business model fits quite naturally with infrastructure companies or with consortia of such companies. Siemens, for example, has established a special Infrastructure and Cities business unit to become a one-stop-shop for city mayors.

Model 4: The mobility products and service provider

A supplier adopting this business model targets cities and/or city mobility solutions providers. He offers technologies e.g. for rolling stock, infrastructure, traffic management and travel planning and information. He targets cities to which he sells standalone solutions or targets city mobility solutions providers as system integrators. This business

Figure 18: Business model outline

Business model	Target customers	Offerings	Core assets and capabilities	Revenue source
Google **Mobility services platform manager**	■ Traveller community at large	Single point of access for getting information, planning, booking and payment for a journey	■ IT enabled platform ■ Consumer interface ■ Supplier sourcing and contracting	■ Transaction fees ■ Interest income ■ Advertising & chip storage space leasing
Mobility chain integrator	■ Individual (high-end) traveller	Personalized seamless journey to get as fast and convenient from A to B	■ Brand ■ Dense service network ■ Partnerships	■ Fee for service
Mobility solution provider	■ Cities ■ Mobility chain integrators	Tailored, integrated multimodal mobility solutions on a turnkey basis	■ System integration and contracting ■ Public private partnerships	■ Case specific
Mobility products and service provider	■ Traveller community ■ Cities ■ Mobility solution providers	Stand alone, high performance, ease to integrate mobility products / services	■ Technology leadership ■ Open boundaries	■ Case specific

Source: Arthur D. Little Lab

model is the prevailing current model for all mobility provides worldwide.

Insights for the executive

Improving urban mobility is a challenge of epic proportions. As the urban populations grow and economic prosperity increases, cities are increasingly under pressure to deliver fast, safe and environment-friendly transport to citizens and businesses. Fortunately, there is a wealth of good-practice examples, technologies and business models on which the various stakeholders can draw to devise effective and sustainable mobility solutions. The stakeholders – users, city government, infrastructure and service providers, technology suppliers, financiers, regulators, etc. – should commit to four actions:

■ Establish a collaborative platform to align objectives and prioritise common initiatives for the city's mobility system;

■ Establish and execute a vision and strategies that clearly articulate what the future mobility system for the city should look like;

■ Discover and respond to user needs and usage patterns with the aim of offering seamless multimodal services;

■ Introduce market mechanisms that ensure fair competition between different transport modes, business models and types of infrastructure, and enable entry by new players.

Once these conditions are fulfilled, there is plenty of scope for commercial enterprises to commit to the development and realisation of mobility solutions, thereby earning a fair return commensurate with the risks taken. Which business model any specific company adopts – i.e. how it makes money – depends on the assets and capabilities it can put to use, the customer segments it targets (the traveller community at large, individual high-end travellers, cities themselves), and the unique products and services it offers (a consumer interface, a personalised service, a turnkey infrastructure solution).

Clearly urban mobility is a major societal challenge. But human ingenuity and innovation, if feeding off a well-articulated and politically backed vision, can bring solutions for the benefit of all.

Arthur D. Little

Founded in 1886, is a global leader in management consultancy; linking strategy, innovation and technology with deep industry knowledge. We offer our clients sustainable solutions to their most complex business problems. Arthur D. Little has a collaborative client engagement style, exceptional people and a firmwide commitment to quality and integrity. The firm has over 30 offices worldwide. With its partner Altran Technologies, Arthur D. Little has access to a network of over 17,000 professionals. Arthur D. Little is proud to serve many of the Fortune 100 companies globally, in addition to many other leading firms and public sector organizations. For further information please visit **www.adl.com**

www.adl.com/Urban_Mobility