Traffic Chaos in India`s Mega Cities despite the Success with Metro Rail
PART I: ACTIVITIES AND INITIATIVES FOR URBAN MOBILITY AS A SERVICE IN INDIA

India`s public Transport – a big Issue

“URBAN MOBILITY” in India

Opinion | India’s Urban Mobility and Congestion Problem; India
Chaos in “URBAN MOBILITY” in India

Updated: 01 Oct 2018, 01:06 AM ISTEjaz Ghani

Its unique Travel Patterns imply that Country Specific and City Level Policies are necessary to address slow Urban Mobility

Traffic congestion has increased dramatically in India. Congestion and the associated Slow Urban Mobility can have a huge adverse impact on both the quality of life and the economy. Are all cities in India congested or just some of them? Are Delhi and Mumbai less or more congested than, say, Patna and Varanasi? Are mobility and congestion different within cities across the centre and periphery, and at different times of the day? How congested are Indian cities compared to cities in the US? What does the future hold?

Our understanding of the underlying reasons for congestion is still evolving. A popular view is that urbanization leads to ever larger cities and increased rates of motorization. These two features eventually lead to a complete gridlock and congestion. However, economic growth also brings about better travel infrastructure, which facilitates uncongested mobility and increases the pace of Urban Mobility. Indian cities have experienced both these trends. These changes are taking place at a much faster pace in India than in the UK and the US. Transportation investments constitute the largest component of lending of many global development institutions. A deeper understanding of the interactions between urbanization, Urban Mobility and congestion will help improve investments in transport and city competitiveness.

Data on urban transportation in India is scarce. In the UK and the US, knowledge on Urban Mobility and congestion stems from surveys of household travel behaviour. However, such surveys are prohibitively expensive to carry out in India. We used other methods to examine Urban Mobility and congestion. We used a popular web mapping and transportation service to generate information for more than 22 million trips across 154
large Indian cities (Mobility and congestion in urban India by Aman Prottoy Akbar, Victor Couture, Gilles Duranton, Ejaz Ghani and Adam Storeygard, 2018, World Bank).

Hard data shows that mobility is slow in most Indian cities. It is slow even outside the peak hours of traffic, and in both large and small cities. India’s mean travel speed across cities is just 24.4 km per hour, much slower than the mean travel speed of 38.5 km per hour in metropolitan cities in the US. There are also big differences in mobility across cities in India. A factor of nearly two separates the fastest and slowest cities. These differences are driven by the differences in uncongested mobility, and not by differences in how congested they are.

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Time does make some difference to Urban Mobility and congestion. The slowest periods in the evening are more than 25% slower than the fastest in the middle of the night. Travel speed starts declining early in the morning and recovers late in the evening. Distance also makes a difference. Longer trips are faster. Trips further away from the city centre are also faster. Congestion really matters close to the city centre, especially in the big cities. Weather characteristics such as rain, humidity, heat, and more windy conditions are associated with higher travel speeds.

**The multi-Purpose Nature of Urban Transport also impacts Urban Mobility in India.**

Roads in cities are multi-purpose public goods, used by various classes of motorized and non-motorized vehicles to travel and park, as well as a wide variety of other users such as street-sellers, children playing and animals. Non-transportation uses of the roadway do slow down motorized vehicles.
The slowest cities in India include the seven largest cities (see Table 1). Which is the slowest city? Kolkata stands out as the most congested and the slowest city in India. Which are the fastest cities? This list is more heterogeneous (see Table 2). Many are small cities. The fastest is Ranipet in Tamil Nadu. Chandigarh is an exception in the list of fast cities, as it is bigger than the rest, with a population of more than one million. But unlike most Indian cities, Chandigarh is a planned city, characterized by a regular grid pattern laid out by the French architect Le Corbusier.

**Policy Challenge**

Slow Urban Mobility in India is primarily due to cities being slow all the time, rather than congested at peak hours. However, congestion is not a nationwide problem. It is concentrated near the centre of the largest Indian cities. Given their importance to the Indian economy, these areas with the highest levels of congestion, such as the city centres of Kolkata and Bengaluru, should be the focus of policy efforts to alleviate congestion.

Indian cities do not experience the familiar twin peak congestion pattern experienced in the UK and the US, due to morning and evening commutes. There is almost no distinct morning peak; instead, there is a slow buildup of congestion that often persists until late into the evening. These unique patterns are consistent with Indian roads being multi-purpose public goods that serve a wide variety of use other than motorized transport that slow down travel.

The unique Indian travel patterns imply that country-specific and city-level policies are necessary. Standard policy recommendations such as congestion pricing or other types of travel restrictions may do little to improve mobility. Instead, potentially costly travel infrastructure investments may be the only way to improve uncongested mobility. Better uncongested mobility generally correlates with the process of faster economic growth.

Despite increased congestion, urbanization is associated with higher Urban Mobility, contrary to the conventional wisdom that urban growth and development condemns developing cities to gridlock. More primary roads and regular grid patterns are associated with faster Urban Mobility. Investment in urban transport also plays an important role in influencing property prices. Land value taxes have huge potential to scale up Urban Mobility as well as maximize finance for development.

Ejaz Ghani is lead economist at the World Bank.

Topics
mint-india-wire India urban mobility traffic congestion

**Transforming Urban Mobility in India; India**

V Sumantran | Updated on September 07, 2018 Published on September 07, 2018
The first of a four-part series moots integration of urban planning with promotion of mass, rather than private, transport.
Across nations, and through decades, economic development has been correlated to personal mobility. This has proven true even in a modern world replete with a wide portfolio of options for tele-connecting. So, as India aspires to be the second largest economy in the world, behind China by 2050, we must prepare for a rapid increase in demand for mobility.

In this four-part series, we will define the challenges, explore tools and opportunities for transforming mobility, propose a flexible framework for a sustainable mobility architecture, and examine its application in the context of a city.

**Urban Sprawl Problems**

Even as one may hope for uniform spread of prosperity across urban and rural India, experience over the past century reveals that per-capita income in a nation spurs when more than half its population is urban. Pundits attribute this to agglomeration economics, whereby, boosted by access to a wider range of opportunities, “people in cities are more productive, more innovative, and have higher skills”. In other words, apart from increased personal mobility, we also need to anticipate faster urbanisation as our economic growth accelerates. As this densification accelerates, we need to urgently address the questions: How should cities order their urban form? What does that mean for the kind of mobility solutions they need to put in place? Urban form and mobility architectures have a symbiotic relationship. Take for example Los Angeles. The addiction of Angelenos to the automobile has promoted unbridled urban sprawl that now stretches from the Pacific Ocean to the San Bernardino mountains. Greater Los Angeles (18 million population spread over 87,000 sq km) ranks number one among US cities in terms of expanse. It is also number one in density and length of roads and highways, yet LA is burdened with the worst traffic congestion and air quality among large US cities.

Increasingly, in the 21st century, planners are awakening to the reality that while they should have been designing cities for people, they were actually designing cities for cars. On the other hand, cities like Tokyo (housing more than twice the population of LA within less than a sixth of LA’s area), Singapore and Hong Kong have more compact footprints and a very significant dependence on mass transit. There are other benefits as well. While sprawling Dallas allocates 40 per cent of urban land area for roads to sustain its car-dependence, Tokyo makes do with allocating a mere 15 per cent of its precious urban land. Sadly, Indian cities do little to limit sprawl — and the proposal in Bengaluru to sustain sprawl with six new interconnected elevated roadways at a cost of over ₹15,000 crore seems to ignore global lessons.

These factors also manifest themselves in economics. Copenhagen with a sensible mix of public transit and bike-lanes spends about 7 per cent of regional GDP on transport, whereas a car-dependent Houston allocates over 17 per cent. Indian cities can ill afford such economic waste. Over the last two decades, Chennai has perversely seen the modal share of public transit diminish even as car and two-wheeler populations have soared, reflecting neglect of planning and well-targeted transit investments.

Densely populated cities also have a markedly lower ecological footprint when they mainly rely on shared or mass transit. New York City has lower per capita carbon emissions, despite higher average income, compared to San Francisco, an advantage mainly attributable to its transportation patterns. Furthermore, air quality degradation from automotive emissions is a growing menace. WHO data says 14 of the top 20 most polluted cities (measured by particulates) are in India.

**Smokescreens Galore**
Scientific data to pinpoint sources of air pollution in India has been subject to much misinterpretation. A detailed emission inventory study is currently underway, led by IIT-Madras, that should shed more light on the matter. However, a recent study in London revealed that even with a large fraction of cars complying with advanced Euro-6 emission standards, vehicular sources accounted for 55 per cent of air pollution (PM2.5). Yet Delhi has struggled to implement a comprehensive Urban Mobility policy to address its unhealthy air.

As India’s continued dependence on expensive imported oil seems certain for the foreseeable future, our mobility architecture must also be guided by energy efficiency. Reducing dependence on fossil fuels through more efficient mobility will contribute to both environmental and economic gains.

The NCR, now home to over 46 million inhabitants, has raced past Tokyo and its sprawl, at 58,300 sq km, shows no signs of restraint. Unless we rethink urban planning and favour densification and transit-oriented development, we will likely retrace the disastrous trajectory of Los Angeles. Transforming Urban Mobility requires a clear articulation of goals, careful framing of policies, targeted investments, and rigorous implementation backed by enforcement.

Fortunately, our quest to transform Urban Mobility can be boosted by several new developments.

The Writer is Chairman, Celeris Technologies
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Transforming Urban Mobility in India —

II; India

V Sumantran | Updated on September 09, 2018 Published on September 09, 2018

Betting big on e-Vehicles
E-Vehicles alone can’t enhance Urban Mobility. Cities must augment Mass and shared Transit Capacity.

After almost four decades of dealing with regulations governing fuel efficiency and exhaust emissions, auto-makers seem to be running out of options to gain further improvements from conventional engines. A modern petrol or diesel car emits less than 5 per cent of the harmful emissions compared to its predecessor from four decades ago. Further investments and innovation are seen to yield diminishing returns. This has spawned a wave of investment in electric vehicles, connected cars, autonomy and shared mobility.

**Betting big on e-Vehicles**

Electric vehicles (EV) have emerged as an increasingly attractive option mainly through improvements in energy-density, power-density and cost of batteries. Batteries based on contemporary chemistry (usually Lithium Ion) are providing the kind of useful range in a passenger car that is acceptable to a growing fraction of users.

Environmentalists and city administrators, who are seeking solutions that limit deterioration in urban air quality, welcome the fact that EVs have zero exhaust emissions and lower carbon emissions than conventional cars. They have fewer moving parts, potentially lowering cost of manufacture and extending useful life.

Yet, electric cars are alone not the panacea for Urban Mobility. In many cities a good fraction of rush-hour traffic comprises single occupant cars. Visualise the typical automobile — it encapsulates an average driver weighing 65 kg in a machine that weighs 1,300 kg — likely more if it is electric. Electric cars may be more efficient than conventional cars but they cannot flout the laws of physics — moving so much mass burns a lot of energy that is typically generated with not insignificant carbon emissions.

Furthermore, this driver would need exclusive allocation of at least 10 sq.m of urban road space. A recent experiment in San Francisco, where the city made visible the cost/value of mundane city assets (like trees, pavements, roads, parking spaces, etc.) was eye-opening, pointing to hidden subsidies enjoyed by car users. It is, therefore, no surprise that cities like Singapore, Hong Kong, New York and Tokyo, that seek to sustain high population densities and high economic activity per square km, have come to depend on mass transit and shared mobility and discourage use of private cars.

The dawning of our digitised economy has provided a multiplier effect for many promising shared-mobility solutions. Even as the prospect of car ownership spreads to a larger fraction of city dwellers, especially in developing economies, a generation that is increasingly populated by digital migrants and digital natives, is growing comfortable with alternatives to car ownership.

They increasingly employ myriad mobility solutions and apps that promise to deflect the trajectory for motorisation. Time wasted in traffic congestion and the spectre of limited and increasingly expensive parking also lessen the attraction to car use. Uber and Ola have proven useful to many affluent urban commuters.

Unfortunately, the wave of urbanisation in many countries has led to gentrification of city centre areas. Lower income groups have been forced to peripheral suburbs lowering opportunities and increasing cost and time they must allocate to commuting. The tenets that govern new mobility architectures must promote inclusive access to mobility. Mexico, for example, has defined mobility as a basic human right and this helps steer policies that
are inclusive. Rides in Uber or Ola are not viable solutions for most commuters. Fortunately, our digitised economy has also had a democratising effect. Now imagine if each ride was to be shared among two or three commuters as with UberPool. This results in further lowering of cost, energy use and carbon emissions per commuter. Carrying this exercise a step further, many cities, including San Francisco and New York, have extended this concept to vans, aggregating 10-12 passengers at a time, further improving footprint and carbon efficiency.

With such demand-based, dynamically-routed services, cities are discovering that they can efficiently augment mass and shared transit capacity while leveraging private capital.

Rediscovering neglected Modes

Many cities are also re-discovering neglected travel modes that are augmented with modern technology.

Pedestrian zones and thoroughfares are reappearing in cities like Seoul, Barcelona and New York. Bike-lanes and bike-sharing solutions are a growing trend in Amsterdam and Paris. Affordable e-bikes expand the attraction of bikes to even elderly populations and allow longer distance travel. These modes come with low cost of use and are environment-friendly. Even that low-profile transportation mode, the humble bus, enjoys iconic status in London where it transports more people than any other mode. And with new all-electric double-deckers and dedicated bus-lanes, they will retain their prominent role in London’s future.

For medium density corridors, bus rapid transit has proven to be a lower investment alternative to underground metro-rail for cities like Curitiba and Seattle. And as Hong Kong has demonstrated, for the kind of high density transit corridors that many Indian cities have, modern metro-rails are unbeatable. We need to accelerate investment in all these modes.

With such a variety of attractive options, it can only be lack of imagination or understanding, if our planners repeatedly come back to solutions that offer more highways and flyovers in our cities. Enrique Penalosa, an urban evangelist and former Mayor of Bogota, has often stressed “what differentiates advanced cities is not highways and flyovers, but rather quality side-walks and cycle ways”.

Each city brings a unique set of constraints. We need a framework that is based upon basic social and economic tenets and relies on a combination of investment, policy and regulations to sensibly harness and steer the multiple modal options, technologies, and mobility solutions. This we will elaborate in the third part of this series.

The Writer is Chairman, Celeris Technologies
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Resetting India’s Urban Mobility Paradigm; India

Vineet Abhishek
DECEMBER 25, 2018 02:11 IST
Pedestrians and Cyclists should occupy the prime, non-negotiable, Position in every form of Urban Mobility Discourse and Intervention

A recent report by The World Bank on India's Urban Mobility congestion in 154 large Indian cities highlights the fact that most Indian cities are slow not due to high traffic congestion, but due to low uncongested mobility. The report highlights that the condition of mobility in general is bad in almost all the cities, there being hardly any gap between the highest speed and slowest speed during the entire day. Kolkata is the slowest city, followed by Bangalore, Hyderabad and Mumbai. Varanasi and Patna are, respectively, the fifth and sixth slowest city, followed by Delhi at the seventh place.

The report goes on to prove that, first, overall mobility is slow in all the cities at all times of the day, or else the speed should have been severely affected by traffic congestion during peak hours leading to speed differentials between peak and non-peak, and second, the condition of mobility in smaller tier-II and tier-III cities is as bad as the metro cities. This report overturns the long-held belief that Indian cities get congested during morning and evening peak hours, and that excess traffic is to be blamed for this congestion, the rationale which forms the bedrock of the oft-suggested solution to road congestion - congestion pricing, latest being The World Bank itself which wanted congestion pricing as one of the initiatives under the Mumbai Urban Transport Project (MUTP) in Mumbai. Moreover the report clearly shows that there is systemic fault in our traffic and city planning which inherently impairs the overall city mobility in India, and makes our cities slower at all times of the day, be there traffic or no traffic.

Eight of the twenty slowest cities belong to the state of Bihar and Jharkhand, and barring two, these cities are outside of the top 100 most populous cities in India. Take the case of Bhagalpur in Bihar - this city with a population of just four lakh (country’s 112th most populous city) is the eighth slowest city in India, just a shade faster than Delhi, but slower than Chennai or Pune. None of the eight cities have a well-developed public transport system and virtually no infrastructure for pedestrians and cyclists (NMTs) even though the NMTs dominate the modal share. This goes on to prove that the tier-II and tier-III cities are in a pathetic state as far as urban planning and transportation policy is concerned, and yet
during most debates and policy interventions it is the metro cities which occupy the prime place, with the smaller cities and towns being relegated to the periphery.

To get out of this mega urban mess that our cities have become, our mobility discourse has to be nuanced enough to, firstly, accept that each class of city and towns, and not just the large ones, need adequate importance, and, secondly, it is the smaller cities which are the low hanging fruit where innovative mobility solutions could be implemented far easily than the metros owing to lower population and easier to surmount real estate hurdles. And most importantly, NMTs should occupy the prime, non-negotiable, position in every form of Urban Mobility discourse and intervention.

Trip lengths in non-metro cities are shorter, within 6 km distance, and more than 50% trips are done by the Non-Motorized Transport mode. However owing to the lack of a developed public transport system or NMT infrastructure, city mobility is paralyzed and slow during all times of the day due to overdependence on personal motorized vehicles (two wheelers and four wheelers) as well as the use of roads for non-transportation purposes. As there is already a high usage of NMTs, more so among low income households for whom NMTs are the only affordable mode of transport, and that there exists a large pool of potential users who will only use this mode once dedicated infrastructure is in place, it all comes down to the right kind of visible, policy-level nudge from city planners and political heads.

A very good beginning is being made through the Smart Cities Programme, and all the selected 100 cities have put NMT promotion as one of the goals in their respective Smart City Proposals (SCP) submitted to the Ministry of Urban Development. However just giving a target of a certain percentage of total city roads to be developed as NMT friendly roads, as is mentioned in the SCPs, is not enough. These proposals should have clearly spelt out the specifics (width, protected/non-protected, parking facilities, bike stands, route plan etc.), and should have given measurable commitments on developing an integrated cycling network which could take commuters from one place to another with comparable ease. Commitment for NMT promotion has also been made in the past, like in the case of JnNURM, however nothing substantial is visible in any of the cities, big or small.

Promotion of NMTs in metros, with longer average trip lengths, will require a different approach than that of smaller cities. Mumbai, with its highly developed public transportation and yet being one of the slowest and congested cities, presents a great opportunity to become a future model template for various potential NMT initiatives. Average daily trip length is 12 km. As per The World Bank report Mumbai is the fourth slowest and second most congested city in India, even though more than 50% commuters use public transport. As a substantial proportion of commuters use public transport, and yet the city is one of the slowest and most congested, it is quite valid to assume that there is great scope for NMTs to solve access to transit (where half of the city’s populace converge adding to the traffic woes around transit stations), which is currently being accessed by private motorized vehicles or unregulated para-transits.

As per MCGM’s Mumbai Development Plan: Preparatory Studies Report, 40% of commuters access suburban railways other than on foot. As the bike parking facilities around suburban railway stations, and the rest of the city, are hardly developed, it can be assumed that almost all – nearly 3.2 million commuters - access these stations using mechanized modes of transport. NMT initiatives, particularly the bike-train combination, can be a good strategy to solve traffic congestion induced during access to transit, at the same time leading to host of other co-benefits.
Kager and Hermes in their seminal paper on bike-transit integration have clearly highlighted the significance of better integration of cycling and transit, and term this integration as a separate, unique mode in itself; for the combination of the two modes entail benefits which are more than the benefits assigned to each of these modes individually. The Netherlands has been a pioneer in promoting the bike-train integration and half of the train commuters access the train stations using bicycles, and one of the most successful initiatives being the OV-Fiets bicycle rental scheme (a multi partnership project involving NS, Pro Rail and The Netherlands government) which ensures that a bike is available to train passengers at their destination.

The bike-transit integration initiatives should be mandatorily made part of all DPRs for metros rails, suburban rails, BRTs and other such transport projects, and it should be ensured that they don’t remain on the periphery as a compliance item only (provisioning total 18 bicycle sharing stands with 560 daily trips by Delhi Metro, when the daily commuters are more than 27.6 lakhs, does not do justice to the need for sustainable transportation). A healthy focus on bike-transit integration can go a long way in solving the transport woes of cities, particularly road access in and around the transit stations which remain perpetually chocked during most times of the day. Bicycle rentals and other such activities should no longer be seen as something which is outside the scope of the transit operators. Rather, as railways operators have done in The Netherlands through the OV-Fiets scheme, bicycles can also be used as a strategy to enhance the effectiveness of transits themselves.

For a city like Mumbai, bicycles linkages with transit can help in increasing the service areas of individual railway stations and hence can lead to fewer mandatory stops of trains; thus helping in increasing the number of train services. This was evident recently when the new time table released by the Western Railways for Mumbai suburban curtailed stoppages of some fast corridor trains at Jogeshwari station which falls on the slow corridor. There was enough public outcry for the authorities to revert the decision. Had there been a good bike-transit integration, commuters would have had access from slow service station like Jogeshwari to rapid service station like Andheri (which is on the fast corridor, and hardly 3 km from Jogeshwari).

All Urban Mobility stakeholders in India have to wake up to the fact that it is the nuanced understanding and strategic policy level commitment to make the mobility multi-modal, efficient - and equitable focus on existing modal share -which will take the Indian cities out of the Urban Mobility mess that we are into presently. Also, this is the right time to make NMTs a part of the election manifestoes here. When NMTs can play an important part in the political manifesto of leaders in Denmark, Paris, Copenhagen and London, there is all the more reason for political parties in India to do so.

What is the Future of Urban Mobility in India? ; India
Urban Mobility can be considered the most important aspect of urban living. A survey by McKinsey & Company last year said by 2030, 60 percent of the world’s population will live in cities.

Over the same period, more than two billion people are likely to enter the middle class, with the majority of them living in cities in emerging markets. The number of megacities with more than ten million people will continue to grow said the report.

India being the third-fastest growing economy in the world cannot ignore the many challenges that mobility in cities are set to face.

Bold, coordinated actions from the private and public sectors in both technologies and business models are the need of the hour. This situation also has the potential to create massive growth opportunity for sectors ranging from logistics to urban mobility consultancy.

Sumit Sharma, the co-founder of GoBOLT, a logistics technology startup, says to better understand the Future of Urban Mobility, we need to better understand the urban freight problem before proposing solutions.

Questions like - who is responsible for urban freight? who are the stakeholders? what goods are being transported? when? from where? what infrastructure is available for freight transport? what are the current and future needs of urban freight transport? what are the impacts of freight transport? what are the direct costs and benefits? - Need to be addressed and are important to understand such that Indian cities function efficiently in 2040-50s.
Aditya Loomba the Director of Luxury Car Rentals Company Eco Rent A Car says passengers will soon want to optimize their time where they can be productive on their wireless devices, while on the move.

“Car Rental Operators will offer greater value by optimizing their assets (vehicles & drivers) by using technology to ensure the cars and drivers are not standing idle,” says Loomba.

With measures such as the introduction of e-tolls and increased acceptance of fuel cards along with demonetisation, the cash dependence is expected to significantly go down, according to Raghav Himatsingka, CEO and co-founder of Truckola, a technology-focused cargo transport company.

Mobility is also expected to become faster by as much as 20% with the introduction of the GST which will decongest the state borders. It is also expected to become easier with the ongoing Dedicated Freight Corridor railway project and the government's intention to promote riverine mobility throughout the country says Himatsingka.

Sharma believes small changes have already started taking place in terms of policy and infrastructure in India. Changes such as prohibition of commercial vehicle entry in cities like Delhi and Mumbai during the day, relocating wholesale markets to new locations and create truck terminals on the periphery of city to address mark key changes.

He believes the creation of SEZs in accordance with optimal interaction with the city traffic and freight movements, developing roads and by-pass roads to minimize freight interaction with the city traffic are some measures being taken across various cities along with the passage of GST will lead to emergence of better urban mobility solutions across all growing cities of India.

Is it the right Time to enter Logistic Services in India?

Sharma says the complex challenge along with rapid urbanization, globalization, influx of technology in our daily lives along with a plethora of ground-breaking changes to the economy ushered in by the government augurs well for the industry and offers ample opportunity for new entrants in to the industry.

Though Himatsingka is optimistic on the outlook of urban mobility, he says this could be bad time for new entrants to make a mark in the industry.

The future outlook of the country looks bright and it that senses it may be the right time to enter the space. However, logistics is amongst the most competitive businesses in the country and unless there is a significant new innovation, it may be hard for an inexperienced newcomer to survive in the industry, says Himatsingka.

Loomba feels this is a great time for last mile delivery services as e-commerce is booming due to smartphone and internet penetration as well as e-payment options.

How India and Germany are cooperating on sustainable Urban Mobility Challenges; India-Germany
Anke Karmann-Woessner, Head of the Urban Planning Department in Karlsruhe, discusses the city-to-city collaboration between Nagpur (Maharashtra) and Karlsruhe (Baden-Württemberg), and the benefits which are achievable as a result.

Maharashtra is the second-largest and fastest-growing state in India. Thanks to its key engineering, automotive, information technology, banking, finance and biotechnology industries, its thriving university landscape and a strong orientation towards the development of smart cities, Maharashtra is an extremely interesting partner for the State of Baden-Württemberg. Baden-Württemberg is one of the leading economic regions in Germany and Europe, with world-famous companies and thousands of successful, small- and medium-sized enterprises, innovative strength and inventive spirit, high productivity and low rates of unemployment.

**IUC European City Pairing Programme**

Based on the cooperation between Nagpur and Karlsruhe, entering into closer collaboration within the International Urban Cooperation (IUC) European City Pairing...
programme was the next natural step. Through the IUC programme, cities and regions across Europe have teamed up with global partners to focus on sustainable development. The expert exchange programme initiative sponsored by the European Commission and the Government of India hosted a delegation from the City of Karlsruhe and the EU Commission’s IUC India. The Karlsruhe delegation brought in experts in relevant fields identified prior to the visit which made it possible for discussions to go into great detail.

**Indian Government’s ‘100 Smart Cities’**

In the future, Nagpur intends to position itself strategically and closely with its international partners, including Germany, implementing ambitious goals within the Indian government’s ‘100 Smart Cities’ development through the exchange of know-how. The Nagpur Municipal Corporation (NMC) hosted colleagues from Karlsruhe for a three-day workshop where discussions focused on smart mobility and transport. In particular, Karlsruhe proposed reaching out to the citizens of Nagpur to raise awareness for cycling infrastructure and prevent additional pollution in the city centre, including a discussion of existing business models. Both cities agreed to work on sustainable urban mobility with a specific focus on non-motorised transport. The experts gave their initial impressions of Nagpur city and the potential for non-motorised transport in urban areas. During the concluding session, the two cities prepared a detailed activity chart to implement the project in a timely manner.

For Dr. Ramnath Sonawane, CEO of the smart city initiative in Nagpur, the expansion of active mobility modes is an essential future component of integrated and sustainable transport planning. The smart city initiative is especially supportive of linking multimodal mobility. The Nagpur Comprehensive Mobility Plan addresses mobility needs by focusing on public and non-motorised transport, rather than catering to the needs of private motorists as an effective means to integrate land use and transport planning. It is a perspective plan for sustainable urban transport over a 20-year horizon period. Public transport in Nagpur is financially sustainable but needs significant improvement. Construction of the metro should significantly improve this situation, access to local public transport is a key requirement.

**Advantages of working with Karlsruhe**

The City of Karlsruhe can contribute experience gained from the Urban Agendas Urban Mobility thematic partnership. Active mobility, that is cycling and walking, is a core component of the action plan drawn up over the last two years, as well as improved access to public transport and smart solutions to deliver multimodal transport concepts.
For many years, the expansion of bicycle traffic has been a focal point of traffic planning in Karlsruhe. As a result, cycling accounts for 26 per cent of the modal split. Working with Karlsruhe University of Applied Sciences, and supported by the state programme of Baden-Württemberg, the real laboratory and the Go-Karlsruhe research project, the current focus is on pedestrian traffic. The approach also focuses on behaviour change, dealing with the very different climate zones, and on strategies of communication and participation. These aspects are key elements in the very diverse cultural spaces.

**Bicycle Rental in India**

The debate around setting up a bicycle-lending scheme focused on the relative merits of flexible and station-based systems. Flexible systems offer advantages because of their quicker and cheaper design, but they are also less visible and require more bicycles for the same perceived customer availability. The key advantage of systems based on docking stations is their better visibility. This is particularly important for user access to metro stops, when start and destination points are known. However, the necessary infrastructure has to be planned in time and budgeted for. For this reason, it makes particular sense to link the payment system to bicycle rental stations to local public transport stops (spatial integration), and partner on tariffs and marketing.

Initially, stations could be located along stops and at points of interest (universities, large office buildings). The primary target group for bicycle rental systems in India are students. This group’s interest can help complement resident engagement. In particular, it is important to invest in mobility behaviour surveys and conduct feasibility studies throughout the entire process. Mobility behaviour in India is closely linked to status thinking. Many Indians would rather buy an expensive motorcycle than a cheap car and the bicycle is still considered a ‘poor man’s vehicle’. This is why it is crucial to involve residents to foster greater identification with the system, through the design of the bikes and final docking stations, and by clarifying trademark rights.

**Data Use and Ownership**

Another crucial point is how data use and ownership is regulated. In Europe, the European Data Protection Regulation applies, as do the General Terms and Conditions for customers. In India, national regulations apply. Data is stored by the on-site operator on Indian servers. Again, General Terms and Conditions regulate the customer relationship with regard to data.

**What is the IUC?**

Funded by the European Union, the International Urban Cooperation (IUC) programme supports the achievement of bilateral policy objectives on urban development and climate change, and Sustainable Development Goals of the New Urban Agenda (Habitat III) such as the Paris Agreement. The programme supports the Global Covenant of Mayors for Climate & Energy by bringing together local governments voluntarily committed to implementing ambitious climate and energy objectives. Many cities may wish to carry out sustainable projects, but lack specific knowledge or capacity. The listed solution providers have experience in helping cities and regions achieve their sustainability goals.

The IUC programme will engage with major international financial institutions and partners to link city decision-makers with potential funders. Target countries include China, India, Japan, Canada, Mexico, USA, Argentina, Brazil, Chile, Colombia and Peru. For component 2, South Korea, Vietnam, Indonesia, Malaysia, Singapore and all Latin
American and Caribbean countries (LAC) are included in the programme. IUC India will continue supporting the two cities and oversee the joint development and implementation of the local action plan.

**Biography**

Anke Karmann-Woessner studied Architecture and Urban Planning at the Technical University of Darmstadt. After gaining a post-grad state examination for senior service in Public Administration, she worked in the Bavarian state public administration and then abroad in France. She has a PhD in European Environmental Law from the Technical University of Kaiserslautern and almost 30 years of experience in all fields of urban development and mobility, as well as in EU, federal and state funded projects, project and competition management, citizen participation, moderation processes, numerous judging and lecturing activities. Since 2013, she has been Head of the Urban Planning Department in Karlsruhe.

**12th Urban Mobility India Conference & Expo 2019, 15th-17th November 2019, Lucknow; India**

**Overview**

The annual Urban Mobility India (UMI) Conference and Expo is a flagship event held under the aegis of the Ministry of Housing and Urban Affairs, Government of India. The event is inaugurated by Hon’ble Union Minister of Housing and Urban Affairs. The genesis of UMI is from the National Urban Transport Policy of the Government of India, 2006 (NUTP), which lays a very strong emphasis on building capabilities at the State and city level to address the problems associated with urban transport and undertake the task of developing sustainable urban transport systems. The event essentially has four components as below:

**Conference**

The primary objective of the conference is to disseminate information to the cities, whose officials attend the conference, and to help them keep up-to-date with best urban transport practices. The conference provides an opportunity for key decision makers and delegates to interact with other professionals, experts, academia, industry, civil society, technology, services providers and other stake holders in Urban Transport both domestic and international so that the delegates can carry home ideas to develop their urban transport along a sustainable path. It is also a forum to discuss key issues relevant to the sector and suggest measures to address them.

**Exhibition**

The expo is a special feature of UMI to disseminate and showcase the latest developments in urban transport technology and systems, implementation of best transport projects, propagation of innovative ideas, good urban transport initiatives and practices in the field. The best two exhibitors are selected by a jury for award.
Research Symposium

The symposium provides a platform to highlight the current research carried out by academia and research institutes in urban transport, especially by young researchers pursuing post graduation or Ph.D. programs. The best three research projects are selected by a jury for award.

Awards for Excellence in Urban Transport

Awards are also presented by the Ministry of Housing and Urban Affairs to best urban transport projects / initiatives selected by an Award Selection Committee in the following six categories:

- Best Non-motorized project
- Best city bus service project
- Best urban Mass transit project
- Best intelligent transport system
- Best initiative on improved road safety
- Best city in urban transport initiative

Preparing for the Future of Urban Mobility in India – Meeting Urban Mobility Challenges; India

- MADHULIKA SRIKUMAR

Observer Research Foundation, with support from UBER, convened a roundtable on The Future of Urban Mobility in India in May this year in Mumbai. Participants also gathered in smaller groups to outline key concerns currently limiting urban mobility — such as supporting infrastructure, principles for regulating the ride-sharing industry, and dynamic pricing. Officials from the Maharashtra state government joined the discussions with members of civil society working at the intersection of innovation and urban mobility, business, and academia. This report is an outcome of the discussions and recommendations proposed by the participants at the roundtable. As India’s urban hubs continue to become more congested and polluted — and with increasing road fatalities and inequity in access — India will need to find a solution to fix its urban mobility crisis. Expanding public transportation services will be key to transforming mobility in India’s urban centres, along with efficient use of existing roads and smarter traffic management through technology-based interventions.
Introduction

While the majority of Indian citizens still live in rural areas, last estimated at 70 percent of the total population — cities in India are also growing, with the number of inhabitants currently in the hundreds of millions. By 2030, India will see the rise of some 68 urban sprawls, each with a population of more than one million; the entire continent of Europe only has 35. It is indisputable that cities are the engines of economic growth. To realise the full potential of its economy and demography, India must not only look to increase its rate of urbanisation but also enhance the quality of life in existing cities. Today, Indian cities are characterised by increasing levels of congestion, pollution, road fatalities, and inequity in access. To build inclusive, safer, and more sustainable cities of tomorrow, technology will play a decisive role in identifying mobility gaps and transforming existing transportation services.

The discussion around Urban Mobility in India stands transformed today for two reasons. First, technology has enabled real-time analysis of public transportation routes and traffic patterns that was previously not possible. Second, public sector agencies have now begun to encourage the use of public transportation through new mobility business models such as on-demand and multimodal trip-planning applications. This is the reflection of a global trend where governments and businesses are exploring mobility solutions through Multimodal Transportation — where users will have the option of seamlessly integrating services like public transportation and ride-sharing, instead of having to choose one over the other. Integrated Payment Systems such as London’s Oyster and Singapore’s EZ-Link allow users to opt for different modes of public transportation through a single smartcard. These solutions, however, cannot be realised through the efforts of any one entity alone. Integration will require collaborative efforts by a diverse set of stakeholders: among them, central and state governments, transit agencies, infrastructure developers, transportation service providers, and data scientists.
As companies explore different ways to provide mobility in Indian cities, through ride-sharing, bus aggregation and car rentals — stakeholders must agree on the guiding principles for regulating the on-demand and ride-sharing industry. Recognising these realities, Observer Research Foundation (ORF), with support from UBER, convened a roundtable on The Future of Urban Mobility in India in early May in Mumbai. The participants included Maharashtra government personnel, and members of civil society working at the intersection of innovation and urban mobility, business, and academia. In addition to a roundtable discussion, a workshop was organised where breakout groups outlined key concerns currently limiting urban mobility—from infrastructure deficits to the absence of clear regulatory principles for on-demand and ride-sharing applications. Following the structure of the workshop, the recommendations are divided into three sections: evaluating infrastructure and promoting innovation in mobility, regulation of the ride-sharing industry, and adoption of dynamic pricing.

1. Evaluating Transportation Infrastructure and promoting Innovation in Urban Mobility

The roundtable participants agreed that deficiencies in supporting infrastructure would need to be addressed before adopting new technologies in Urban Mobility such as driverless or electric cars. The transportation infrastructure in India—consisting of roads, suburban railways, metro lines and fuel stations—is inadequate in supporting current needs or any future rise in population. Poor transportation infrastructure development may be attributed to lack of political will, skills, and coordination amongst public agencies both at the state and city level. For example, there is insufficient route allocation for public transportation, leading to over-crowding in some routes and deficit in others. Experts have earlier noted other reasons for delay in development of infrastructure, including failure in devising and applying common design standards during construction and high costs and time-consuming processes involved in land acquisition.

Further, the absence of reliable travel data, until now, has made it difficult for public officials to assess the impact of infrastructure projects on urban mobility and to identify future needs. This is no longer the case with developments in geo-mapping technologies and open standards, with GTFS (General Transit Feed Specification) being the most commonly used. Transit agencies need to make GTFS feeds on routes and schedules and GIS locations on transport infrastructure publicly available. Some transit agencies have also released data sets on budgetary, performance and ridership data. Government officials and businesses can make pointed investments in supporting infrastructure by analysing historical data on roadways and transportation. This data can be useful for policymakers, transit agencies, and urban planners to enable infrastructure to facilitate better mobility through efficient use of existing roads and smarter traffic management. Moreover, open transport data in other countries has led to the development of third-party mobile applications sharing real-time transit information, which enables users to plan their trips better, leading in turn to increased ridership and improved customer experience. Indeed, studies have shown that open data in transportation presents huge economic opportunities—valued at between US$720 and US$920 billion globally—as it results in innovation in multi-modal planning apps and new mobility businesses.
Specific Recommendations

- The public and private sectors must collaborate to devise and develop India-centric solutions to fix the country’s cities. Government agencies should invest resources to make transportation data open to the public to encourage innovation through development of new business models to mitigate the mobility crisis in the country.

- The private sector can share data on number of vehicles, traffic patterns, accidents, and user behaviour to allow policymakers to introduce evidence-based regulations on pricing and safety. Companies must share data in an anonymous, aggregate manner and effectively address any privacy concerns of users when sharing data. The regulators, meanwhile, will need to ensure that proprietary rights of the companies are protected and consider the role of intermediaries to handle the data. In addition to this, regulators must have the systems in place to leverage the most from available data.

- Private car ride-sharing and car-pooling services will form only a part of the solution. Policymakers must look at revamping public transportation and infrastructure to transform urban mobility.

- Regulations must be introduced to encourage efficient use of existing roads and smarter traffic management. For example, not allowing trucks and large commercial carriers to ply city roads during the day.

- Policymakers must collaborate with data scientists to explore mechanisms to implement congestion pricing and dynamic pricing for parking spaces.
• The ride-sharing industry in the country must look at reducing, even eliminating, driver dependency on middlemen or intermediaries to procure cars. The ride-sharing industry must explore different credit-rating processes for their driver-partners.

• Transit agencies must ensure that buses are equipped with GPS tracking in order to provide real-time schedules and routes.

• Governments must ensure that the adequate ecosystem is in place before adopting new technologies in mobility. For instance, to adopt electric vehicles, cities must have first installed sufficient number of charging stations.

• Authorities must consider revising the regulatory framework in place to use vehicles for commercial use.

**Principles for Governing the Ride-Sharing Industry in India**

Participants in ORF’s roundtable agreed that regulations governing the ride-sharing industry must promote user safety and competition in the market. However, regulation should not dictate business models and must be non-prescriptive or ‘light touch’. After all, the transport department is usually an incumbent in the market and must not play the role of a regulator.

To guide regulation, principles based on fairness, equity and safety must first be established with the purpose of incentivising new and smaller players in the market. Regulation — or the lack of it — plays an important role in promoting innovation. This, when companies are trying to push the government to legalise new mobility models such as using private cars for ride-sharing — with some state governments contemplating banning ride-sharing altogether. However, regulators have the additional burden of protecting user safety and would be cautious before adopting new business models. As drivers of traditional taxi services and ride-sharing companies demand government intervention to safeguard their interests, to prevent falling incomes and changing incentive structures — companies must be transparent in their policies and directly address issues involving their drivers. Companies must share with regulators their data on pricing mechanisms and user behavior, such as user demand and willingness to pay, to help promote evidence-based policymaking.

In Maharashtra, the enforcement of the City Taxi Rules, 2017 might have an adverse effect on competition as it imposes a significant license fee on driver-partners seeking to operate through ride-sharing applications. Ride-sharing companies should be allowed to regulate themselves and the point of entry for public regulation must only lie in safeguarding consumer safety and competition in the market. The licensing authority must not prescribe either a price floor or cap on surge pricing, and regulators must instead consult with the Competition Commission of India (CCI) before regulating pricing.

**Specific Recommendations**

• The government, along with other stakeholders, must first agree on general principles to govern the ride-sharing industry before adopting any regulation.
• Ride-sharing platforms must be allowed to self-regulate. Authorities must avoid excessive regulation — for instance, the Maharashtra City Taxi Rules requires app-based taxis to adhere to a minimum limit for engine capacity and requires operators to have 30 percent of the vehicles on their platform over 1400 cc.

• Regulators must consult CCI to ensure that policies on licensing, vehicle standards and pricing are not anti-competitive — they must not act as a barrier to entry for drivers looking to join taxi aggregators.

• Accidents and criminal behaviour involving their drivers during the course of the journey must be mitigated through minimum insurance.

Fig. 2: Four Stages of Mobility, Source: Morgan Stanley Research, Adam Jonas, 2015

III. Adopting dynamic Pricing to meet Urban Mobility Challenges

Ride-sharing companies price their fares dynamically based on variables including estimated time and distance of the predicted route, estimated traffic, and the number of riders and drivers using the service at a given moment. [xvii] During high demand for rides, prices peaks to reflect the ‘surge’ in demand to ensure that pickups are available for riders who are willing to pay the increased fare. UBER has attracted criticism for inflating prices after terrorist attacks, [xviii] during natural disasters [xix] and even while Delhi implemented its odd-even scheme in early 2016. [xx] In the aftermath of the London Bridge attack in June this year, UBER suspended their surge pricing after some delay [xxi] and refunded those users who were charged an increased
fare [xxii] — a practice the company has followed earlier during terror incidents. [xxiii] State governments including Delhi, [xxiv] Karnataka [xxv] and most recently, Maharashtra, [xxvi] have clamped down on taxi aggregators charging surge pricing by introducing caps on fares. Governments introduce caps on surge pricing to safeguard consumer interests and prevent predatory pricing.

Surge or dynamic pricing helps in increasing vehicle utilisation and reliability, and dynamic pricing based on demand and supply of drivers on a real-time basis ensures access to mobility. However, during emergencies such as natural disasters and terrorist attacks, surge pricing must be suspended. [xxvii] The dynamic pricing model must also be imported to parking spaces to deter driving and to encourage public transportation. Dynamic pricing in the ride-sharing industry has been successful in influencing user behaviour in India. In the future, policymakers must consider dynamic pricing mechanisms based on variables such as road congestion, fuel efficiency, and carbon emissions. [xxviii]

**Specific Recommendations**

- Ride-sharing applications must suspend surge pricing during natural calamities, civil unrest, terrorist attacks and in other special circumstances prescribed by the state government.

- The CCI should intervene in pricing of ride-sharing applications only when the anti-competitive effects of the same can be proven.

- The State Government may prescribe fares temporarily to arrest instances of anti-competitive practices after due consultation with the CCI.

- Use dynamic pricing to charge for parking — on streets and in parking lots — to discourage people from using personal transportation.

India’s urban mobility challenge will only become more acute in the coming decade as cities become more crowded, polluted and unsafe. Any mobility crisis is a unique one, seeing as it involves a multitude of actors from transit agencies to ICT entrepreneurs. To meet the challenge effectively, a dialogue between stakeholders is essential to evaluate assets and to devise innovative mobility solutions. To encourage new businesses that leverage technology to provide mobility, policymakers must first agree on principles for regulation based on fairness, safety and equity. New mobility is a lucrative industry — one that can serve local communities and provide opportunities to many. As the Maharashtra government looks to make sustainable urban transport a priority, Mumbai can become a model for policymakers and entrepreneurs in India to use ICT to provide customised, safe and sustainable transportation to all. [xxix]

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**Endnotes**


See for example the MBTA (Massachusetts Bay Transportation Authority) dashboard where data on reliability, ridership, financials and customer satisfaction have been made public.


UBER’s fares are priced according to above the mentioned variables - https://help.uber.com/h/34212e8b-d69a-4d8a-a923-095d3075b487


Haryana Government to run electric Buses in Gurgaon; India

1 min read . Updated: 05 Jul 2017, 10:35 AM IST PTI

Haryana Government will operate 75 to 100 electric buses, manufactured by JBM Solaris plant in Poland, in Gurgaon in the first phase

As compared to ordinary buses, each electric bus would help save about 4.25 lakh litres of diesel and reduce carbon emissions by 1,150 tonnes in 10 years of operation.
Chandigarh: The Haryana government will set up an environment-friendly transportation system in Gurgaon on the pattern of Poland, state minister Kavita Jain said on Tuesday.

The urban local bodies minister, who is leading a delegation on a visit to the plant of JBM Solaris Electric Vehicles Ltd in Poland’s Ponzan, said “In the first phase, 75 to 100 electric buses would be operated”.

As compared to ordinary buses, each electric bus would help save about 4.25 lakh litres diesel and reduce carbon emissions by 1,150 tonnes in 10 years of operation, she was quoted as saying in a Haryana government release.

This would help in improving the environment, she said, adding that the central and state governments were committed towards operating electric vehicles in the country.

In the first phase, electric vehicles would be operated in Gurgaon, which has excellent infrastructure and facilities in residential, commercial and public sectors, and is located in the national capital region, she said.

This would not only reduce traffic congestion, but also provide better public transport system to an average of 50,000 people every day. Gurgaon metropolitan development authority, Municipal Corporation, Gurgaon and Haryana State Industrial and Infrastructure Development Corporation (HSIIDC) would bear 50%, 40% and 10% of the cost of the project, respectively, she said.
JBM Group has already established plant for manufacturing of CNG buses in Ballabhgarh near Faridabad, which would soon begin manufacturing electric buses under the Make in India programme, she added.

**PART II: ACTIVITIES FOR URBAN MOBILITY AS A SERVICE; INTERNATIONAL**

**Breeze Hydrogen multiple-Unit Order expected soon; UK**

15 May 2019

**UK: Alstom** is hopeful of confirming an order before the end of this year for its Breeze hydrogen multiple-unit trains being developed in partnership with leasing company Eversholt Rail, suggesting that the first trains could enter service ‘as early as 2022’.

Unveiling a scale model of the three-car HMU at the Railtex trade fair on May 14, Head of Business Development & Marketing for Alstom UK & Ireland Mike Muldoon said ‘the momentum continues to build around hydrogen trains in the UK. We believe they have a key role to play in helping the railway meet government targets to remove diesel trains by 2040.’

Whilst accepting that electrification is preferable for high speed main lines and busy suburban routes, Muldoon suggested that the re-engineered fuel cell trainsets could play a valuable role on regional routes during a 15 to 20-year transition period. ‘Brand new designs for hydrogen trains will come when the market is there’, he predicted.

Alstom and Eversholt are looking to convert some of the BR-built Class 321 EMUs that date from the early 1990s. These four-car sets are ‘some of the UK’s most reliable rolling stock’, but are due to be displaced by new vehicles over the next 18 months. Conversion would be undertaken at the Alstom facility in Widnes, ‘creating high quality engineering jobs in this new, emerging sector’.

According to Alstom, the two pre-series iLint multiple-units in Niedersachsen have now passed 100 000 km of operation in passenger service since being launched in September 2018, and production of the first series fleet is in progress with more orders to follow. The Breeze would harness much of the same technology, but modified to fit the more constricted UK loading gauge.
The converted HMUs would have three roof-mounted banks of fuel cells on each of the two driving vehicles, producing around 50% more power than the iLint. Two passenger seating bays and one door vestibule behind each cab would be replaced by storage tanks. The fuel cells would feed underfloor battery packs which would also store regenerated braking energy. The current DC traction package on the centre car would be replaced by new AC drives and a sophisticated energy management system. Despite the loss of some seating space, each set of three 20 m vehicles would provide slightly more capacity than a two-car DMU with 23 m cars which it would typically replace.

Noting that other companies were also developing prototype hydrogen trains for the UK market, Alstom said it had submitted business cases for 'sensible' fleet deployment opportunities, of typically 10 trainsets or more. It noted that suitable refuelling infrastructure would have to be developed in parallel with train conversion, although this could potentially be shared with other applications. Ideally, the trains would use ‘green’ hydrogen manufactured by electrolysis using surplus renewable energy rather than ‘brown’ hydrogen from steam methane reforming.

Alstom is looking to achieve a ‘worst case’ range of around 1 000 km between refuelling, with the Breeze trains running at up to 145 km/h. Nevertheless, the first deployments would be based on ‘out and back’ diagramming with the trains returning to depot on a daily basis. This would become less of a constraint once additional fuelling infrastructure became available.

Related news

- 08 May 2019 - Fuel cell proof-of-concept train to be tested
- 07 Feb 2019 - IMechE recommends electrification instead of hydrogen trains
- 24 Jan 2019 - Hydrogen train goes on tour
- 07 Jan 2019 - Breeze UK hydrogen multiple-unit proposal unveiled
- 10 Dec 2018 - SNCF to run fuel cell train in 2022
- 17 Sep 2018 - Hydrogen multiple-units enter service
- 15 May 2018 - Alstom and Eversholt plan fuel cell EMUs
- 09 Nov 2017 - Hydrogen could replace diesel in 15 years says LNVG, as fuel cell train contract signed

This Year “Rail+Metro China 2019” will focus on Driving Smart Rail into an Intelligent Future, Rail + Metro Platform, Shanghai; China

**Come to Shanghai this November** 2019 to grasp the future of mass transit with 20,000 fellow transport industry professionals from around the world.

Rail+Metro China is the most authoritative and established B2B platform for China’s fast expanding metropolitan and intercity railway industries. With the backing of the China Association of Metros (CAMET), the China Council for the Promotion of International Trade (CCPIT), the Shanghai Transportation Trade Association and Shanghai Shentong Metro Group, as well as many other trade, industry and academic organizations, the quality of exhibit and showcase content from CRRC, Bombardier, Alstom and hundreds of
other exhibitors has emblazoned the reputation of the show over the last two decades as the must-attend rail transit industry event in the Asia-Pacific region.

The China International Railway Conference (CIRC) is an influential multi-platform conference taking place alongside Rail+Metro China with the endorsement of APEC and the firm support of China’s Ministry of Transport and the Chinese Academy of Sciences. CIRC 2018 presented a line-up 120 industry leaders, experts and influencers as speakers to an audience of over 1500 delegates, with this year expected to go even further.

In November, CIRC 2019 will host a series of forums, seminars and workshops covering everything from railway investment & construction to urban railway operation and maintenance, modern trams to smart rail technology, and much more besides.

This year we will bring together the rail industry in an exploratory celebration of insight and possibility. Join us to grasp the future!

“Mi Teleférico”, Cablecar Metro in Bolivia; Bolivia

Sustainable Urban Development and Mobility with Cablecar Metro

Urban Mobility with Metro Cable Car, “Mi Teleférico” in Las Paz; Bolivia
Mi Teleférico (Spanish pronunciation: [mi teˈlefeɾiko], English: My Cable Car), also known as Teleférico La Paz–El Alto (La Paz–El Alto Cable Car), is an aerial cable car urban transit system serving the La Paz–El Alto metropolitan area in Bolivia. As of September 2018, the system consists of 25 stations along eight lines: Red, Yellow, Green, Blue, Orange, White, Sky Blue, and Purple. Another three lines are in planning or construction: Brown, Silver, and Gold.

Upon the completion of the 10-kilometre (6.2 mi) Phase One (Red, Yellow, and Green Lines) in 2014, the system was considered to be the longest aerial cable car system in the world. Based on its master plan, the completed system, which is being built by the Doppelmayr Garaventa Group, is intended to reach a length of 33.8 km (21.0 mi) with 11 lines and 30 stations. While other urban transit cable cars like Medellín's Metrocable complement existing rapid transit systems, Mi Teleférico is the first system to use cable cars as the backbone of the urban transit network. In 2018, Mi Teleférico won a Latam Smart City Award in the category of "Sustainable urban Development and Mobility".

Mi Teleférico was planned in order to address a number of problems, including a precarious public transit system that could not cope with growing user demands, the high cost in time and money of traveling between La Paz and El Alto, chaotic traffic with its subsequent environmental and noise pollution, and a growing demand for gasoline and diesel fuel, which are subsidized by the state. The Red, Yellow, and Purple lines connect the neighboring cities of La Paz and El Alto, which are separated by a steep slope about 400 m (1,300 ft) tall, and which were previously only connected by winding, congested roads.

**History**

**Background**

The neighboring cities of El Alto and La Paz are the second and third most populous cities in Bolivia. Despite their proximity, travel between the two has always been a challenge, due to a difference in elevation of about 400 m (1,300 ft). La Paz, the national capital of Bolivia, is located in a canyon on the Choqueyapu River, while El Alto, a poorer but growing city with a majority indigenous population, is located above it on the Altiplano plateau. Prior to the construction of the cable car, travel between La Paz and El Alto was limited to heavily crowded, winding streets, and the only public transit consisted of buses and minibuses that often got stuck in traffic. In order to alleviate this situation, the idea of connecting the two cities with a cable car has been proposed several times since the 1970s.

In the 1970s, a team planned an aerial cable car route connecting the neighborhoods of La Ceja in El Alto and La Florida in La Paz.

In 1990, a feasibility study was undertaken for a cable car between La Ceja in El Alto and the Plaza de San Francisco in La Paz. The most controversial aspects of the plan were the fare, the low passenger capacity, and the proximity to the Basilica of San Francisco. During the 1991 municipal elections, the Conciencia de Patria (CONDEPA) party candidate argued against a cable car, claiming it would cost minibus drivers their livelihoods and impact privacy.

In the 1993 municipal elections, mayoral candidate Mónica Medina, also of the CONDEPA party, made aerial transit one of her campaign promises, modifying the original idea of a single line into a system of interconnected cable car lines with a hub on Lainnakota hill.
In 2003, the project returned to the table, but details such as tower placement stalled the work. The planned San Francisco terminal was moved to the Zapata soccer field near the Higher University of San Andrés, but the idea was still too controversial to move ahead.

In 2011, the Municipal Government of La Paz carried out a study on potential ridership demand, and found that the city handles 1.7 million trips per day, including 350,000 trips between La Paz and El Alto.

**Phase One**

In July 2012, Bolivian President **Evo Morales Ayma** drafted a bill for the construction of a cable car to connect El Alto with the center and south of La Paz and sent it to the Plurinational Legislative Assembly. Morales called together the mayor of La Paz, Luis Revilla, the mayor of El Alto, Édgar Patana, and the governor of the La Paz Department, César Cocarico, to participate in the project. The project was financed by the country's National Treasury with an internal loan from the Central Bank of Bolivia.

The system's Phase One consisted of the Red Line (Línea Roja), Yellow Line (Línea Amarilla), and Green Line (Línea Verde), which are also the colors of the Bolivian flag. Phase One was inaugurated and began operation on 30 May 2014.

**Phase Two**

On 1 July 2014, Evo Morales announced five new interconnected lines to be built in the coming years. On 26 January 2015, the law permitting construction of Phase Two was passed, increasing the number of new lines to six and committing US $450 million to the project. A seventh line was announced in February 2016, and an eighth was announced in July 2016. Phase Two will extend the system by over 20 km (12 mi). On 13 July 2017, it was announced that the cost of Phase 2 would be increased to US $506 million.

Phase Two began operation in 2017 with the inauguration of the Blue Line (Línea Azul) on 3 March 2017, followed by the Orange Line (Línea Naranja) on 29 September 2017. On 24 March 2018, the White Line (Línea Blanca) and the first section of the Sky Blue Line (Línea Celeste) were opened. The second and final section of the Sky Blue Line was opened on 14 July 2018. The remaining five lines will be the Purple Line (Línea Morada), the Brown Line (Línea Café), the Silver Line (Línea Plateada), and the Gold Line (Línea Dorada). As of March 2018, the Purple and Silver Lines are under construction.

**Other Cities**

**Oruro**

Mi Teleférico contributed to the construction of the Teleférico Turístico "Virgen del Socavón" (Our Lady of the Mines Tourist Cable Car) in Oruro, Bolivia. The cable car connects the city center to the Virgen del Socavón statue and shrine on nearby Santa Bárbara hill, which plays an important role in the city's carnaval celebrations. The cable car, which opened on 7 February 2018, consists of a single 800-metre (2,600 ft) line with two stations and 16 cars. It has a capacity of 1000 passengers per hour, and a one-way trip takes approximately 3 minutes. The project was originally due to open in November 2016, but it suffered repeated delays until Mi Teleférico took over construction work in 2017.
**Sucre**

As of 2017, the Empresa Estatal de Transporte por Cable "Mi Teleférico" was in the process of planning a cable car system for the city of **Sucre**.

**Lines**

**Lines in Operation**

The *Mi Teleférico* system consists of monocable aerial cable car lines. Most lines have a maximum capacity of 3000 passengers per hour, while the Sky Blue Line has a capacity of 4000 passengers per hour. The network has a total of seven lines, with 443 cars on the Red, Green, and Yellow Lines, 208 on the Blue Line, 127 on the Orange Line, 131 on the White Line, and 155 on the Sky Blue Line. Each car seats 10 passengers. Cars depart every 12 seconds, and the network is open 17 hours a day.

According to *Mi Teleférico*, the Red, Yellow, and Green Lines combined transport between 80,000 and 90,000 passengers per day. Of these, the Yellow and Red Lines, the two lines that link La Paz and El Alto, account for some 70,000 rides. During its opening week, the Blue Line moved 41,000 passengers in one day, and it has increased ridership on the Red Line by 15%.

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<th>Terminus stations</th>
<th>Length Travel Stations</th>
<th>Cabin Capacity</th>
<th>Speed Towers</th>
<th>Opened</th>
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### Time Table

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<th>Length</th>
<th>Travel Time</th>
<th>Stations</th>
<th>Cabins</th>
<th>Capacity</th>
<th>Speed</th>
<th>Towers</th>
</tr>
</thead>
<tbody>
<tr>
<td>Red Line</td>
<td>16 de Julio/Jach'a Qhathu – Estación Central/Taypi Uta</td>
<td>2.4 km</td>
<td>10 min 3</td>
<td>109</td>
<td>3000</td>
<td>5 m/s 19</td>
<td></td>
<td>30 May 2014</td>
</tr>
<tr>
<td>Yellow Line</td>
<td>Mirador/Qhana Pata – Chuqui Apu/Libertador</td>
<td>3.9 km</td>
<td>13.5 min 4</td>
<td>169</td>
<td>3000</td>
<td>5 m/s 31</td>
<td></td>
<td>15 September 2014</td>
</tr>
<tr>
<td>Green Line</td>
<td>Chuqui Apu/Libertador – Estación Central/Taypi Uta</td>
<td>3.7 km</td>
<td>16.6 min 4</td>
<td>165</td>
<td>3000</td>
<td>5 m/s 27</td>
<td></td>
<td>4 December 2014</td>
</tr>
<tr>
<td>Blue Line</td>
<td>Rio Seco/Waña Jawira – 16 de Julio/Jach'a Qhathu</td>
<td>4.7 km</td>
<td>17 min 5</td>
<td>208</td>
<td>3000</td>
<td>5 m/s 38</td>
<td></td>
<td>3 March 2017</td>
</tr>
<tr>
<td>Orange Line</td>
<td>Estación Central/Taypi Uta – Héroes de la Revolución/Villarruel</td>
<td>2.6 km</td>
<td>10 min 4</td>
<td>127</td>
<td>3000</td>
<td>5 m/s 26</td>
<td></td>
<td>29 September 2017</td>
</tr>
<tr>
<td>White Line</td>
<td>Plaza Villarruel – San Jorge</td>
<td>2.9 km</td>
<td>13.1 min 4</td>
<td>131</td>
<td>3000</td>
<td>5 m/s 26</td>
<td></td>
<td>24 March 2018</td>
</tr>
<tr>
<td>Sky Blue Line</td>
<td>El Prado – Chuqui Apu/Libertador</td>
<td>2.6 km</td>
<td>11.8 min 4</td>
<td>155</td>
<td>4000</td>
<td>6 m/s 26</td>
<td></td>
<td>Section 1: 24 March 2018 Complete Line: 14 July 2018</td>
</tr>
<tr>
<td>Purple Line</td>
<td>6 de Marzo San Jose – Moncayo</td>
<td>4.3 km</td>
<td>16.2 min 3</td>
<td>190</td>
<td>4000</td>
<td>6 m/s 34</td>
<td></td>
<td>28 September 2018</td>
</tr>
<tr>
<td>Brown Line</td>
<td>Monumento Busch – Las Villas</td>
<td>0.7 km</td>
<td>3.8 min 2</td>
<td>27</td>
<td>2000</td>
<td>5 m/s 7</td>
<td></td>
<td>20 December 2018</td>
</tr>
<tr>
<td>Silver Line</td>
<td>16 de Julio/Jach'a Qhathu – Mirador/Qhana Pata</td>
<td>2.6 km</td>
<td>11.7 min 3</td>
<td>117</td>
<td>3000</td>
<td>5 m/s 21</td>
<td></td>
<td>9 March 2019</td>
</tr>
</tbody>
</table>

### Future Lines

<table>
<thead>
<tr>
<th>Line</th>
<th>Terminus stations</th>
<th>Length</th>
<th>Travel time</th>
<th>Stations</th>
<th>Cabins</th>
<th>Capacity</th>
<th>Speed</th>
<th>Towers</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gold Line</td>
<td>Irpawi/Irpavi – Cota Cota</td>
<td>2.2 km</td>
<td>7.6 min 3</td>
<td>106</td>
<td>3000</td>
<td>5 m/s</td>
<td>2020</td>
<td></td>
</tr>
</tbody>
</table>
All stations have both a Spanish name and an Aymara name.

### Red Line (Línea Roja)

<table>
<thead>
<tr>
<th>Aymara Name</th>
<th>Spanish Name</th>
<th>Connections</th>
<th>City</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Taypi Uta</td>
<td>Estación Central</td>
<td>Orange Line</td>
<td>La Paz</td>
<td>former central railway station</td>
</tr>
<tr>
<td>Ajayuni</td>
<td>Cementerio</td>
<td></td>
<td>La Paz</td>
<td>main cemetery</td>
</tr>
<tr>
<td>Jach’a Qhathu</td>
<td>16 de julio</td>
<td>Blue and Silver Lines</td>
<td>El Alto</td>
<td></td>
</tr>
</tbody>
</table>
### Yellow Line (Línea Amarilla)

<table>
<thead>
<tr>
<th>Aymara Name</th>
<th>Spanish Name</th>
<th>Connections</th>
<th>City</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Chuqui Apu</td>
<td>Libertador</td>
<td>Green and Sky Blue Lines</td>
<td>La Paz</td>
<td></td>
</tr>
<tr>
<td>Suphu Kachi</td>
<td>Sopocachi</td>
<td></td>
<td>La Paz</td>
<td></td>
</tr>
<tr>
<td>Quta Uma</td>
<td>Buenos Aires</td>
<td></td>
<td>La Paz</td>
<td></td>
</tr>
<tr>
<td>Qhana Pata</td>
<td>Mirador</td>
<td>Silver Line</td>
<td>El Alto</td>
<td></td>
</tr>
</tbody>
</table>

### Green Line (Línea Verde)

<table>
<thead>
<tr>
<th>Aymara Name</th>
<th>Spanish Name</th>
<th>Connections</th>
<th>City</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Irpawi</td>
<td>Irpavi</td>
<td>Gold Line (2020)</td>
<td>La Paz</td>
<td></td>
</tr>
<tr>
<td>Aynacha</td>
<td>Obrajes</td>
<td></td>
<td>La Paz</td>
<td>a free funicular provides access from Calle 17 to the station</td>
</tr>
<tr>
<td>Pata Obrajes</td>
<td>Alto Obrajes</td>
<td></td>
<td>La Paz</td>
<td></td>
</tr>
<tr>
<td>Chuqui Apu</td>
<td>Libertador</td>
<td>Yellow and Sky Blue Lines</td>
<td>La Paz</td>
<td></td>
</tr>
</tbody>
</table>

### Blue Line (Línea Azul)

<table>
<thead>
<tr>
<th>Aymara Name</th>
<th>Spanish Name</th>
<th>Connections</th>
<th>City</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Jach'a Qhathu</td>
<td>16 de julio</td>
<td>Red and Silver Lines</td>
<td>El Alto</td>
<td></td>
</tr>
<tr>
<td>Qhana Thaki</td>
<td>Plaza Libertad</td>
<td></td>
<td>El Alto</td>
<td></td>
</tr>
<tr>
<td>Suma Qamaña</td>
<td>Plaza La Paz</td>
<td></td>
<td>El Alto</td>
<td></td>
</tr>
<tr>
<td>Yatina Uta</td>
<td>Plaza UPEA</td>
<td></td>
<td>El Alto</td>
<td>Universidad Pública de El Alto</td>
</tr>
<tr>
<td>Waña Jawira</td>
<td>Río Seco</td>
<td></td>
<td>El Alto</td>
<td></td>
</tr>
</tbody>
</table>

### Orange Line (Línea Naranja)

<table>
<thead>
<tr>
<th>Aymara Name</th>
<th>Spanish Name</th>
<th>Connections</th>
<th>City</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Taypi Uta</td>
<td>Estación Central</td>
<td>Red Line</td>
<td>La Paz</td>
<td>former central railway station</td>
</tr>
<tr>
<td>Riosinho Pampa</td>
<td>Armentia</td>
<td></td>
<td>La Paz</td>
<td></td>
</tr>
<tr>
<td>Apachita</td>
<td>Periférica</td>
<td></td>
<td>La Paz</td>
<td></td>
</tr>
<tr>
<td>Villarroel</td>
<td>Héroes de la Revolución</td>
<td>White Line</td>
<td>La Paz</td>
<td>underground station</td>
</tr>
</tbody>
</table>

### White Line (Línea Blanca)

<table>
<thead>
<tr>
<th>Aymara Name</th>
<th>Spanish Name</th>
<th>Connections</th>
<th>City</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Jalsuri</td>
<td>San Jorge</td>
<td>Sky Blue Line</td>
<td>La Paz</td>
<td></td>
</tr>
<tr>
<td>Kimsachata</td>
<td>Triangular</td>
<td></td>
<td>La Paz</td>
<td></td>
</tr>
<tr>
<td>Qhuirwa Uma</td>
<td>Busch</td>
<td>Brown Line</td>
<td>La Paz</td>
<td></td>
</tr>
<tr>
<td>Inalmama</td>
<td>Villarroel</td>
<td>Orange Line</td>
<td>La Paz underground station</td>
<td></td>
</tr>
</tbody>
</table>

### Sky Blue Line (Línea Celeste)

<table>
<thead>
<tr>
<th>Aymara Name</th>
<th>Spanish Name</th>
<th>Connections</th>
<th>City</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Chuqui Apu</td>
<td>Del Libertador</td>
<td>Yellow and Green Lines</td>
<td>La Paz</td>
<td></td>
</tr>
</tbody>
</table>
When the system first opened, riders experienced delays of 2 to 25 minutes, which the government attributed to technical problems and riders holding doors.\[citation needed\]

On February 14, 2015, a eucalyptus tree fell, striking an empty cabin on the Yellow Line, dislocating the cable and leaving passengers stranded for three hours. Nineteen passengers suffered bruises and other minor injuries, but there were no major injuries, and only minor damage to three cabins.\[35\]

On May 9, 2016, a tower from the construction of the Blue Line fell, with nine injured and no deaths.

### Intermodal Transfers

Beginning in December 2014, the Mi Teleférico and La Paz Bus systems began allowing passenger transfers at the Chuqui Apu station.\[36\]

### Mobile Application

Mi Teleferico has released a mobile application for Android and Apple with information about existing and future lines.
Gondola Lift for public Cable Transport, Arial Transit; International

From Wikipedia, the free Encyclopaedia

This article is about the means of cable transport. For other uses, see Gondola.

London's Air Line over River Thames

London's Air Line over River Thames
The **Mi Teleférico** cable car System in **La Paz, Bolivia**, used for **Mass Transportation** Purposes, is both the longest and highest urban Cable Car Network in the World.

The Téléphérique in **Jounieh, Lebanon** takes passengers to the **Our Lady of Lebanon** Shrine.

**Tochal Mountain Telecabine in Tehran** at 3,800 meters **Elevation**

Classic 1960s 4-seater monocable gondola lift in **Emmetten, Switzerland**, built by **GMD Mueller**. This lift was of the same type as the old **Whistler, British Columbia** gondola.
Interior of a gondola lift station, in this case an intermediate station where gondolas detach from the line, automatically travel through the building on tracks and attach to the line of the second section. The drive motors for both sections are visible below the bullwheels.

A Gondola Lift is a means of [cable transport] and type of [aerial lift] which is supported and propelled by cables from above. It consists of a loop of [steel cable] that is strung between two stations, sometimes over intermediate supporting towers. The cable is driven by a [bullwheel] in a terminal, which is typically connected to an [engine] or [electric motor]. They are often considered continuous systems since they feature a haul rope which continuously moves and circulates around two terminal stations. Depending on the combination of cables used for support and/or haulage and the type of grip (detachable grip vs. fixed grip), the capacity, cost, and functionality of a gondola lift will differ dramatically. Because of the proliferation of such systems in the Alpine regions of Europe, the French language name of Télécabine is also used in an English language context.

12-Passenger Gondola Lift in Åre, Sweden, built by Poma

Gondola lifts should not be confused with [aerial tramways] as the latter solely operates with fixed grips and simply shuttles back and forth between two end terminals. Both are types of [cable car].

Types

Passenger Lift

In some systems the passenger cabins, which can hold between two and fifteen people, are connected to the cable by means of spring-loaded grips. These grips allow the cabin to be detached from the moving cable and slowed down in the terminals, to allow passengers to board and disembark. Doors are almost always automatic and controlled by a [lever] on the roof or on the undercarriage that is pushed up or down. Cabins are driven through the terminals either by rotating [tires], or by a chain system. To be accelerated to and decelerated from line speed, cabins are driven along by progressively swifter (or slower) rotating tires until they reach line or terminal speed. On older installations, gondolas are accelerated manually by an operator. Gondola lifts can have intermediate stops that allow for uploading and downloading on the lift. Examples of a lift with three stops instead of the standard two are the Village Gondola and the Excalibur Gondolas at Whistler Blackcomb.

In other systems the cable is slowed down intermittently to allow passengers to disembark and embark the cabins at stations, and to allow people in the cars along the route to take photographs, such as Lebanon’s Téléférique which offers an exceptional view to the Mediterranean, the historical Jounieh Bay and the pine forest at the 80% slope which this gondola lift goes over. Such a system is called Pulse Cabin because usually more than one cabin are loaded at a time before the trip begins.
Systems where a single cable provides both support and propulsion of the cabins are called monocable gondolas.\(^4\) Another type of gondola lift is the bi-cable gondola, which has one other stationary cable, besides the main haul rope, that helps support the cabins. Famous examples of this type of lift include the Ngong Ping Cable Car in Hong Kong, the Singapore Cable Car, and the Sulphur Mountain Gondola in Banff, Canada. This system has the advantage that the stationary cable's strength and properties can be tailored to each span, which reduces costs. There are also tri-cable gondolas that have two stationary cables that support the cabins. They differ from aerial tramways in that the latter consist only of one or two usually larger cabins, moving up and down, not circulating. Bi- and tri-cable systems provide greater lateral stability allowing the system to operate in higher cross-winds.

Open-air gondolas, or cabriolet as commonly called, are fairly uncommon and are quite primitive because they are exposed to the elements. Their cabins are usually hollow cylinder, open from chest height up, with a floor and a cover on the top. They are usually used as village gondolas and for short distances. An example of these are the Cabriolets at Mont Tremblant Resort in Quebec, Canada, and at Blue Mountain Ski Resort (summer only, in the winter it is converted to a six person high-speed chairlift.) in Ontario, Canada, The Canyons Resort in Park City, Utah, Mountain Creek, and the new Village Cabriolet at Winter Park Resort in Colorado. Open-air gondolas can also come in a style similar to a pulse gondola, like the Village Gondola at Panorama Ski Resort, British Columbia.

The first gondola built in the United States for a ski resort was located at the Wildcat Mountain Ski Area. It was a two-person gondola built in 1957 and serviced skiers until 1999. The lift was later demolished in 2004. The lift and its cabins were manufactured by a former Italian lift company: Carlevaro-Savio. One of the longest gondola rides in the world, Gondelbahn Grindelwald-Männlichen, is in the Bernese Oberland in Switzerland and connects Grindelwald with Männlichen.

**Ropeway Conveyor**

A ropeway conveyor or material ropeway is essentially a subtype of gondola lift, from which containers for goods rather than passenger cars are suspended.

Ropeway conveyors are typically found around large mining concerns, and can be of considerable length. The COMILOG Cableway, which ran from Moanda in Gabon to Mbinda in the Republic of the Congo, was over 75 km in length. The Norsjö cable car in Sweden had a length of 96 km.

In Eritrea, the Italians built the Asmara-Massawa Cableway in 1936, which was 75 km long.

Conveyors can be powered by a wide variety of forms of power sources: electric motors, internal combustion engines, steam engines, or gravity. Gravity is particularly common in mountainous mining concerns, and directly employed; the weight of loaded down-going containers pulling the returning empties back up the slope. Gravity can also be used indirectly, where running water is available; a waterwheel is powered by gravity acting on water, and is used to power the cable.

**Urban Transport**

While gondola lifts are traditionally used for ski resort purposes, in recent years they are finding increased usage in urban environments. Cable cars used for urban transit include the Metrocable in Medellín, Colombia; Portland Aerial Tram in Portland, Oregon, United
States; Metrocable in Caracas, Venezuela; Trolcable in Mérida, Venezuela; Cable Aéreo in Manizales, Colombia; Mi Teleférico in La Paz, Bolivia; Mexicable in the State of Mexico, Mexico; Yenimahalle-Şentepe teleferik in Ankara, Turkey; the Emirates Air Line in London, UK, and the TransMiCable in Bogotá, Colombia, due to open at the end of 2018. The Metrocable systems in Medellín and Caracas are fully integrated with the public transit network which provides passengers the ability to seamlessly transfer to the local metro lines.

In terms of urban gondola systems for the future, TransLink in Metro Vancouver has proposed to build a gondola up Burnaby Mountain to Simon Fraser University in an announcement in September, 2010. The project was sidelined in 2014, but was revived in 2017.

In late 2012, a widespread aerial gondola system was proposed for Austin, Texas in an effort to expand mass transit options in the rapidly growing city. The proposal was rejected by the local transit agency in 2017.

A proposed gondola system in Montreal was ultimately rejected by the Old Port of Montreal.

Disney Skyliner is a gondola lift system which began construction in 2017 at Walt Disney World in Florida. When completed, the system will connect two theme parks with several Disney-operated hotels.

The technical department of Bergen municipality, Norway suggested in 2016 to build a cable car. The proposed gondola lift was inspired by a similar project in Gothenburg, Sweden and was planned for the Western part of Bergen harbor.

List of Accidents
The National Ski Areas Association reports 0.138 fatalities per 100 million miles transported compared to 1.23 for cars.

- October 22, 1979: One person was killed and 17 other injured when two gondolas fell from the "Swiss Sky Ride" at the Texas State Fair. Winds gusting to 40 miles per hour caused three cars to collide and two fell on midway games below the cable.
- January 29, 1983: The Singapore Cable Car disaster, which saw seven people killed when two cabins plunged into the sea after the cableway was hit by a Panamanian-registered oil rig being towed.
- September 5, 2005: Nine people died and ten were injured when a 750 kg concrete block was accidentally dropped by a construction helicopter in Sölden, Austria. Hundreds had to be evacuated from the lift.
- July 13, 2006: Five people, including a three-year-old girl, were injured after two cable cars collided and one crashed to the ground. The accident took place at the Nevis Range, near Fort William in northwest Scotland. There were no fatalities and the gondola was deemed safe for operation shortly after the accident.
- February 18, 2007: A gondola car derailed from the cable at Ski Apache in New Mexico and rolled backwards hitting another car. Eight people were involved in the crash but only two suffered minor injuries.
- March 2, 2008: A man fell out of a gondola in Chamonix and died, perhaps after he and one of his friends leaned on and broke the plexiglass window.
- December 16, 2008: Ten people were injured (none seriously), and others left stranded after a tower supporting the Excalibur gondola lift on Blackcomb mountain collapsed, at the Whistler Blackcomb ski resort in Whistler, Canada.
- Cologne Cable Car has closed in July 2017 due to an accident. All passengers could be safely rescued. Ropes have entangled due to strong winds. It reopened 2019.
In September 2015, Addis Ababa introduced the first Light Rail Transit System (LRT) in sub-Saharan Africa. This tram, a symbol of Ethiopian renewal, was nevertheless barely used by the capital’s residents during the first few months. However, at the time of our research trip in April 2017, access to the tram during rush hour was difficult and the trams were overcrowded.

Looking beyond communication and anecdote, the introduction of this tram – raising the issue of Urban Mobility in cities which are changing very quickly – is at the heart of the issues of social and economic changes on the continent, and particularly urban development. As for the tram, it concentrates on, or even perhaps reconciles, the major issues of these rapid urban changes. On the one hand, it is typical of the “city showcase” policy, a symbol of professed modernity and attractiveness. The symbol is strengthened by its unique nature: the first Light Rail Transit in sub-Saharan Africa and it aspires to be a model for the entire continent. On the other hand, it aims to connect remote areas to central districts efficiently, by its speed, but also by its social accessibility. Indeed, the affordable cost of tickets, largely subsidised by the public authorities, could help to promote the mobility of residents in precarious situations. Does the Addis Ababa tram combine the professed modernity and a response to the fundamental social issues?
African cities are becoming increasingly populous and spread out and are undergoing rapid and acute changes. At the same time, African countries are aspiring to make their capitals showcases of professed economic dynamism and modernity. Urban sprawl and the concentration of citizens create serious challenges. That of **Urban Mobility** is crucial and it is both social – increasing **Urban Mobility** needs, longer distances and difficulties in accessing the city – and economic – congestion, a negative impact on business and attractiveness. The Addis Ababa **Light Rail Transit** has been designed to provide a dedicated **Mass Transit Solution with Right of Way** to meet these challenges. After two years of operation, and at a time when a growing number of similar projects are being planned (for example the Metro in Abidjan and the Dakar TER), this report reviews the challenges of the planning process of the Addis Ababa **LRV Tram** and provides a picture of the **Urban Mobility** it enables.

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**Santiago to expand Commuter Rail Network; Chile**

May 20, 2019  
Written by [Ian Thomson Newman](mailto:iIanThomsonNewman)

ENVIRONMENTAL approval was granted in mid-May for a $US 1.56bn project to introduce a second commuter rail service in the Chilean capital running 25 km from Santiago to Malloco on the line to Melipilla.
Chilean State Railways (EFE) plans to start work next year and to open the line in 2025.

This was followed on May 17 by a surprise announcement by Chile’s president, Mr Sebastián Piñera, of plans for a third commuter rail line running north from Quilicura, on an extension of Santiago Metro Line 3, to Batuco and eventually Tiltile. The Ministry of Transport says that a basic engineering study was completed for the scheme in December 2017. The ministry says it will now respond in July to an environmental evaluation that commenced at the end of the 2017.

EFE has been planning a suburban service between Santiago and the dormitory town of Melipilla, 61km southwest of Santiago, since the mid-1990s. The project did get to the tendering stage, but there were no bidders due to an underestimated budget requirement and disagreements between EFE and Santiago Metro over the location of the city centre terminal.

However, EFE did not abandon the project, and the first stage as far as Malloco formed part of the company’s 2014-16 development plan. Yet, works were not initiated, one problem being an inability to obtain environmental approval.

**Fares Integration**

Within the urban area, as far as Ciudad Satelite, fares will be integrated within Santiago’s “¡bip!” public transport fares system, which also encompasses the city’s buses and metro. Melitren, as the project is known, will have interchanges with metro lines 1 and 6.

Since Santiago Metro plans to complete new lines 7, 8 and 9 as well as extensions to lines 2, 3 and 4 by 2026, it is implied that Santiago’s urban and suburban rail network will increase from 160 km to 296 km, within a space of seven years, excluding the line to Batuco.
NETHERLANDS: The Lansingerland-Zoetermeer interchange which brings together RandstadRail light rail, NS rail and bus services, a park-and-ride site and cycling facilities at a site to the east of Den Haag and north of Rotterdam has been officially inaugurated by State Secretary for Infrastructure & Water Management Stientje Van Veldhoven and the Mayors of Lansingerland and Zoetermeer.

NS Sprinter services on the Den Haag – Gouda line began calling at the newly-completed Lansingerland-Zoetermeer station in December, and the inauguration ceremony on May 17 was held two days before the start of services on a 2 km, two-stop extension of RandstadRail Route 4 from Javalaan via Van Tuyllpark.

Mayor of Lansingerland Pieter van de Stadt said the opening should not been seen as the final stage of the development, but as a step towards developing a network of high-quality public transport in the area.

The station has been designed with provision for RandstadRail to be extended south to Rotterdam, and for the railway to be increased from two to four tracks.
Alderman Marc Rosier of Zoetermeer said usage of the NS station was already higher than expected, with almost 1,000 passengers boarding or alighting each day. This is expected to reach 2,500 passengers/day with the opening of the light rail line.

Related news

- 01 Feb 2018 - Electric buses ordered for Den Haag
- 06 Jul 2017 - Den Haag introduces tram and bus mobile ticketing
- 14 Dec 2016 - Rotterdam light rail vehicle loan agreement signed
- 23 Aug 2016 - New Den Haag Centraal RandstadRail platforms open
- 12 Jul 2016 - Rotterdam and Den Haag operating contracts renewed

Station Berlin Ostkreuz – Largest local Transport Hub/Interchange for Connectivity in Berlin; Germany

Dipl.-Ing. Karin Kamitz in Eisenbahn Technische Rundchau, ERT, May 2019, No. 5, page 34, DVV Media Group, Hamburg, Germany
In the years from 2006 to 2018, while 340 000 passengers in city trains and regional trains were passing the station Berlin Ostkreuz every day, the largest local transport hub for intermodal connectivity was completely reconstructed during normal railway operation. This was a logistics challenge for all employees involved in construction or planning, a trial for patience for the passengers, residents and engineers. The result is a modern, barrier-free hub station, which connects road traffic, trams and regional transport with urban, suburban and interurban Metro Rail, City Rail and Railways best as possible, and whose 176 years of history have remained visible.

Mesa Extension includes USA’s second Light Metro/Light Rail Transit, LRT, Rail Roundabout Intersection; USA

20 May 2019

**USA:** Celebrations on May 18 marked the opening of the 3·0 km Gilbert Road extension of the Valley Metro in Mesa, Arizona. This takes the Phoenix area light rail network to 45 km and 38 stops.

The extension runs along Main Street from Mesa Drive to Gilbert Road, and includes the second roundabout in the USA to be incorporated into a light rail system. There are two stops at Stapley Drive and Gilbert Road which feature ‘whimsical and eye-catching art’, and the terminus serves a park-and-ride site.
A groundbreaking ceremony in October 2016 marked the start of work on the extension, which was built by Stacy & Witbeck and Sundt with a joint venture of WSP and PGH Wong providing programme management, inspection and systems integration services.

The $152m cost was met from federal and local funds. ‘The project team worked with Valley Metro as a cohesive group’, said WSP Office Engineer Mike Sotak following the opening. ‘By negotiating and collaborating early in the project, we were able to reduce construction costs by over $6m.’

‘This light rail extension is another economic engine for the city of Mesa’, said Mayor of Phoenix Kate Gallego at the opening ceremony. ‘Across the Valley, we are excited for light rail to continue expanding.’

Light rail ‘connects people to work, students to school and ideas to communities’, Gallego added. ‘We need more light rail, not just for economic growth, but for our fast-growing community to advance sustainably.’

Related news

- 30 Nov 2018 - FTA allocates $281m for five transport projects
- 19 Oct 2016 - Valley Metro extension groundbreaking
- 24 Aug 2015 - Phoenix opens Central Mesa light rail extension
- 18 Feb 2014 - Students attend Central Mesa light rail welding
- 15 Jan 2013 - Second Phoenix light rail extension breaks ground
- 01 Jun 2012 - Groundbreaking launches Central Mesa light rail construction
- 12 Jan 2009 - Phoenix light rail starter line up and running

London orders Fuel Cell powered Double-Deck Buses; UK

16 May 2019
UK: Transport for London has placed a £12m order for Wrightbus to supply what the authority says will be the world’s first hydrogen-powered double-deck buses, and their associated fuelling infrastructure.

The 20 buses will be fitted with FCveloCity-HD 85 kW fuel cell modules from Ballard Power Systems.

They are to be used on routes 245, 7 and N7 from 2020. TfL said they would have on-board USB charging points, making bus travel ‘even more attractive’.

The vehicles will need to be refuelled once a day for 5 min, which TfL said would make them ‘much quicker to power up when compared with conventional battery-electric buses.’

TfL is leading the procurement within the Joint Initiative for hydrogen Vehicles across Europe project, which aims to bring down the cost of vehicles by buying in bulk with other authorities; JIVE aims to deploy 139 zero-emission fuel cell buses and associated refuelling infrastructure across five countries.

More than £5m for the order is being provided by the EU’s Fuel Cells & Hydrogen Joint Undertaking and the Innovation & Networks Executive Agency, and there is £1m from the Office of Low Emission Vehicles.

‘Innovating and using hydrogen means we have flexibility in matching the right fuel with the operational requirements of the network’, said Claire Mann, TfL’s Director of Bus Operations, when the order was announced on May 10. ‘We are also pleased to be leading an initiative that brings down the cost of buying the greenest buses across the continent and within our own country, as we know pollution doesn’t respect national or local boundaries.’

Related news

- 11 Feb 2019 - Emission-free bus funding announced
- 22 Aug 2018 - Zhengzhou to test hydrogen fuel cell buses
- 01 Mar 2018 - Köln and Wuppertal order hydrogen fuel cell buses
- 28 Oct 2017 - Fuel cell tram enters service in Tangshan
- 20 Sep 2017 - Ballard to supply hydrogen fuel cells to Pau buses
- 05 Jul 2017 - Rotterdam tests hydrogen fuel cell buses
- 21 Jun 2017 - London transport strategy targets zero emissions by 2050
- 26 Jan 2017 - Talking JIVE about fuel cells
- 21 Apr 2015 - Hydrogen-fuelled double-deck tram on test

Anaheim Transportation Network orders Battery Buses; USA

15 May 2019
USA: California's Anaheim Transportation Network has awarded BYD a contract to supply 40 battery-electric buses. Half of these will be the BYD K9M design, the others the shorter BYD K7M and articulated K11M.

The order is being placed through two existing contracts in Washington and Georgia, which local authorities and transit agencies can use to benefit from economies of scale.

ATN was one of 28 California projects selected in 2018 to receive a grant from the Transit & Intercity Rail Capital Program, which provides awards from the Greenhouse Gas Reduction Fund to help finance projects to reduce emissions. ATN is also using funding from the state of California, Anaheim Tourism Improvement District and the City of Norwalk.

'We've been operating four of BYD's 40 ft K9Ms on our routes over the past two years, and based on their performance, we are confident in BYD's quality product and their support of our efforts to electrify our fleet,' said ATN Executive Director Diana Kotler on April 14, adding that the ATN would have a '57% zero-emission fleet by 2020.'

Related news

- 13 May 2019 - Electric buses handed over in Badajoz
- 07 May 2019 - BYD wins further Swedish electric bus order
- 15 Apr 2019 - BYD launches 'longest electric bus'
- 19 Feb 2019 - BYD signs Salvador monorail contract
- 09 Jan 2019 - Medellin orders BYD electric buses
- 14 Dec 2018 - BYD electric buses delivered to São Paulo
RMV orders 27 Hydrogen Trains from Alstom; Germany

May 21, 2019

Written by David Burroughs

RHINE-MAIN Transport Authority (RMV) subsidiary Fahma has awarded Alstom and Infraserv Höchst a €500m contract to supply 27 hydrogen fuel cell Coradia iLint multiple units, which will replace diesel trains on four regional lines in the Taunus region north of Frankfurt-am-Main from 2022.

Alstom will supply the trains, and has a €360m share of the contract. The order also includes the supply of hydrogen, maintenance and the provision of reserve capacity for the next 25 years. Alstom will supply the hydrogen in cooperation with Infraserv Höchst, with the refuelling station to be located at the Höchst industrial park in Frankfurt.

“The purchase of 27 trains is a lighthouse project for fuel cell mobility, about which I’m very pleased,” says parliamentary state secretary of the German Ministry of Transport and Infrastructure, Mr Enak Ferlemann. “The federal government supports this investment in climate-friendly mobility by assuming 40% of the additional vehicle costs incurred in comparison with diesel vehicles, as well as by providing proportional support for the hydrogen filling station. The project can serve as a model for the German Transport Ministry. We hope that many other projects in Germany will follow this example.”

A lack of electrification of the Hessen network means there is still a large proportion of diesel trains operating in the state, Hessen’s minister of transport, Mr Tarek Al-Wazir, says.

“In Hessen, transport is responsible for one third of greenhouse gas emissions,” he says. “Steam instead of diesel soot is therefore an exciting approach.”
The new fuel cell trains will replace DMUs on four lines:

- RB11 Frankfurt-Höchst – Bad Soden
- RB12 Frankfurt – Königstein
- RB15 Frankfurt – Bad Homburg – Brandoberndorf, and
- RB16 Friedrichsdorf – Friedberg.

The trains will be equipped with comprehensive passenger information systems including monitors with real-time information. They will also have space for bicycles, wheelchairs and pushchairs and will offer complimentary Wi-Fi. The new trains will provide 160 seats, increasing capacity by up to 40%.

The first two Coradia iLint trains have already been in regular passenger service in the Elbe-Weser network in Lower Saxony since September 2018, and the Local Transport Authority of Lower Saxony (LNVG) plans to operate 14 Coradia iLint trains on the network from 2021.

“This award sets two records: with the commissioning of the new vehicles in 2022, RMV will have the world’s largest fleet of fuel cell trains in passenger transport and it is the largest order in the history of our subsidiary Fahma,” says RMV managing director, Prof Knut Ringat.

Categories: Europe FleetMain line News
Tags: Germany Hydrogenhydrogen fuelStadler
Review of Urban Mobility and Transport in India

Chaotic Traffic in India’s Mega Cities despite successful Metro Rail
Preface

Indian cities have been witnessing rapid motorisation. The total number of motor vehicles in many cities has more than doubled in the last 10 years alone, causing severe congestion, air pollution, increasing incidence of road accidents and a very rapid increase in the consumption of petroleum fuels. It is well recognised that poor transportation has the potential to adversely impact the economic efficiency of our cities as well as the health and well-being of urban Indians. Although the country adopted a National Urban Transport Policy in April, 2006 emphasising on the prioritisation of public transport and non-motorised modes over personal motor vehicles, the pace of motorisation has continued. Clearly there is a need to step back and review what has happened so far so that future directions can be better aligned to deal with the emerging problems.

It is in the above context that this paper reviews the past trends, the current situation, the measures taken so far, the gains from them as well the gaps that still remain. It projects multiple scenarios for the future and, thereafter, it suggests a way forward.

This review becomes particularly important in the light of the national effort to build 100 smart cities and undertake the renewal of 500 cities. The transport system in the cities will have to be at the core of such renewal and hence this paper would prove useful for decision makers who are charged with the responsibility of developing Indian cities. The authors hope that this effort will prove useful in the task of building urban India as the “Engines of our Economic Growth”.
Acknowledgement

This paper has been written by a team from the Institute of Urban Transport (India) and Center for Science Technology and Environmental Policy (CSTEP). The team comprised Dr. O.P. Agarwal, Ms. Sujaya Rathi, Ms. Kanika Kalra, Ms. Megha Gupta, Ms. Sugandha Pal, Ms. Anantha Lakshmi, Ms. Shrimoyee Bhattacharya and Ms. Adyasha Mishra.

The authors would like to thank the Urban Mass Transit Company (UMTC) for the immense support it received from them. In particular it would like to thank Mr. Ajai Mathur, Mr. N. Seshadri and Mr. Ankush Malhotra. Our thanks are also due to Dr. Ke Fang and Mr. Atul Agarwal from the World Bank for their support and guidance. We would also like to thank the Communications and Policy Engagement Team from CSTEP for their editorial support.
# Contents

Preface ............................................................................................................................................................ i

Acknowledgement ......................................................................................................................................ii

1. Introduction ....................................................................................................................................... 1

2. Trends and Current Situation ........................................................................................................ 2
   2.1. Urbanisation ....................................................................................................................................... 2
       2.1.1. Nature of Urbanisation ........................................................................................................ 3
   2.2. Motorisation ....................................................................................................................................... 5
       2.2.1. Impact on Public Transport ................................................................................................. 8
       2.2.2. Travel Demand....................................................................................................................... 8
       2.2.3. Road Length ............................................................................................................................ 9
       2.2.4. Impact of Rapid Motorisation ........................................................................................... 10
   2.3. Mobility and Urban Poor ....................................................................................................... 15

2.4. Connectivity with the Suburbs ............................................................................................. 17

2.5. Status of Urban Public Transport in India ......................................................................... 17
   2.5.1. Industry Structure ............................................................................................................... 17
   2.5.2. Performance of Bus Services in Metropolitan Cities ................................................... 18

2.6. Rail Services ....................................................................................................................................... 19
   2.6.1. Delhi Metro .......................................................................................................................... 21

2.7. Suburban Railways ................................................................................................................... 21

2.8. Intermediate Public Transport (IPT) Systems ................................................................... 22

2.9. Summary ....................................................................................................................................  23

3. Urban Transport Projection and Scenario Analysis ................................................................ 24
   3.1. Urban Population Projection ................................................................................................... 24

   3.2. Transport –Energy-Emissions Model .................................................................................. 25

   3.3. Analysis of Alternative Scenarios ......................................................................................... 25
       3.3.1. Results of the Analysis ........................................................................................................ 27

4. Initiatives and Impact ..................................................................................................................... 30
   4.1. Brief Historical Perspective .................................................................................................. 30
   4.2. Recent Actions Taken .............................................................................................................. 30
<table>
<thead>
<tr>
<th>Section</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>4.2.1. National Urban Transport Policy of India</td>
<td>31</td>
</tr>
<tr>
<td>4.2.2. National Urban Renewal Mission</td>
<td>32</td>
</tr>
<tr>
<td>4.3. Results of the Effort – Gains and Challenges</td>
<td>33</td>
</tr>
<tr>
<td>4.3.1. Gains</td>
<td>33</td>
</tr>
<tr>
<td>4.4. Challenges that Still Remain</td>
<td>34</td>
</tr>
<tr>
<td>5. Way Forward</td>
<td>38</td>
</tr>
<tr>
<td>6. Conclusion</td>
<td>42</td>
</tr>
<tr>
<td>References</td>
<td>43</td>
</tr>
<tr>
<td>Annexure</td>
<td>46</td>
</tr>
</tbody>
</table>
List of Tables

Table 1: Share of Urban Population in Different Countries ......................................................... 2
Table 2: Categorisation of Cities ........................................................................................................ 3
Table 3: Population Growth in Different Categories of Cities .......................................................... 4
Table 4: Share of Buses in Total Motor Vehicles ............................................................................. 8
Table 5: Changes in Per Capita Trip Rate, Public Transit Share, Walking Share, and Motorised Trip Length ................................................................................................................................. 8
Table 6: Urban Road Length in Kilometres 1971-2011 .................................................................... 10
Table 7: Peak Hour Journey Speed on Major Road Network ............................................................. 11
Table 8: Annual Average Air quality Level for Various Cities, 2010 .................................................... 13
Table 9: Pollution Levels ................................................................................................................... 14
Table 10: Performance Comparison of City Bus Services (2012-2013) (“SRTUS,” 2014) ................. 18
Table 11: Key Features of the Operational Metros .......................................................................... 20
Table 12: Delhi Metro Ridership ......................................................................................................... 21
Table 13: Suburban and Non – Suburban Train kms (“Indian Railways,” 2012) ............................... 22
Table 14: Urban Population (2011 and Projected 2021-51) ............................................................... 24
Table 15: Description of the Scenarios ............................................................................................. 26
## List of Figures

<table>
<thead>
<tr>
<th>Figure</th>
<th>Description</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Share of Population by Different Category of Cities</td>
<td>3</td>
</tr>
<tr>
<td>2</td>
<td>Increasing Motorization Levels</td>
<td>5</td>
</tr>
<tr>
<td>3</td>
<td>Category-wise Registered Vehicles in India</td>
<td>5</td>
</tr>
<tr>
<td>4</td>
<td>Dominant Share of Two-Wheelers</td>
<td>6</td>
</tr>
<tr>
<td>5</td>
<td>Trends in Vehicles/1000 population in Select Indian Cities</td>
<td>7</td>
</tr>
<tr>
<td>6</td>
<td>Trends in Urban Vehicle Density Trend (Vehicles/sq.km.) in Selected Indian Cities</td>
<td>7</td>
</tr>
<tr>
<td>7</td>
<td>Increasing Road Network in the Cities</td>
<td>9</td>
</tr>
<tr>
<td>8</td>
<td>Congestion on Delhi's Roads</td>
<td>10</td>
</tr>
<tr>
<td>9</td>
<td>No. of Road Accidents (Million)</td>
<td>12</td>
</tr>
<tr>
<td>10</td>
<td>Fatalities per Million Population</td>
<td>12</td>
</tr>
<tr>
<td>11</td>
<td>Share of Road Accidents in Terms of Road User Categories, 2011</td>
<td>12</td>
</tr>
<tr>
<td>12</td>
<td>Road Traffic Death Rate (per 100000 Population)</td>
<td>13</td>
</tr>
<tr>
<td>13</td>
<td>Price of Crude Oil (USD/Barrel)</td>
<td>15</td>
</tr>
<tr>
<td>14</td>
<td>Comparative Modal Split</td>
<td>16</td>
</tr>
<tr>
<td>15</td>
<td>Ridership in Various Cities (in Millions) (“STRUS,” 2014)</td>
<td>18</td>
</tr>
<tr>
<td>16</td>
<td>Model Flow</td>
<td>25</td>
</tr>
<tr>
<td>17</td>
<td>Annual Vehicles Kilometres Travelled (in Billion Kms.)</td>
<td>27</td>
</tr>
<tr>
<td>18</td>
<td>Annual Passenger Motorised Travel Demand (in BPKMS)</td>
<td>27</td>
</tr>
<tr>
<td>19</td>
<td>Annual Crude Oil Use (Million Barrel)</td>
<td>28</td>
</tr>
<tr>
<td>20</td>
<td>Annual Emissions –CO₂ (Metric Tonnes)</td>
<td>28</td>
</tr>
<tr>
<td>21</td>
<td>Annual Import Bill from Urban Passenger Transport (Rs crores)</td>
<td>28</td>
</tr>
<tr>
<td>22</td>
<td>Motor Vehicle Growth in Delhi (In ‘000)</td>
<td>36</td>
</tr>
</tbody>
</table>
List of Annexures

Annexure 2: Total Number of Registered Vehicles in India ........................................................................ 47
Annexure 3: City Categories ...................................................................................................................... 48
Annexure 4: Model Description .................................................................................................................. 49
Annexure 5: List of MRTS Projects in India in the Last 15 years ............................................................... 66
Annexure 6: Sector-Wise Break-up of Funds Allocated under JnNURM ..................................................... 67
1. INTRODUCTION

The last two decades have seen India’s urban population grow by almost 3% per year, though the total population has grown by less than 2% per year on an average. Projections indicate that by 2026, 38% of Indians will live in cities and the urban population will grow to 534 million (“Population Projections 2026,” 2006), as against 31% and 377 million as per the 2011 census. Based on the United Nations estimates (Urban Agglomerations, 2014), these numbers are likely to grow to 52% and 875 million, by 2050. This means that India currently has an urban population that is greater than its total population in 1951 and it will add almost as many more people to its cities in the next 35 years (one generation).

Cities are referred to as the “engines of economic growth”. Despite having only about 30% of the total population, nearly 62-63% , of India’s Gross Domestic Product (GDP) comes from the urban areas (“HPEC,” 2011). Future growth is also likely to concentrate primarily on the urban areas, and its estimated contribution to GDP is likely to reach 75% by 2030. Hence, anything that constrains the smooth functioning of cities has the potential to constrain India’s economic growth. It is in recognition of this that the Government has decided to upgrade 100 cities into “Smart Cities” and also take up the renewal of 500 cities. Unfortunately, the transport situation is posing a serious threat to the smooth growth of urban areas – health and well-being of its people and the economic efficiency of cities.

Even with the current size of the urban population, Indian cities are facing severe congestion, deteriorating air quality, increasing emission of Green House Gas (GHG) from the transport sector, an increasing incidence of road accidents and an exploding growth in the demand for petroleum fuels that threatens the energy security of the country. With the urban population projected to grow more than double in the next one generation, the situation is likely to go completely out of control and thwart India’s economic development efforts unless remedial measures are taken quickly.

Accordingly, this report seeks to review the current urban transport situation in the country, highlight the gains from efforts made so far, present the challenges that still remain and suggest measures that need to be taken in moving towards the future. It comprises of five sections. Section 2, immediately following this introduction, presents the historical growth and the current situation, section 3 makes projections for the future under various scenarios, section 4 highlights the initiatives taken, the gains from these efforts and the challenges that still remain and finally section 5 presents the suggestions for better managing urban transportation challenges in the future.
2. TRENDS AND CURRENT SITUATION

This section elucidates the current nature of urbanisation, motorisation trends and its impact on cities.

2.1. URBANISATION

India’s urban population went up from 25.86 million to 377.11 million during the period 1901 to 2011. The share of urban population increased from 11% to 31% during the same period. The rate of population growth increased after Independence up to the 1970s, but has been decreasing thereafter. It went up from 2.37% in the 60s to 3.85% during the 70s, but thereafter came down to 2.84% during 2001-2011 (Details in Annexure 1).

An urban population that is only 31% of the total population is low as compared to many other parts of the world, as seen from the Table 1 below.

Table 1: Share of Urban Population in Different Countries

<table>
<thead>
<tr>
<th>S.No.</th>
<th>Country</th>
<th>% Urban Population</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Singapore</td>
<td>100</td>
</tr>
<tr>
<td>2.</td>
<td>Hong Kong</td>
<td>100</td>
</tr>
<tr>
<td>3.</td>
<td>Netherlands</td>
<td>93.4</td>
</tr>
<tr>
<td>4.</td>
<td>Japan</td>
<td>91.3</td>
</tr>
<tr>
<td>5.</td>
<td>South Korea</td>
<td>91.0</td>
</tr>
<tr>
<td>6.</td>
<td>Australia</td>
<td>89.2</td>
</tr>
<tr>
<td>7.</td>
<td>Brazil</td>
<td>84.6</td>
</tr>
<tr>
<td>8.</td>
<td>United States</td>
<td>82.4</td>
</tr>
<tr>
<td>9.</td>
<td>United Kingdom</td>
<td>79.6</td>
</tr>
<tr>
<td>10.</td>
<td>Malaysia</td>
<td>72.8</td>
</tr>
<tr>
<td>11.</td>
<td>China</td>
<td>53.7</td>
</tr>
<tr>
<td>12.</td>
<td>Egypt</td>
<td>43.5</td>
</tr>
<tr>
<td>13.</td>
<td>Mauritius</td>
<td>41.8</td>
</tr>
<tr>
<td>14.</td>
<td>Pakistan</td>
<td>36.2</td>
</tr>
<tr>
<td>15.</td>
<td>Bhutan</td>
<td>35.6</td>
</tr>
<tr>
<td>16.</td>
<td>Thailand</td>
<td>34.1</td>
</tr>
<tr>
<td>17.</td>
<td>Myanmar</td>
<td>32.6</td>
</tr>
<tr>
<td>18.</td>
<td>India</td>
<td>31.3</td>
</tr>
</tbody>
</table>


Therefore, it would be reasonable to expect that India’s urban population will continue to grow for several decades. In fact, as stated in the previous section, the urban population is projected to reach 875 million by 2050 and comprise 58% of the total population of the country. Therefore, our cities need to be prepared to accommodate the large increase that is expected in their population, in order to survive, let alone thrive.
2.1.1. Nature of Urbanisation

This section looks at the nature of urbanisation, focussing on the following questions:

- Has the urban growth focussed on a few large cities only or it is spread across a larger set of cities, and
- In which size of cities is the growth happening the fastest?

For this purpose we have categorised our cities into 9 classes as follows in Table 2 below. The number of cities and population share of each class is given in Annexure 3.

### Table 2: Categorisation of Cities

<table>
<thead>
<tr>
<th>Class</th>
<th>Population</th>
</tr>
</thead>
<tbody>
<tr>
<td>I A</td>
<td>Over 5.0 million</td>
</tr>
<tr>
<td>I B</td>
<td>1.0 – 5.0 million</td>
</tr>
<tr>
<td>I C</td>
<td>0.1 – 1.0 million</td>
</tr>
<tr>
<td>II</td>
<td>50,000 – 99,999</td>
</tr>
<tr>
<td>III</td>
<td>20,000 – 49,999</td>
</tr>
<tr>
<td>IV</td>
<td>10,000 – 19,999</td>
</tr>
<tr>
<td>V</td>
<td>5000-9999</td>
</tr>
<tr>
<td>VI</td>
<td>less than 5000</td>
</tr>
</tbody>
</table>

Source: Census of India

Figure 1 below gives the relative share of the population (urban/total) in each category of cities, from 1901 to 2011.
This shows that Class I cities have tended to dominate the urban population with the other cities diminishing in their respective shares. Therefore, the focus of the study is more on this class of cities and look at the growth pattern within this class. For this purpose, Class I cities were further sub-divided we use three sub-groups – Class 1A for cities with more than 5 million people, 1B for cities with 1.0 to 5.0 million people and 1C for those between 0.1 to 1.0 million people.

The growth rates were examined during 1981-1991, 1991-2001 and 2001–2011. For this purpose, data from around 10 cities in each subgroup were studied. Table 3 below presents the results:

**Table 3: Population Growth in Different Categories of Cities**

<table>
<thead>
<tr>
<th>Class</th>
<th>City Name</th>
<th>Population (in lakh)</th>
<th>Annual Growth Rate</th>
<th>Average Growth Rates</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Mumbai</td>
<td>94.2</td>
<td>126</td>
<td>163.7</td>
</tr>
<tr>
<td>1A</td>
<td>Delhi</td>
<td>57.6</td>
<td>94.2</td>
<td>138.5</td>
</tr>
<tr>
<td></td>
<td>Bangalore</td>
<td>29.2</td>
<td>41.4</td>
<td>57</td>
</tr>
<tr>
<td></td>
<td>Hyderabad</td>
<td>26</td>
<td>43.3</td>
<td>57.4</td>
</tr>
<tr>
<td></td>
<td>Ahmedabad</td>
<td>25.6</td>
<td>33.6</td>
<td>45.3</td>
</tr>
<tr>
<td></td>
<td>Chennai</td>
<td>42.4</td>
<td>53.4</td>
<td>65.6</td>
</tr>
<tr>
<td></td>
<td>Kolkata UA</td>
<td>91.9</td>
<td>110.4</td>
<td>132.1</td>
</tr>
<tr>
<td>1B</td>
<td>Surat</td>
<td>9.3</td>
<td>15.2</td>
<td>28.1</td>
</tr>
<tr>
<td></td>
<td>Pune</td>
<td>17.2</td>
<td>24.9</td>
<td>37.6</td>
</tr>
<tr>
<td></td>
<td>Jaipur</td>
<td>10.2</td>
<td>15.2</td>
<td>23.2</td>
</tr>
<tr>
<td></td>
<td>Lucknow</td>
<td>10.1</td>
<td>16.7</td>
<td>22.5</td>
</tr>
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<td></td>
<td>Kanpur</td>
<td>16.4</td>
<td>20.3</td>
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<td></td>
<td>Nagpur</td>
<td>12.2</td>
<td>16.6</td>
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</tr>
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<td></td>
<td>Indore</td>
<td>8.3</td>
<td>11.1</td>
<td>15.2</td>
</tr>
<tr>
<td></td>
<td>Patna</td>
<td>9.5</td>
<td>11.4</td>
<td>17</td>
</tr>
<tr>
<td></td>
<td>Vadodara</td>
<td>7.8</td>
<td>11.3</td>
<td>14.9</td>
</tr>
<tr>
<td></td>
<td>Ghaziabad</td>
<td>2.72</td>
<td>4.54</td>
<td>9.68</td>
</tr>
<tr>
<td></td>
<td>Nashik</td>
<td>4.4</td>
<td>7.3</td>
<td>11.5</td>
</tr>
<tr>
<td></td>
<td>Faridabad</td>
<td>3.3</td>
<td>6.2</td>
<td>10.6</td>
</tr>
<tr>
<td>1C</td>
<td>Chandigarh</td>
<td>4.5</td>
<td>6.42</td>
<td>9</td>
</tr>
<tr>
<td></td>
<td>Hubli and Dharwad</td>
<td>5.27</td>
<td>6.48</td>
<td>7.86</td>
</tr>
<tr>
<td></td>
<td>Bareilly</td>
<td>3.75</td>
<td>5.87</td>
<td>7.18</td>
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<tr>
<td></td>
<td>Gurgaon</td>
<td>0.89</td>
<td>1.21</td>
<td>1.35</td>
</tr>
<tr>
<td></td>
<td>Tiruchirappalli</td>
<td>3.6</td>
<td>7.1</td>
<td>8.7</td>
</tr>
<tr>
<td></td>
<td>Jamnagar</td>
<td>2.77</td>
<td>3.4</td>
<td>4.4</td>
</tr>
</tbody>
</table>
## Review of Urban Transport in India

<table>
<thead>
<tr>
<th>Class</th>
<th>City Name</th>
<th>Population (in lakh)</th>
<th>Annual Growth Rate</th>
<th>Average Growth Rates</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Shimoga</td>
<td>1.5</td>
<td>1.9</td>
<td>2.7</td>
</tr>
<tr>
<td></td>
<td>Kolar</td>
<td>0.83</td>
<td>1.13</td>
<td>1.4</td>
</tr>
<tr>
<td></td>
<td>Satara</td>
<td>0.95</td>
<td>1.08</td>
<td>1.5</td>
</tr>
<tr>
<td></td>
<td>Shimla</td>
<td>1.1</td>
<td>1.44</td>
<td>1.71</td>
</tr>
<tr>
<td></td>
<td>Tumkur</td>
<td>1.79</td>
<td>2.48</td>
<td>3.02</td>
</tr>
</tbody>
</table>


This seems to indicate that the fastest growth has been taking place in cities within the 1 – 5 million population range. Thereafter, it slows down. Even in the 0.1 – 1.0 million population range the growth is fairly fast, though it speeds up once it reaches the 1.0 million level. Therefore, it is extremely important that the planning process does not ignore the 1B and 1C subgroups of cities by focusing all the attention on the 1A subgroup, which, on account of their size, are the more prominent ones.

### 2.2. MOTORISATION

Urbanisation has also led to rapid motorisation. Figure 3 shows the growth in the number of registered motor vehicles from 1951 to 2011. The detailed data may be seen in Annexure 2. In fact, the growth rate in the number of vehicles has been much faster than in the population itself.

**Figure 2: Increasing Motorization Levels**

**Figure 3: Category-wise Registered Vehicles in India**
The total number of registered motor vehicles in India increased from about 0.3 million in 1951 to nearly 142 million in 2011 (MoRTH, GoI, 2013) an increase of 7.7%p.a. as against a population increase of 3.8%p.a. during the same period. During 2001-2011 the growth was even faster at 10% per annum. This increase has also been accompanied by a major transformation in the composition of the motor vehicle fleet, with two-wheeler taking over a dominant role. The share of two-wheelers stood at 72.4% during 2011 as compared to 8.8% during 1951. On the other hand the share of cars, jeeps and taxis which was at 52% in 1951 came down to 13.5% in 2011. The share of buses declined from 11.1% in 1951 to 1.0% in 2011.

The early 1980s seem to have been a turning point when the pace of motorisation took on a steeper trajectory. 1991 led to an even faster growth rate, which does not seem to show signs of slowing down very much. The entry of the affordable and fuel efficient Maruti car as well as attractive motor bikes seems to have fuelled this growth. The lure of the motorbike led to the share of motorized two-wheelers having gone up steeply. It seems that the economic liberalisation in 1991, which allowed a range of fuel efficient and attractive motor bikes to enter the Indian market, enabled this growth in motorisation. A nation starved of quality personal motor vehicles, due to the inward looking policies of the past, suddenly discovered personal mobility and took to it in a big way. A poor quality and inadequate public transport system made motorized two-wheelers extremely popular. This was complemented by the easy availability of motor cycles, at low capital and operating cost and attractive loan options.

Like the population growth, motorisation has also not been uniform across cities, with some having grown faster than others. The older cities like Mumbai and Kolkata seem to have had a slower growth in motorisation compared to the smaller and faster growing cities, as seen from Figure 3 below. While part of the reason could be their respective rates of population growth, the other could be the fact that some have sprawled more than others. Cities with pre-existing mass transit systems, like Mumbai and Kolkata, showed lower vehicular growth.

It has been observed that the per capita vehicle ownership rate has increased in most of the cities except in Chandigarh, where these rates were already high. As indicated in the Figure 5, Chandigarh had the highest vehicle ownership per 1,000 population when compared to...
other urban agglomerations such as Delhi, Bangalore etc. in 2001. However this has now been surpassed by cities like Indore and Chennai.

**Figure 5: Trends in Vehicles/1000 population in Select Indian Cities**

![Graph showing trends in Vehicles/1000 population in Select Indian Cities]

Source: Road Transport Year Book, 2012 (MoRTH, GoI, 2013) and Census of India

Figure 6 presents the trends in urban vehicle density (vehicles / sq km) across various classes of cities. The number of vehicles per square kilometre is increasing in almost all the cities which have been presented, except in Agartala, Agra, Ahmedabad, and Pune – where due to considerable increase in the area of the city, the vehicle density has decreased. However, this could be a transitory phase as the numbers will go up once the benefits of urbanisation reach the new areas.

**Figure 6: Trends in Urban Vehicle Density Trend (Vehicles/sq.km.) in Selected Indian Cities**

![Graph showing trends in Urban Vehicle Density Trend (Vehicles/sq.km.) in Selected Indian Cities]

Source: Road Transport Year Book, 2012 (MoRTH, GoI, 2013)

Thus, the smaller cities, which do not have a good public transport system are witnessing very rapid motor vehicle growth. It is essential to arrest this trend quickly as otherwise it will be unmanageable.
2.2.1. Impact on Public Transport

The rapid growth in motor vehicles has had its impact on the share of Public Transport vehicles and obviously on the share of trips made by Public Transport. While buses constituted about 11% of the total motor vehicles in India in 1951, the share fell to a mere 1.1% in 1991. It seems to have stabilised at this level thereafter. The number of buses per capita has no doubt gone up, but the overall share in the vehicle fleet has reduced sharply, as seen in Table 4 below.

Table 4: Share of Buses in Total Motor Vehicles

<table>
<thead>
<tr>
<th>Year</th>
<th>Census Population (million)</th>
<th>Total registered vehicles ('000)</th>
<th>Registered buses ('000)</th>
<th>Buses to Million Population</th>
<th>Share of buses to total vehicles (per cent)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1951</td>
<td>361</td>
<td>306</td>
<td>34</td>
<td>94.2</td>
<td>11</td>
</tr>
<tr>
<td>1961</td>
<td>439</td>
<td>665</td>
<td>57</td>
<td>129.8</td>
<td>9</td>
</tr>
<tr>
<td>1971</td>
<td>548</td>
<td>1865</td>
<td>94</td>
<td>171.5</td>
<td>5</td>
</tr>
<tr>
<td>1981</td>
<td>683</td>
<td>5391</td>
<td>162</td>
<td>237.2</td>
<td>3</td>
</tr>
<tr>
<td>1991</td>
<td>846</td>
<td>21374</td>
<td>331</td>
<td>391.3</td>
<td>2</td>
</tr>
<tr>
<td>2001</td>
<td>1027</td>
<td>54991</td>
<td>634</td>
<td>617.3</td>
<td>1.1</td>
</tr>
<tr>
<td>2011</td>
<td>1210</td>
<td>141866</td>
<td>1604</td>
<td>1325</td>
<td>1.1</td>
</tr>
</tbody>
</table>


2.2.2. Travel Demand

Travel Demand is a function of the population, per capita trip rate and per capita trip length. Travel demand has, grown faster than the population because it is a function of both the rising number of trips undertaken due to increased income as well as the increased trip lengths on account of increased sprawl. A comparison of travel behaviour over the last few years reveals that there is both an increase in per capita trip rates, as well as the per capita trip lengths as can be seen from Table 5 below. Besides, the share of public transit trips and non-motorised trips has been decreasing.

Table 5: Changes in Per Capita Trip Rate, Public Transit Share, Walking Share, and Motorised Trip Length

<table>
<thead>
<tr>
<th>Category</th>
<th>Population Range (In million)</th>
<th>2007</th>
<th>2011</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>&lt;0.5</td>
<td>0.7-0.76</td>
<td>0.7-1.60</td>
</tr>
<tr>
<td>2</td>
<td>0.5 – 1.0</td>
<td>0.81-1.02</td>
<td>0.36-1.56</td>
</tr>
</tbody>
</table>

---

1 For 2011, the sample size of cities is different(larger). Source: Compilation of Comprehensive Mobility Plans, Institute of Urban Transport, 2014
Public Transit Share

<table>
<thead>
<tr>
<th>Category</th>
<th>Population Range (In million)</th>
<th>2007 (In million)</th>
<th>2011 (In million)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>&lt;0.5</td>
<td>0.0-15.6</td>
<td>0-12</td>
</tr>
<tr>
<td>2</td>
<td>0.5 – 1.0</td>
<td>0.0-22.5</td>
<td>0-12</td>
</tr>
<tr>
<td>3</td>
<td>1.0 -2.0</td>
<td>0.0-50.8</td>
<td>0-36.3</td>
</tr>
<tr>
<td>4</td>
<td>2.0 -4.0</td>
<td>0.2-22.2</td>
<td>0-38.82</td>
</tr>
<tr>
<td>5</td>
<td>4.0-8.0</td>
<td>11.2-32.1</td>
<td>5.77-25.52</td>
</tr>
<tr>
<td>6</td>
<td>Above 8.0</td>
<td>35.2-54.0</td>
<td>27.72-36.65</td>
</tr>
</tbody>
</table>

Walk/NMT Share

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>&lt;0.5</td>
<td>37</td>
<td>32</td>
</tr>
<tr>
<td>2</td>
<td>0.5 – 1.0</td>
<td>58</td>
<td>38</td>
</tr>
<tr>
<td>3</td>
<td>1.0 -2.0</td>
<td>52</td>
<td>41</td>
</tr>
<tr>
<td>4</td>
<td>2.0 -4.0</td>
<td>43</td>
<td>36</td>
</tr>
<tr>
<td>5</td>
<td>4.0-8.0</td>
<td>43</td>
<td>36</td>
</tr>
<tr>
<td>6</td>
<td>Above 8.0</td>
<td>36</td>
<td>31</td>
</tr>
</tbody>
</table>

Motorised Trip Lengths

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>&lt;0.5</td>
<td>1.04-3.52</td>
<td>3.83-4.53</td>
</tr>
<tr>
<td>2</td>
<td>0.5 – 1.0</td>
<td>2.23-3.66</td>
<td>3.58-7.2</td>
</tr>
<tr>
<td>3</td>
<td>1.0 -2.0</td>
<td>4.1-6.04</td>
<td>5.87-13.81</td>
</tr>
<tr>
<td>4</td>
<td>2.0 -4.0</td>
<td>3.85-7.71</td>
<td>5.6-8.03</td>
</tr>
<tr>
<td>5</td>
<td>4.0-8.0</td>
<td>7.1-10.03</td>
<td>8.03-11.35</td>
</tr>
<tr>
<td>6</td>
<td>Above 8.0</td>
<td>9.33-13.14</td>
<td>11.2-15.79</td>
</tr>
</tbody>
</table>

2.2.3. Road Length

The urban road length went up from 123120 km in 1981 to 411840 km in 2011- i.e. by 3.35 times. As against this the number of motor vehicles went up from 5.4 million to almost 142 million i.e. by over 26 times during this period as can be seen from Table 6. Cleary the road space available per motor vehicle has come down drastically.

Figure 7: Increasing Road Network in the Cities
Table 6: Urban Road Length in Kilometres 1971-2011

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Urban Roads Length in KMS</td>
<td>72120</td>
<td>123120</td>
<td>180799</td>
<td>252001</td>
<td>411840</td>
</tr>
<tr>
<td>Urban Population (Million)</td>
<td>109</td>
<td>159</td>
<td>217</td>
<td>285</td>
<td>377</td>
</tr>
<tr>
<td>Urban Roads in km per million population</td>
<td>662</td>
<td>774</td>
<td>833</td>
<td>884</td>
<td>1092</td>
</tr>
<tr>
<td>Registered Motor Vehicles (Million)</td>
<td>1.9</td>
<td>5.7</td>
<td>21.4</td>
<td>55</td>
<td>141.9</td>
</tr>
<tr>
<td>Total Population (Million)</td>
<td>548</td>
<td>683</td>
<td>846</td>
<td>1027</td>
<td>1210</td>
</tr>
<tr>
<td>Registered Motor Vehicles/Million Population</td>
<td>3,467</td>
<td>8,346</td>
<td>25,296</td>
<td>53,554</td>
<td>1,17,273</td>
</tr>
<tr>
<td>Ratio of Urban Roads/Million urban population and registered vehicles /million population</td>
<td>0.18</td>
<td>0.1</td>
<td>0.03</td>
<td>0.02</td>
<td>0.01</td>
</tr>
</tbody>
</table>

Source: Basic Road Statistics, 2011

Registered vehicles per million population has increased by 219% while urban roads per million increased by only 124%, in the last decade. The road space for vehicles has decreased (from 0.18 km per vehicle to 0.01 per vehicle) in the last few decades, resulting in high levels of congestion in all cities. The calculations in the Table above presume that the motor vehicle ownership levels and the road length increases have been uniform across urban and non-urban areas. Although a detailed analysis of this is outside the scope of this paper, it appears that motor vehicle growth has been faster in urban areas. Thus, the problems of increasing congestion are worse than what the Table seems to indicate.

2.2.4. Impact of Rapid Motorisation

a. Congestion

Given the rapid rate of motorisation, and the reduced road space for motor vehicles, coupled with the fact that people are making longer trips and more trips, it is not surprising that cities in India are witnessing severe congestion. Sights as seen in Figure 5 (Yusuf Sarai, in New Delhi), are common in most cities in India – in some cases a lot worse.

A feature not commonly seen elsewhere in the world is the extent of heterogeneity in the vehicles using the roads. Bicycles, cycle rickshaws, auto-rickshaws, taxis, motorbikes, two-wheelers, cars and buses all compete for the same road space. Therefore vehicles capable of travelling at high speeds end up...
travelling at the speed of the slowest vehicle on the road. Table 7 below shows the average peak hour journey speed in about 20 cities across the country and some cities from other parts of the world.

**Table 7: Peak Hour Journey Speed on Major Road Network**

<table>
<thead>
<tr>
<th>City</th>
<th>Average Journey Speed (KMPH) on major corridors 2010**</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gangtok</td>
<td>19</td>
</tr>
<tr>
<td>Chandigarh</td>
<td>32</td>
</tr>
<tr>
<td>Amritsar</td>
<td>25</td>
</tr>
<tr>
<td>Trivandrum</td>
<td>19</td>
</tr>
<tr>
<td>Madurai</td>
<td>23</td>
</tr>
<tr>
<td>Agra</td>
<td>16</td>
</tr>
<tr>
<td>Kochi</td>
<td>20</td>
</tr>
<tr>
<td>Patna</td>
<td>25</td>
</tr>
<tr>
<td>Varanasi</td>
<td>18</td>
</tr>
<tr>
<td>Nagpur</td>
<td>25</td>
</tr>
<tr>
<td>Jaipur</td>
<td>16</td>
</tr>
<tr>
<td>Kanpur</td>
<td>17.4</td>
</tr>
<tr>
<td>Surat</td>
<td>25</td>
</tr>
<tr>
<td>Pune</td>
<td>22</td>
</tr>
<tr>
<td>Ahmedabad</td>
<td>15</td>
</tr>
<tr>
<td>Hyderabad</td>
<td>15</td>
</tr>
<tr>
<td>Chennai</td>
<td>15</td>
</tr>
<tr>
<td>Bangalore</td>
<td>18</td>
</tr>
<tr>
<td>Delhi</td>
<td>15</td>
</tr>
<tr>
<td>Kolkata</td>
<td>17.7</td>
</tr>
<tr>
<td>Singapore</td>
<td>28.6</td>
</tr>
<tr>
<td>Melbourne</td>
<td>35</td>
</tr>
<tr>
<td>Sydney</td>
<td>34</td>
</tr>
<tr>
<td>London</td>
<td>29</td>
</tr>
</tbody>
</table>

**Source: Compiled from CMPs OF Cities in India**

This shows that in most of our cities, both large and small, travel speeds are slower than in cities like Singapore, London, Melbourne, and Sydney. In fact, in many of the Indian cities, the speeds are comparable to average cycling speeds (i.e. 15-16 kmph). If improvements are not made on priority, it would get worse with expensive cars only being able to cruise at walking speeds.

**b. Safety**

Figure 9 and 10 give the number of road accidents and fatalities during 2002-2011. It can be seen from these that the number of road accidents increased by 22% during 2002 – 2011 whereas the number of fatalities increased by 45% during the same period.
Figure 9: No. of Road Accidents (Million)

Source: Road Accidents in India, 2012

Figure 10: Fatalities per Million Population

Source: Road Accidents in India, 2012

Figure 11: Share of Road Accidents in Terms of Road User Categories, 2011

Source: Tiwari G. (2013)

Figure 11 shows the categories of persons affected by road accidents. As seen from this, pedestrians and two-wheeler users are the most vulnerable. Besides, there is a huge
variation in fatality risk across cities of India, ranging from 3.2 fatalities per 100,000 people in Kolkata to 34.4 fatalities per 100,000 people in Vishakhapatnam in 2009 (Singh, 2012). When compared globally, the per capita incidence of road accidents in India is lower than in China, Vietnam and Brazil but much higher than in the US and UK, as seen in Figure 12.

Figure 12: Road Traffic Death Rate (per 100000 Population)

Uncontrolled air pollution has adversely affected the health of the people and their quality of life. For example, with about 4.5 million registered vehicles, Delhi has acquired the dubious distinction of being the fourth most polluted city in the world. The data on air quality as given in Table 8 shows that although SO\textsubscript{2} and NO\textsubscript{2} levels are below the National Ambient Air Quality Standard (NAAQS) in most cities, the Suspended Particulate Matter (both respirable and non-respirable) is disturbingly high in most cities.

Similarly the annual average SPM levels in other smaller and medium sized cities are also given in the Table 8.

Table 8: Annual Average Air Quality Level for Various Cities, 2010

<table>
<thead>
<tr>
<th>Class</th>
<th>City Name</th>
<th>SO\textsubscript{2}</th>
<th>NO\textsubscript{2}</th>
<th>PM\textsubscript{10}</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Annual Average ((\mu g./m^3))</td>
<td>NAAQS</td>
<td>Annual Average ((\mu g./m^3))</td>
</tr>
<tr>
<td>1a</td>
<td>Mumbai</td>
<td>4</td>
<td>19</td>
<td>97</td>
</tr>
<tr>
<td></td>
<td>Delhi</td>
<td>5</td>
<td>55</td>
<td>261</td>
</tr>
<tr>
<td></td>
<td>Bangalore</td>
<td>14</td>
<td>31</td>
<td>89</td>
</tr>
<tr>
<td></td>
<td>Hyderabad</td>
<td>5</td>
<td>24</td>
<td>79</td>
</tr>
<tr>
<td></td>
<td>Ahmedabad</td>
<td>15</td>
<td>21</td>
<td>95</td>
</tr>
<tr>
<td></td>
<td>Chennai</td>
<td>9</td>
<td>15</td>
<td>59</td>
</tr>
<tr>
<td></td>
<td>Kolkata UA</td>
<td>11</td>
<td>62</td>
<td>99</td>
</tr>
<tr>
<td>1b</td>
<td>Pune</td>
<td>29</td>
<td>39</td>
<td>82</td>
</tr>
</tbody>
</table>
The data reveals that high pollution levels are not just a concern for megacities, but are fast becoming a concern for all cities. With increased vehicular use, these pollutants will become as much a concern in the smaller cities as they have been in the large ones.

Further, trends, from the 6 major cities, as shown in Table 9 reveals that while SO\textsubscript{2} and SPM levels have been coming down, NO\textsubscript{X} levels have been increasing.

### Table 9: Pollution Levels

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Delhi</td>
<td>13.7</td>
<td>15.6</td>
<td>12.2</td>
<td>14</td>
<td>195</td>
</tr>
<tr>
<td>Mumbai</td>
<td>49.5</td>
<td>15.9</td>
<td>7.7</td>
<td>8</td>
<td>291</td>
</tr>
<tr>
<td>Kolkata</td>
<td>65.1</td>
<td>47.2</td>
<td>18</td>
<td>11</td>
<td>88</td>
</tr>
<tr>
<td>Chennai</td>
<td>10.3</td>
<td>10.3</td>
<td>6.6</td>
<td>16</td>
<td>146</td>
</tr>
<tr>
<td>Bangalore</td>
<td>7.3</td>
<td>41.6</td>
<td>10.8</td>
<td>9</td>
<td>83</td>
</tr>
<tr>
<td>Hyderabad</td>
<td>60</td>
<td>7.6</td>
<td>9.7</td>
<td>5</td>
<td>82</td>
</tr>
<tr>
<td>NAAQS</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>100</td>
</tr>
</tbody>
</table>

Source: [http://www.cpcb.nic.in](http://www.cpcb.nic.in) as accessed on 19\textsuperscript{th} September, 2014
d. Energy Consumption

The consumption of petroleum fuels in India went up from 6.6 million tonnes in 1981 to 56.32 million in 2011. Since India is a net importer of petroleum fuels, the steep increase in fuel consumption has resulted in a huge drain on the country’s foreign exchange reserves, the import bill having gone up from Rs. 53 Billion (USD 883 Million) in 1980-81 to almost Rs. 7,400 Billion (USD 123 Billion) in 2011-12, i.e. nearly 140 times (Ministry of Petroleum, 2011-12).

Figure 13: Price of Crude Oil (USD/Barrel)

Source: Ministry of Petroleum, 2011-12

This huge oil import bill is also highly vulnerable to fluctuations in the international oil prices. The average growth rate in the price of crude oil has been a staggering 67.63% over the last decade (2004-2014) as can be seen from Figure 13. It has witnessed many periods of negative and positive growth as seen in Figure 10 but the decadal trend has been on increasing prices. With this trend likely to continue, the rapid motorisation in our cities presents a serious threat to our energy security.

2.3. MOBILITY AND URBAN POOR

The poor constitute a significant share of the urban population. As per the Census of India, 2011, nearly 17% of the urban population resides in slums. A study by the Center for Study of Science Technology and Policy (CSTEP) on Bangalore slums reveals a vast difference in
the travel mode choice of people in the slums compared to those in the rest of the city, as given in the figure 14:

**Figure 14: Comparative Modal Split**

![Comparative Modal Split](image)


While in the rest of the city, on an average, 75% of the commuters travel more than 30 minutes to work, analysis of 36 slums in Bangalore indicates that majority of the slum dwellers travel less than 30 minutes. While both groups use public transport, a large share of the slum population resorts to walking and cycling compared to the rest.

Although riding a bus, walking and cycling constitute the main modes of transport for the urban poor, these modes do not receive adequate attention in mobility planning. For example, when it comes to improving bus services, the focus is more on improving the quality, often resulting in higher costs. However, the CSTEP study found that fares were too high and unaffordable for 73% of the people surveyed. It also found that low frequency, absence of shelters; travel time, inadequate seat reservation and harassment were some of the major concerns in using public transport. Pedestrians and cyclists on the other hand, considered inadequate street lighting, absence of cycle parking, poor roads, hygiene, road repairs, walker-unfriendly footpaths, unsegregated traffic and unsafe crossings to be matters of prime importance. Transport strategies, budgets and plans do not adequately address these needs. Instead investments in high cost public transport, signal free road corridors, car parking facilities, premium buses, etc. seem to dominate. Thus, mobility planning is not poor focussed.
2.4. CONNECTIVITY WITH THE SUBURBS

The influence of urban centres often extends to its suburbs both in the immediate neighbourhood and at some distance. Most urban centres have a daily floating population that comes into the urban centre, from the suburbs for business, job, etc. This means, there is a significant amount of suburban travel and therefore, suburban connectivity is important for the economic activity in a city. In the larger cities like Mumbai, Kolkata, Chennai and Delhi, the Indian railways have been running suburban rail services. In most others, suburban connectivity is provided by infrequent bus services. In Delhi, the metro has been extended to Gurgaon and Noida with plans to also connect Faridabad and Ghaziabad. In fact the lines connecting Gurgaon and Noida are the most densely used routes.

2.5. STATUS OF URBAN PUBLIC TRANSPORT IN INDIA

2.5.1. Industry Structure

There are several industry structures for urban public buses in India. In many cities, a State Government owned Transport Corporation runs public bus services. In some such cases the same Corporation runs buses on intra-city routes as well as on inter-city routes. The Andhra Pradesh State Road Transport Corporation (APSRTC) runs bus services in Hyderabad as well as in the entire state of Andhra Pradesh. In others there are separate state owned entities for city services and inter-city services. The Bangalore Metropolitan Transport Corporation runs public bus services in Bangalore whereas other state owned entities operate these services elsewhere in the state. In the States of Gujarat and Maharashtra, where greater powers have been devolved to the local bodies, there are municipally owned bus companies that run city services. The Ahmedabad Municipal Transport Service (AMTS) runs buses in Ahmedabad and the Brihanmumbai Electricity Supply and Transport Undertaking (BEST) runs buses within Mumbai.

Yet another model is of a large number of private bus operators running buses in a city under the authority of permits obtained from the Transport Department. Most small cities tend to have this arrangement. However, in some cities, like Guwahati, these small bus owners compete with State owned companies.

A more recent arrangement encouraged by the Central Government has been of city level Special Purpose Vehicles (SPVs) set up to determine the level of service and private operators being contracted to run such services. This structure is emerging in cities which did not have bus services in the past or do not have strong state owned operations...
dominating the market. Indore, Bhopal, Raipur, Bhubaneshwar, etc. are examples of such arrangements. This is, in fact, in line with the emerging global trend. Indore was a pioneer in this, but others have picked up.

### 2.5.2. Performance of Bus Services in Metropolitan Cities

**Ridership:** The bus ridership patterns in select urban bus services are shown below. It can be observed that DTC and Metropolitan Transport Corporation of Chennai (MTC) have seen an increase in ridership of 91% and 36% respectively during the period 2006-7 to 2010-11. As against this, BEST has seen a decrease of 26% as can be seen from Figure 15.

**Figure 15: Ridership in Various Cities (in Millions)**

![Ridership in Various Cities (in Millions)](image)

A comparison of some of the urban bus services is given in Table 10.

**Table 10: Performance Comparison of City Bus Services (2012-2013)**

<table>
<thead>
<tr>
<th>Providers</th>
<th>AMTS</th>
<th>BMTC</th>
<th>BEST</th>
<th>CSTC</th>
<th>CTU</th>
<th>DTC (CNI)</th>
<th>PMPML</th>
</tr>
</thead>
<tbody>
<tr>
<td>Average fleet held (number)</td>
<td>1,120</td>
<td>6,330</td>
<td>4,259</td>
<td>779</td>
<td>472</td>
<td>5,602</td>
<td>3,585</td>
</tr>
<tr>
<td>Staff / Bus ratio</td>
<td>5.12</td>
<td>5.42</td>
<td>8.6</td>
<td>7.04</td>
<td>4.07</td>
<td>6.8</td>
<td>6.56</td>
</tr>
<tr>
<td>Staff Productivity (kms / staff / day)</td>
<td>25.83</td>
<td>37.07</td>
<td>19.84</td>
<td>13.01</td>
<td>53.2</td>
<td>25.41</td>
<td>40.1</td>
</tr>
<tr>
<td>Average age of fleet (years)</td>
<td>6.7</td>
<td>4.6</td>
<td>6.6</td>
<td>5.4</td>
<td>6.1</td>
<td>6.5</td>
<td>4.3</td>
</tr>
</tbody>
</table>
As seen from the above, the performance has varied across cities. By and large, BMTC, CTU and MTC have tended to perform well. BMTC was known to be the one corporation that earned operating profits, though in 2012-13 even they incurred losses.

In fact, in many cases, the inability to even replace old vehicles through fleet renewal has led to poor services and informal private operators taking over the role of providing urban public transport services. Significant gains are possible even if some of the poor performers try to reach higher levels of performance.

## 2.6. RAIL SERVICES

Rail services can be classified into metro rail services, i.e. those that primarily provide intra city services, and suburban rail, i.e. those providing suburban connectivity.

Unfortunately, there is no clear delineation of responsibility with regard to these two types of rail based systems. Historical evolution tends to guide the current ownership and operating patterns. The Indian Railways, as the traditional provider of rail based system, built and operates the Kolkata metro, and does the same with a small metro system in Chennai. Apart from this it operates all suburban rail systems. However, as the railways found their intra-city rail systems to be loss making, they wanted to focus on the national network.
Accordingly a pattern of joint ownership of metro rail systems emerged, with the national and state governments forming joint ventures to build and operate such systems. Delhi was the first in this direction with the setting up of the Delhi Metro Rail Corporation that runs the Delhi metro. This company is now expanding its network to connect the satellite cities of Noida, Gurgaon, Ghaziabad and Faridabad. New metro systems are coming up in Bangalore, Chennai, Kolkata, Mumbai, Cochin, Nagpur, etc. on a joint ownership model. Some lines in Mumbai and a metro system in Hyderabad are coming up under public-private partnership arrangements. A system in Gurgaon is operating as purely a private initiative.

It is to be noted that the impact of the Metro on different cities is different. As of 2014, Delhi Metro had an operational length of 193 Km and the average ridership of 2.5 million commuters per day, with a passenger per Km ratio of 13,087. On the other hand, Kolkata Metro with an operational length of 29.7 km and a ridership of 0.65 million has a passenger per km ratio of 21,886, implying a better utilisation per km length of investment. Dense urban form and a less dispersed population may be the cause of such higher usage of metro rail system in Kolkata. The same when compared internationally as shown in Table 11 indicates that globally most of the successful metros have an average ridership of around 20,000 per kilometre, the highest being Tokyo at 27,915.

Table 11: Key Features of the Operational Metros

<table>
<thead>
<tr>
<th>S.No.</th>
<th>Metro Name</th>
<th>Daily Passengers (in lakh)</th>
<th>Operation Length (in km.)</th>
<th>Passenger Served / km.</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Delhi Metro*</td>
<td>25.23</td>
<td>192.81</td>
<td>13,087</td>
</tr>
<tr>
<td>2.</td>
<td>Kolkata</td>
<td>6.5</td>
<td>29.7</td>
<td>21,886</td>
</tr>
<tr>
<td>3.</td>
<td>Bangalore</td>
<td>0.41</td>
<td>14.6</td>
<td>2,808</td>
</tr>
<tr>
<td>4.</td>
<td>Gurgaon Rapid Metro</td>
<td>0.32</td>
<td>5.1</td>
<td>6,275</td>
</tr>
<tr>
<td>5.</td>
<td>Mumbai Metro (Versova – Ghatkopar)</td>
<td>2.5</td>
<td>11.4</td>
<td>21,930</td>
</tr>
<tr>
<td>1.</td>
<td>Tokyo</td>
<td>85</td>
<td>304.5</td>
<td>27,915</td>
</tr>
<tr>
<td>2.</td>
<td>Seoul</td>
<td>69</td>
<td>326.5</td>
<td>21,133</td>
</tr>
<tr>
<td>3.</td>
<td>Beijing</td>
<td>67.4</td>
<td>442</td>
<td>15,249</td>
</tr>
<tr>
<td>4.</td>
<td>Moscow</td>
<td>65.5</td>
<td>325.5</td>
<td>20,123</td>
</tr>
<tr>
<td>5.</td>
<td>Shanghai</td>
<td>62.4</td>
<td>533</td>
<td>11,707</td>
</tr>
<tr>
<td>6.</td>
<td>Guangzhou</td>
<td>50</td>
<td>256.2</td>
<td>19,516</td>
</tr>
<tr>
<td>7.</td>
<td>Hong Kong</td>
<td>39.6</td>
<td>175</td>
<td>22,629</td>
</tr>
<tr>
<td>8.</td>
<td>Singapore</td>
<td>21.8</td>
<td>150.8</td>
<td>14,456</td>
</tr>
</tbody>
</table>

2.6.1. Delhi Metro

Delhi metro system is currently the world’s thirteenth largest metro system. It serves the mobility needs for intra-city trips of commuters in Delhi as well as connects Delhi with its satellite towns like Gurgaon, Noida, and Ghaziabad. It has a total network of 193 km. (including airport express line) as of June, 2014 and carries around 2.5 million commuters daily.

Table 12: Delhi Metro Ridership

<table>
<thead>
<tr>
<th>Lines</th>
<th>Length (Km.)</th>
<th>Passengers</th>
<th>Passengers/km</th>
</tr>
</thead>
<tbody>
<tr>
<td>Red Line</td>
<td>25.09</td>
<td>3,60,512</td>
<td>14,369</td>
</tr>
<tr>
<td>Yellow Line</td>
<td>44.65</td>
<td>8,87,003</td>
<td>19,866</td>
</tr>
<tr>
<td>Blue Line</td>
<td>58.67</td>
<td>9,81,252</td>
<td>16,725</td>
</tr>
<tr>
<td>Green Line</td>
<td>18.46</td>
<td>90,669</td>
<td>4,912</td>
</tr>
<tr>
<td>Violet Line</td>
<td>23.24</td>
<td>1,85,464</td>
<td>7,980</td>
</tr>
<tr>
<td>Airport Line</td>
<td>22.70</td>
<td>18,512</td>
<td>815</td>
</tr>
<tr>
<td>Total</td>
<td>192.81</td>
<td>25,23,412</td>
<td>13,087</td>
</tr>
</tbody>
</table>

Source: www.delhimetrail.com as accessed on 19th September, 2014

The Table 12 shows that while some lines of the Delhi metro are heavily used, others carry far fewer passengers. This could be due to low demand between the points connected, the relative density of habitation on the respective corridors, etc. The low ratio of passengers per km. for Delhi metro is attributed to low ridership on two lines of the metro system, namely the Violet Line (Connecting Central Secretariat to Badarpur and having a daily ridership of 7,980 passenger/km) and Green Line (connecting Inder Lok to Mundka with only 4,912 passenger/km daily). The Yellow Line (Connecting Jahanagirpuri to Gurgaon) carries almost 20,000 passengers/km daily, which is comparable with the most intensely used metro systems in the world.

Since several more metro systems are being built, there are important lessons to be learnt from the Delhi experience in choosing the alignments well.

2.7. SUBURBAN RAILWAYS

Suburban railways constitute a major part of the urban mass transit systems in select cities in India like Mumbai, Kolkata, Chennai, and Hyderabad. The suburban services are divided by zones, namely, Central Railway, Eastern Railway, Southern Railway, South Eastern railway, and Western Railway.

Central railways and Western Railways carried more than 60% of the suburban traffic during 2006-2011. Sub-urban rail accounted for over 50% of the passengers carried on Indian Railways daily, though only 14% of the passenger km. carried every day. Thus, Indian
railways play a very important role in meeting the needs of urban mobility, especially in Mumbai.

As shown in Table 13, suburban passenger train kms of the Indian Railways increased by 114% during the period 1980-81 to 2011-12 and vehicle kms increased by 146% during the same period. The sub urban train kms contributed 12% to the total train kms (suburban and non-suburban) travelled by Indian railways in 1980-81, but have since declined to 5% in 2011-12. During the same period the share of suburban railways (vehicle kms) has declined from 10% to 7%. The density of operations of suburban services has increased from 36.6 train kms per running track km/day, to 46.4, an increase of 27%, whereas the non-suburban density of train services has doubled.

Table 13: Suburban and Non-Suburban Train kms (“Indian Railways,” 2012)

<table>
<thead>
<tr>
<th>Year</th>
<th>Suburban (Millions)</th>
<th>Non-suburban (Millions)</th>
<th>Train kms</th>
<th>Vehicle kms</th>
<th>Sub-urban</th>
<th>Non-suburban</th>
</tr>
</thead>
<tbody>
<tr>
<td>1980-81</td>
<td>35.55</td>
<td>601.5</td>
<td>258</td>
<td>5,582</td>
<td>36.6</td>
<td>9.7</td>
</tr>
<tr>
<td>1990-91</td>
<td>48.37</td>
<td>840.7</td>
<td>316</td>
<td>7,739</td>
<td>40</td>
<td>11.5</td>
</tr>
<tr>
<td>2000-01</td>
<td>56.04</td>
<td>1,029.5</td>
<td>397</td>
<td>11,035</td>
<td>47.1</td>
<td>13.8</td>
</tr>
<tr>
<td>2010-11</td>
<td>73.25</td>
<td>1,438.5</td>
<td>581</td>
<td>18,207</td>
<td>46.7</td>
<td>19.2</td>
</tr>
<tr>
<td>2011-12</td>
<td>76.14</td>
<td>1,479.3</td>
<td>605</td>
<td>19,340</td>
<td>46.4</td>
<td>19.4</td>
</tr>
</tbody>
</table>

Thus, the Indian Railways seems to be focusing greater attention on inter-city transport than on suburban transport, thus suggesting that the suburban systems are better to come under the jurisdiction of agencies that manage urban transport systems. This would also seem logical as the nature of suburban transport systems is closer to that of urban transport systems than inter-city transport systems.

2.8. INTERMEDIATE PUBLIC TRANSPORT (IPT) SYSTEMS

Informal public transport systems like auto-rickshaws, cycle-rickshaws, informal car-pooling systems, etc., also called as Intermediate Public Transit Systems (IPT) forms a vital share of the public transit systems in any city, ranging from 3-8 percent of the total modal shares in different sized cities. Nearly 75% of the global auto rickshaw population is found in India (“Autorickshaw Sector,” 2012). Their role as a feeder to existing public transit systems, providing the first-last mile connectivity helps increase the coverage of the main/trunk public transit systems like the Metro/suburban rail/bus transit. This is true for cities that are larger and have some sort of public mass transit system available. IPT plays the role of public transit systems, especially in small and medium sized cities where formal public transit system is absent. Small towns with low population, small trip lengths, scattered economic
nodes, always cannot justify an efficient public transit systems. Thus, IPT can be seen as an alternative to public transit systems in these cities – it is demand driven and has evolved with the growth of the city. Due to their informal nature, there are issues of planning, organisation, safety, efficiency, and environment friendliness that need to be addressed, to improve these systems and more effectively addresses the travel needs of the people in these cities.

2.9. SUMMARY

Thus, as urbanisation continues, motorisation is taking place at an even faster pace. In particular, the smaller cities are witnessing the fastest growth. Motorized two-wheelers occupy the dominant share in a city’s vehicular fleet. Public transport systems have proved inadequate to help reverse the declining share in their use. Air pollution, fuel consumption and the impact on our import bill have been severe. Clearly, the situation will only get worse as the next section will highlight.
3. URBAN TRANSPORT PROJECTION AND SCENARIO ANALYSIS

This section projects the *intra-city urban passenger transport* demand in Indian cities with population of 0.1 million and above, to estimate its impact on congestion, energy consumption and emissions. The intent of the analysis is to bring out the different policy priorities that need to be adopted. It recognises that urban passenger transport demand is a function of the number of people who travel, the average number of trips each of them makes and the average length of each of these trips. It first makes the projections on a Business as Usual (BAU) basis and thereafter it analyses multiple scenarios.

### 3.1. URBAN POPULATION PROJECTION

Between 2001 and 2011, India's population grew from 1.03 billion to 1.2 billion at an average annual growth rate of 1.6%. As against this the urban population went up from 286 million to 377 million during the same period, a growth rate of over 3% per year. The population projections based on Registrar General of India estimates (*"Population Projections 2026,"* 2006) assumes total population growth rate of 1.3% between 2011-2015, about 1.1% between 2016-2020 and 0.92% between 2021-2051. Further, the urban population share was assumed to increase by 1.4% per year for the projected years. Based on these assumptions, the population projection up to 2051 are as in Table 14 below:

**Table 14: Urban Population (2011 and Projected 2021-51)**

<table>
<thead>
<tr>
<th>India</th>
<th>2001</th>
<th>2011</th>
<th>2021*</th>
<th>2031*</th>
<th>2041*</th>
<th>2051*</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total Population (Billion)</td>
<td>1.03</td>
<td>1.21</td>
<td>1.35</td>
<td>1.48</td>
<td>1.61</td>
<td>1.75</td>
</tr>
<tr>
<td>Urban Population (Million)</td>
<td>286</td>
<td>377</td>
<td>485</td>
<td>588</td>
<td>705</td>
<td>839</td>
</tr>
<tr>
<td>Population in cities of 0.1 Million and above Population</td>
<td>265</td>
<td>340</td>
<td>413</td>
<td>495</td>
<td>589</td>
<td></td>
</tr>
<tr>
<td>Urban Population Share (%)</td>
<td>27.8</td>
<td>31.1</td>
<td>35.8</td>
<td>39.8</td>
<td>43.8</td>
<td>47.8</td>
</tr>
</tbody>
</table>

This analysis focuses on the majority of the urban population (70%) spread over 468 cities (2011 census), having a total population of 265 million. The current percent share of each category is maintained to project their population for 2021 and 2031. The total population for the various categories of cities considered is projected to increase at 28% by 2021 and at 56% by 2031 in comparison with the 2011 estimates.

---

2 CAGR 2011-2021-2.55%,
3 CAGR-2021-2031-1.94%
4 There is no underlying trend, so the current share is maintained.
3.2. TRANSPORT – ENERGY-EMISSIONS MODEL

Transport demand in any economy is largely influenced by demographic growth as well as economic growth. These are perhaps best reflected through population (rural/urban) and change in Per Capita Trip Rates (PCTR) as well as trip lengths. The analysis is based on the city categories above, using the averages of each category for trip rates, trip lengths and mode share. The assumptions are derived from available 2011 estimates from the Traffic and Transportation Study, MoUD, 2008. As well as data from various Comprehensive Mobility Plans on trip rates, trip lengths and mode shares. The model flow is as elaborated in Figure 16.

**Figure 16: Model Flow**

The outputs are passenger travelled demand expressed in passenger kilometres (PKMs), energy consumption and emission factors for different modes with respect to each category of city. The detailed methodology for the analysis may be seen at Annexure 4. The next sections illustrates scenarios based on different urban transport policy interventions.

3.3. ANALYSIS OF ALTERNATIVE SCENARIOS

The alternative scenarios were created over the business as usual scenario (BAU) and are explained in Table 15, using some policy options elaborated in the Annexure 4.
### Table 15: Description of the Scenarios

<table>
<thead>
<tr>
<th>Alternative Scenarios</th>
<th>Overview</th>
<th>Details</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Scenario 1</strong></td>
<td>Business as usual (BAU)</td>
<td>This scenario will represent the future based on the existing trends (Assumptions in Annexure 4)</td>
</tr>
<tr>
<td><strong>Scenario 2</strong></td>
<td>Promoting NMT</td>
<td>The scenario considers improvement in NMT infrastructure with the assumption of increasing the modal share of NMT modes by 10%.</td>
</tr>
<tr>
<td><strong>Scenario 3</strong></td>
<td>Promoting Public Transit Ridership</td>
<td>This scenario presumes an increase in the public transport mode share, as follows through improvements in public transport systems:</td>
</tr>
<tr>
<td></td>
<td></td>
<td><strong>Category of City</strong></td>
</tr>
<tr>
<td></td>
<td></td>
<td>1</td>
</tr>
<tr>
<td></td>
<td></td>
<td>2</td>
</tr>
<tr>
<td></td>
<td></td>
<td>3</td>
</tr>
<tr>
<td></td>
<td></td>
<td>4</td>
</tr>
<tr>
<td></td>
<td></td>
<td>5</td>
</tr>
<tr>
<td></td>
<td></td>
<td>6</td>
</tr>
<tr>
<td></td>
<td></td>
<td>1. Of the PT share (for category 5 and 6 cities) - 50% will be served by Metro/Rail traction in 2021 and 2031.</td>
</tr>
<tr>
<td><strong>Scenario 2+3</strong></td>
<td>Promoting Public Transit (PT) Ridership and Non-motorized transport</td>
<td>This scenario will be a combination of scenarios 2 and 3 above</td>
</tr>
</tbody>
</table>
| **Scenario 4**        | Clean Technology-focus on personal vehicles | 1. Focus on increased energy efficiency  
2. Electric vehicle penetration: Penetration levels over BAU scenario: Two–wheelers-10% (2021), 15% (2031) and cars – 5% (2021), 10% (2031). |
| **Scenario 5**        | Clean Technology-focus on electric traction for public transit (buses) | 15% of the Billion Passenger Kilometres (BPKMS) is travelled by electric buses in 2021 and 30% by 2031. |
| **Scenario 4+5**      | Clean Technology-focus on electric traction for public transit (buses) and personal vehicles | This is a combination of scenarios 4 and 5. |
| **Scenario 6**        | Improving Urban Structure | The focus of this scenario will be development of compact cities with high density and multi-nuclei development, resulting in BAU trip lengths (i.e. no increase in trip lengths compared to the BAU scenario)  
1. Motorised trip lengths same as 2011 for 2021 and 2031  
2. NMT mode share remains constant as of 2011 (does not decrease) |
| **Scenario 6A**       | Aggressive Urban Structure and Form Control | This is a more aggressive policy regime compared to Scenario 6, focussing on compact cities that induces NMT trips with:  
1. With reduced motorised trip lengths by 5% and 10% for 2021 and 2031 respectively |
### Alternative Scenarios Overview Details

<table>
<thead>
<tr>
<th>Scenario</th>
<th>Overview</th>
<th>Details</th>
</tr>
</thead>
<tbody>
<tr>
<td>Scenario 7</td>
<td>A multi-pronged approach</td>
<td>This is a combination of scenarios 2, 3, 4, 5 and 6A</td>
</tr>
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</table>

### 3.3.1. Results of the Analysis

The results of the analysis, using the model, are illustrated in figures 17 to 21 below.

**Figure 17: Annual Vehicles Kilometres Travelled (in Billion Kms.)**

![Graph showing annual vehicles kilometres travelled across different scenarios for years 2021, 2031, and 2011.](image)

**Figure 18: Annual Passenger Motorised Travel Demand (in BPKMS)**

![Graph showing annual passenger motorised travel demand across different scenarios for years 2021, 2031, and 2011.](image)
Some of the key findings from this analysis are the following:-

- The motorised passenger travel demand in the BAU scenario would double by 2021 and triple by 2031 compared to the 2011 scenario.

5 More than 1 lakh population
Cities with less than 1 million population would contribute almost 30% of this demand, with another 30% coming from cities in the 1-5 million population range.

The smaller cities would emerge as energy hot spot in the future and this problem would not remain a matter of concern only in the larger cities.

Efforts towards increasing the share of public transport and enhancing the share of non-motorised modes together (scenario 2 and 3) would have a significant effect in curbing this growth in the motorised travel demand. These efforts will be further strengthened, if land use plans emphasize the development of compact cities and take advantage of integrated land use and transport planning.

Purely technology focused measures such as introducing electrical vehicles would not have an effect on the demand for motorised travel. However, it would help reduce the demand for petroleum fuels.

The annual petroleum fuel consumption in urban transport will go up by two times by 2021 and four times by 2031 in the BAU scenario. Improvements in public transport and non-motorised modes would help reduce the annual fuel consumption and consequently the annual emission of carbon dioxide.

Potential savings of Rs. 79,200 crore and Rs. 1,78,700 crore in the annual fuel import bill are possible by 2021 and 2031, if holistic measures to reduce the motorised travel demand are taken by our cities.

A reduction of 70 Million Metric Tonnes and 140 Million Metric Tonnes of Carbon Dioxide is possible by 2021 and 2031, if such measures are taken.
4. INITIATIVES AND IMPACT

4.1. Brief Historical Perspective

Urban transport initiatives in India, post-Independence were restricted to a few cities like Kolkata, Mumbai and Chennai. Suburban trains and trams were a feature in all these cities, even before Independence and post-Independence public bus services transit efforts continued in these cities, with the SRTUs. However, the first ever Metro in India was conceived in 1949 and the first Metro rail route in India was made operational in 1984. So the understanding of the need for public transit systems for urban transport is not new, but did not receive too much attention during the first few decades after independence.

4.2. Recent Actions Taken

Four developments, spread over a period of 20 years from 1986 to 2006, have helped initiate and accelerate efforts to deal with the rapidly emerging problems of urban transport in India. These are the following:

- First, in 1986, was the recognition of urban transport as a separate subject in the allocation of responsibilities within the Central Government and its assignment to the Ministry of Urban Development. This signalled recognition that urban transport is an issue that needs to be addressed and is distinct from inter-city transport. It also signalled the recognition that it needs to be dovetailed with other aspects of urban planning.
- The second was the decision taken in 1996 to build a metro rail system in Delhi as a partnership between the national government and the concerned state government. This signalled the willingness to invest large amounts in mitigating the problems of urban transport and that the local governments need to be involved in the process. The Delhi metro was completed as a very well executed project and became a beacon for other cities to focus attention on improving public transport as a way to deal with congestion rather than by enhancing the capacity of the road network.
- The third was the launching of the National Urban Renewal Mission, in 2005, which offered significant financial support from the national government to the cities for investments in urban infrastructure, subject to the acceptance of a series of conditions. The conditions primarily aimed at delegating greater authority to the cities and making the services financially sustainable. For transport related investments the focus was on proposals that were in conformity with a National Urban Transport Policy that was being formulated at that time.
- The fourth was the adoption of a National Urban Transport Policy, in 2006, which primarily emphasised investments in public transport and non-motorized modes as against road
widening and construction of flyovers – this was indeed a major achievement at a time when inaugurating a new flyover was considered popular by every leader.

The last two developments have been explained in greater detail in the sections that follow.

4.2.1. National Urban Transport Policy of India

One of the major initiatives that triggered increased attention to sustainable transport in the cities was the formulation and adoption, in April 2006 ("NUTP," 2006), of a National Urban Transport Policy. Under severe pressure for “doing something” about the deteriorating transport situation in the largest cities of the country, the Ministry of Urban Development decided to formulate a National Urban Transport Policy and, in April, 2003, set up a committee to prepare a draft. One of the major issues was whether a National Policy was really required since urban transport was essentially a State subject. However, it was agreed that a National Policy was justified for the following reasons:

- Several key agencies work under the Central Government
- Several Acts and Rules relevant for urban transport are administered by the Central Government
- There is a need to guide state level action plans within an overall framework
- There is a need to guide Central financial assistance towards improving urban mobility
- There is a need for coordinated capacity building, research and information dissemination.

The major elements of the National Urban Transport Policy are the following:

- Incorporating Urban Transport as an important parameter at the planning stage rather than being a consequential requirement
- Reduced travel demand by bringing about better integration of land use and transport planning to improve access to jobs, education, etc.
- Equitable allocation of road space
- Encourage investments in public transport and non-motorized transport so that the dependence on personal motor vehicles is reduced.
- Improved public transport-Offer the Central Government’s financial support to all the State capitals and other cities with a population of over one million, for setting up Mass Transit Systems
- Introduction of Intelligent Transport Systems (ITS)
- Support the principle that the Government provides the capital infrastructure, but the direct and indirect beneficiaries pay for the operating costs.
- Innovative financing mechanisms, with greater involvement of private sector
- Encourage a coordinated approach to the management of urban transport through the establishment of Unified Metropolitan Transport Authorities in all million plus cities
Offer support for better awareness and capacity building and knowledge enhancement in urban transport planning at the State level—individual and institutional

Encourage incentives that will facilitate the use of cleaner fuel and vehicle technologies, so that the pollution caused by motor vehicles gets reduced.

4.2.2. National Urban Renewal Mission

At the same time that the National Urban Transport Policy was being debated, a realisation was also emerging that the hitherto emphasis on rural development had led to a neglect of urban areas, which suffered from poor infrastructure. The occurrence of severe rains in Mumbai, in 2004, which virtually brought the commercial capital of India to a stand-still, helped highlight the neglect faced by urban areas. Also, realising that though less than 30% of the population resided in urban areas, more than 60% of the GDP came from such areas, the government decided that the time had come to correct the past neglect. It launched the “Jawahar Lal Nehru National Urban Renewal Mission (NURM)” (“JnNURM,” 2005) in December 2005 committing substantial funds for investments in urban infrastructure. Speaking at the formal launch event of this Mission, the Minister for Urban Development said that this manifested recognition of the fact that urbanisation was irreversible and here to stay.

This mission had the following features:

- The requirement that a city first prepares, after extensive public consultation, an overall City Development Plan (CDP), presenting a strategic vision of what the city wanted to be;
- A priority list of investments was required to be incorporated in the CDP so that investments are made with a clear priority in mind and not in an ad-hoc manner;
- Central Government’s support by way of financial grants for investments in urban infrastructure ranging from 35% of the project cost for the large cities which have the ability to raise resources on their own, to 50% for medium sized cities and going up to 90% for smaller, disadvantaged cities;
- Substantial funds earmarked for this purpose - the National Government committed an amount of Rs. 50,000 crore (approximately $10 billion) to be spent over a period of 7 years, with the expectation that this would leverage at least a similar amount from State Governments, the private sector and financial institutions;
- Reforms in urban governance to enable financial sustainability of the physical assets created and their operation – essentially to ensure that the assets created would not need financial support on a continuous basis and would be able to recover their operating costs;
- Establishment of a Central Sanctioning and Monitoring Committee (CSMC) that would first scrutinize the CDPs and only thereafter approve individual project proposals for the Central Government’s financial support.
The National Urban Renewal Mission, coupled with the NUTP, provided the thrust needed for the changes that took place in seeking solutions to the problems of urban gridlock and poor air quality. NURM provided substantial funds and, armed with generous support from the National budget, cities were able to come up with ambitious plans for infrastructure development. Coupled with this, the NUTP provided a framework and a direction for possible interventions towards sustainable transport. It essentially conveyed a message that if you seek to make investments towards sustainable transport, funds would be available.

4.3. RESULTS OF THE EFFORT – GAINS AND CHALLENGES

The initiatives taken since 1986 have led to several positive consequences, but many challenges still remain. While the directions have broadly been right, the pace and emphasis seem to require a review along with a closer alignment with the emerging urbanisation scenario in India.

4.3.1. Gains

The positive consequences include:

- Urban transport has clearly been recognised as a problem that needs attention and to be treated differently from inter-city transport. A well thought out and sound policy framework, in terms of the National Urban Transport Policy, is in place and accepted by all stakeholders as a guiding document.

- A partnership between the national, state and local governments for investments in urban infrastructure through the JnNURM, catalysed an interest in developing our cities. It highlighted the importance of cities as the engines of economic growth. While this programme has now closed, a successor and vastly more ambitious programme is in the offing by the new government. This implies that irrespective of political philosophy, the need for large investments in urban infrastructure is acknowledged across all political parties.

- It has been recognised that improving public transport, rather than enhancing highway capacity, is the right approach to deal with the problems, this approach is not being challenged, even if some projects aimed at road capacity enhancement are still being taken up. This is evident from the fact that several cities have taken up mass transit projects and others are working towards improving their public bus services. Apart from this, 66 cities were provided with national governments grant support for the purchase of public transport buses. A list of the mass transit projects taken up in the country over the last 15 years is given at Annexure 5.

- There is recognition that public bus services have a poor social image and that this needs to be corrected through better infrastructure, planning and services. The social image of the bus needs to be changed from being perceived as a poor man’s compulsion to a mode of choice for the higher income groups as well. It has also been recognised that the industry
structure for city bus services needs to change as these services are, by nature, very different from inter-city bus services. This would align it to the emerging industry structure globally. In order to secure these outcomes, the central government imposed the following pre-conditions while supporting cities to procure buses for city bus services:

- The buses are to be of improved quality and design
- Institutional mechanisms are to be put in place to coordinate urban transport actions
- Separate SPVs, distinct from inter-city bus operators, are to be established to manage city bus services
- Dedicated funds are to be established to pay for urban transport
- The private sector are to be tapped for operations
- Policies are to be put in place for parking and advertisement

Urban transport has been recognised as an important component of urban planning. For the first time in the country, the Planning Commission of India set up a separate working group to develop an approach paper on urban transport for the 11th Five Year Plan (FYP) (2007 – 2012). This practice was continued for the 12th FYP. On all previous occasions a working group on urban development included a component on urban transport in its recommendations. This was an indication of the growing attention and awareness of the urban transport problems. The working group on urban transport for the 11th FYP recommended an outlay of over ₹ 1,82,686.50 crore (USD 30 Billion) for urban transport during the FYP period. It was a comprehensive set of recommendations covering the needs of all classes of cities and it was for the first time that such an exercise to look at the needs of cities beyond the larger metropolises was taken up. For the 12th FYP the working group recommended an investment of Rs. 3,883 Billion (USD 64 Billion) (“12th Plan Urban Transport,” 2012)

There was recognition of the importance of capacity building and local research. There was also recognition that cities needed technical handholding. Hence, an Institute of Urban Transport, that was set up in 1997, but was languishing for lack of funds, became active and had to quickly hire more people to take up the capacity building and handholding activities. An Urban Mass Transit Company (UMTC), which was set up in 1992 but had been dormant since then was quickly revived to provide consulting support to the cities. Centers of Excellence were set up in Delhi, Chennai, Ahmedabad and Warangal to undertake research and help build manpower capacity in this growing field.

In short, urban transport has become an area that draws considerable attention and is no longer the least important in urban governance. There has, indeed, been a sea of change.

**4.4. CHALLENGES THAT STILL REMAIN**

Despite these positive consequences, which have helped bring about a visible transformation from creating capacity to accommodate increased motorisation towards improving public transport, several challenges still remain. Most important among them are the following:
Governance of urban transport is still highly fragmented and urban transport actions are managed by a multitude of agencies in any city. Often these agencies report to different levels of government. Such fragmentation leads to uncoordinated planning with sub-optimal outcomes.

The institutional arrangements for holistic planning continue to be weak. Institutions that could take a comprehensive responsibility for urban transport do not exist except in a few cities. While some cities have set up Unified Metropolitan Transport Authorities, they are essentially committees of influential officials but with little compulsion to really take coordinated action. They lack the support of a strong technical secretariat that can take a comprehensive set of measures that encompass mass transit, bus services, road network planning, land use planning, parking strategies, traffic management, etc. The Mumbai Metropolitan Development Authority (MMRDA) and the Chennai Metropolitan Development Authority (CMDA) seem to be the pioneers, but others are yet to pick up. Delhi, the capital city, has been planning to set up a Unified Metropolitan Transport Authority, but has been unable to get the required legislation in place yet.

Integrated land use and transport planning has not been institutionalised. Although cities have been required to prepare Comprehensive Mobility Plans (CMPs), these have, at best, tried to take into account multiple transport sub-systems, without really integrating them as a part of a larger city transport system network. In any case, land use and transport plans have not been integrated. The land use plans are developed as “master plans” under a legal requirement. However, CMPs are prepared as a pre-requisite for accessing funds from the national government. Though a National Urban Transport Policy is in place, it lacks legal backing. As a result, non-compliance with the policy cannot be penalised. Thus, the agencies directly responsible for urban transport may comply, but those less directly responsible for it do not give it the seriousness it deserves.

The industry structure for public transport has not moved in line with global trend. Either State owned public corporations continue to provide monopoly services, like in Hyderabad, Bangalore, Pune and several other cities, or multiple small owners operate services with minimal regulation, thereby offering a low quality of service. The kind of industry structure that has evolved in cities like London, Seoul, Vancouver or Curitiba has eluded Indian cities. There have been some efforts towards setting up organising authorities, but these have had limited success. Most cities have not set them up and in a few cases where they have, private operators have not come forward in adequate measure to operate services on structured contracts. Indore started this trend through the Indore City Transport Services Limited (ICTSL) and Bhopal picked it up too. However, replication elsewhere has been weak. Delhi has been able to procure private operators for only a few of the routes for which it invited offers.

High cost and construction focused projects are the major attraction for the urban transport leadership. Deterministic models and their ridership forecasts and fare revenues are usually made based on optimistic projections. The focus in most of the cases is biased to support a particular transport mode rather than being on a transport mode resulting from
the projections. Thus consideration of major public transport investment seems to be towards high-cost metro rail systems, without an adequate and professional evaluation of lower cost but equally effective alternatives. The successful completion of the Delhi Metro and the glamour of this facility, vis-à-vis normal bus transport, made it a very attractive proposition. Coupled with claims about “profits from day one” and easy availability of funds from international sources, the Metro became a popular option for political leaders at State and municipal levels. The Delhi Metro is something all cities would like to replicate, regardless of whether they need it or not.

- There is little attempt at integrating mass transit planning with land use or even with other feeder systems. As a result situations such as the metro not carrying enough trips when compared internationally and yet being completely choked become the order of the day. The Delhi Metro carries about 2 million people per day for a 189 km network, which is below the average for several metro systems in large cities, and yet it is extremely crowded. The reasons for this need to be studied and this anomalous situation needs to be avoided in future projects.

- Motorisation has continued to take place and high cost projects have not helped reduce the sale or use of motor vehicles. Congestion in Delhi has not come down despite the huge investments in the metro system in the city. The motor vehicle growth trends in Delhi since the opening of the Delhi Metro can be seen in Figure 19 below. This shows that the number of motor vehicles went up from 3.7 million in 2002 to 7.2 million in 2011 – a doubling in just 10 years, despite the metro.

**Figure 22: Motor Vehicle Growth in Delhi (In ‘000)**

![Motor Vehicle Growth in Delhi](image)

Source: Road Transport Year Book, July 2012

- Initiatives towards demand management have virtually not started. Despite the large metro rail network in Delhi there is not enough effort at limiting the amount of parking or even raising parking fees in the areas that are well served by the metro. Road use pricing initiatives are yet to be contemplated even in such areas. Other efforts towards restraining car use or ownership is rather slow.

- Though the JnNURM sought to offer funds for initiatives that complied with the National Urban Transport Policy, a substantial portion was allocated to road widening projects –
those that were out of line with the NUTP. Almost 60% of the total funds allocated to the Urban Transport Sector was towards projects for building roads, flyovers, and rail over bridges. (Details Annexure 6)

- There have been some efforts towards promoting alternative fuels, but these have been few and will not be able to go a long way. On a direction from the Supreme Court of India, Delhi was compelled to convert all its buses and para-transit to CNG. Yet other cities have not replicated this. A few small areas do have electric vehicles and an Electric Vehicle Task Force has also been set up under the Ministry of Heavy Industry. However, these have not led to much visible progress towards alternative fuels, especially when the consumption of petroleum fuels and the impact on the nation’s foreign exchange is so large. Thus an urgent focus on investment for electrification of the public bus system is vital. Although initial investments may be large, but plans of technology transfer and indigenisation of the technology would make this effort sustainable.

- Initiatives towards innovative financing have also remained weak. The primary source of funding has been the public budget and efforts at raising resources from additional fuel taxes or land value capture or even commercial exploitation of property have been few and weak.

- Attention has also largely been towards the larger cities and adequate attention has not been paid to the smaller cities where land use patterns are still emerging and much can be done at early stages of development to ensure a sustainable and low carbon growth path. The urgency seems to be in dealing with the existing problems rather than on the problems that would emerge very soon. The two need to be taken up together so that the medium sized cities do not make the same mistakes that the larger ones did.

- Urban transport is an extremely complex area and requires an understanding of several diverse disciplines. Unfortunately, the capacity for good urban transport planning is seriously lacking, especially in the cities. This is leading to serious problems as efforts continue to be made for enhancing infrastructure capacity for “moving cars, not people”. This needs to change and the folly of just encouraging further motorisation needs to be understood.

Thus, while the efforts so far have been in the right direction, the expected outcomes have not been realised. A case in point is Delhi. Despite a huge investment in a world class metro rail system and huge subsidies to the bus system, a young lady could not find a proper bus to reach her destination, at a reasonable hour and a well inhabited part of the city and had to, perforce, take an illegally operated bus. She was brutally raped and finally lost her life. This incident speaks very poorly about how transport planning takes place in the city. It highlights that fragmented and uncoordinated plans have not proved very useful, despite the cost to the public budget.
5. WAY FORWARD

Given the projections for the next few decades, and the challenges that remain today, it is critical for India’s economic growth that it gets mobility in its cities sorted out. Otherwise cities will get choked and economic growth will be severely constrained. Cities will no longer be liveable and the health and well-being of urban residents will be badly compromised. With so much change taking place, it is clear that a more comprehensive and multi-modal approach to mobility planning is essential. This section highlights some of the issues that need to be mainstreamed and some change of direction that seems to be needed.

a. Institutionalisation of the preparation of integrated land use and transport plans

First are foremost, it is essential to institutionalize the preparation of integrated land use and transport plans, perhaps as part of the master planning exercise, and with legal backing. The Town and Country Planning Acts need to be amended to incorporate this aspect. As a first step, all cities of over 0.5 million people need to prepare this and following quickly thereafter should be all cities, regardless of their population size.

b. Integrated project approach for public transit projects

Undoubtedly, the initiatives that have been put in place for enhancing and improving the public transport systems need to continue, perhaps with greater vigour. At the project level, there needs to be an enhanced drive towards an integrated project approach for public transit projects. They must take into account feeder networks, transit oriented development plans, integrated fare systems, pedestrian access, parking facilities, etc. with a view to develop a system that serves the entire city in a sustainable manner. It needs to be recognised that corridor based initiatives do not help much and investments get made without securing the expected outcomes. Thus, the strategy needs to change from a corridor approach to a city-wide, or even region-wide, approach. Holistic plans that are multi-modal in nature and encompass land-use plans need to be developed and implemented in a systematic manner. So, a project appraisal framework, focused on the performance of the project within the system, need to be in place.

c. Need for an institution that has comprehensive responsibility for urban transport

For such holistic plans to be developed and implemented, it is necessary to have an institution that has comprehensive responsibility for urban transport and not just for a portion of it. It should be empowered to oversee all of urban transport and be able to enforce its decisions. Ideally it needs to have legislative backing, but most importantly, the
funds required for urban transport must flow through it and not through other channels. It is the financial muscle that would give it the authority to develop comprehensive plans and ensure that they get implemented. Otherwise, individual agencies tend to be able to get away with developing their own plans in isolation and building high cost systems without any integration with other systems. However, the institution’s focus needs to be on planning, co-ordination, monitoring and evaluation of project performance within the transport system, and not on project operations.

d. Focus on smaller cities

These efforts should not be confined to only the larger cities but should also spread to other secondary cities that are often growing faster than the larger cities. Besides, these are the ones that are still growing and an early design of the transport system can lead the growth along a sustainable and low carbon path. The strategy should be for the transport system leads the growth of the city rather than the transport system catching up with the sprawl that may have already taken place.

e. NMT – a mode of choice

This would mean pedestrian oriented planning and design of streets and public places with provision of NMT infrastructure to encourage the NMT mode, to be a mode of choice in all the categories of cities. This would help in retaining the share of existing NMT in all the categories of cities, especially in category 1, 2 and 3 cities while restricting the growth of average trip length by sustainable urban planning (infill rather than spreading out), urban design and non-motorised infrastructure. Land use planning should take care of formal as well as informal developments, enhancing NMT infrastructure so that walking and cycling is a mode of choice, and not the only mode used by captive (urban poor) users.

f. Public transport – a mode of choice

There needs to be a paradigm shift in how public transport should be positioned. As of now it has an image of being the only option for those who cannot afford a personal vehicle. However, it needs to be positioned as a mode of choice for those who can also afford their own motor vehicle. This means a quantum improvement in the quality of the public transport system – quality that encompasses convenience, cleanliness, reliability and safety and not just affordability. Improved quality of service can mean higher costs and thereby higher fares, but affordability needs to be ensured by using innovative financing methods that make indirect beneficiaries also pay for public transport.
g. Land a valuable resource for transport infrastructure finance

Huge investments will be required, not just in the capital cost of construction or purchase of buses, but also in the operation of services. A High Power Expert Committee set up by the Government of India to estimate investment requirements in urban infrastructure has estimated that approximately Rs. 21,783 Billion (approx. $ 434 Billion) would be needed for investments in transport infrastructure alone in Indian cities over the next 20 years. These are huge requirements and cannot all be met from the public budget without seeking additional sources for this purpose. The global experience is that land is a valuable resource and can be a key provider of the finances required. Commercial exploitation of land by developing property on them or capturing a portion of the land value increase due to transport investments would be a good way of securing additional resources. Charging indirect beneficiaries, such as personal motor vehicle users by way of an additional tax on gasoline or through high parking fees would provide additional resources.

h. Change in the structure of the public transport industry - segregation of planning and operational roles

The public transport industry structure needs to change. Neither the model of a monolithic public transport operator nor the model of lightly regulated private operators is good. Therefore, the global trend has been towards a public entity planning for the services that should be available and using a competitive procurement process for the private sector to operate services. This is the model that needs to be encouraged as it effectively combines the efficiency of the private sector in operations with the public sector’s responsibility of ensuring universal service. One way of doing this would be for existing state owned entities to consider reviewing their role and become planning and procurement entities rather than being operating entities. In cities that have a large number of small private bus operators, new public entities that can consolidate the services and manage a systematic contracting process should be setup.

i. Integrating sub-urban/commuter railway services with intra-urban transit system

Urban boundaries are spreading beyond municipal boundaries. Therefore, transport networks need to be designed with a regional focus, integrating the needs for suburban travel with those of the needs for urban travel. Worldwide, there are three levels of services – urban, sub-urban and inter-city, whereas in India we still have only have two.
j. Focus on demand management

There has to be a strong focus towards demand management. Measures that help to reduce the demand for travel, either by way of reducing the number of motorised trips that people make or the length of such motorised trips, would go a long way in bridging the gap between the demand for and supply of transport services. Good integration of land use and transport plans would help reduce trip lengths and facilities for e-Commerce or policies that allow home based work on some days would help reduce the number of trips that people make. In addition high quality public transport would reduce the number of trips on personal motor vehicles.

k. Focus on alternative fuel technologies

Finally, alternative fuel technologies need to be encouraged. India spends too much on importing petroleum fuel and is highly susceptible to the volatility of oil prices. In the longer term it needs to look at alternatives. A strong push towards electric vehicles, like China, would be a good initiative for the country to look at. An Electric Vehicle Task Force has been set up in the Ministry of Heavy Industries and this should develop an ambitious action plan towards increasing electric vehicle use in the country, especially for public bus services in the cities.
6. CONCLUSION

It has become clear that massive urbanisation and the transport problems it presents will be one of the most important challenges facing India in the future. Recognising the importance of this issue, the Government of India has taken important steps to meet the challenge through a variety of mechanisms primarily through the adoption of a National Urban Transport Policy and the launch of the National Urban Renewal Mission. These have led to several important gains, the most important of which has been the realisation that public transport improvement and not road capacity enhancement is the way forward. However, several challenges still remain. The way forward needs to emphasise a comprehensive and coordinated approach rather than a fancy for high cost facilities. It needs to emphasise governance structures that enable comprehensive planning and coordinated implementation. It needs to work towards innovative financing and alternative fuels. It needs to emphasise that good urban transport planning has to be “People” focused rather than “Engineering” focused.

Urban transport issues thus cannot be solved by a single ministry’s initiative, they need to be a part of an integrated agenda for the Ministries of Petroleum, Energy, Finance, Education, Road Transport, Industry, Environment and Forests, etc., along with the Ministry of Urban Development.
References


**Annexure**


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<th>Total Population CAGR per year (%)</th>
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### Annexure 2: Total Number of Registered Vehicles in India

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</table>
Annexure 3: City Categories

For the analysis the different urban agglomeration and cities in India with a population greater than or equal to 0.1 million as per the 2011 census are classified under 6 categories. The number of cities, population and share of population per each category of cities are mentioned in the below:

<table>
<thead>
<tr>
<th>Range</th>
<th>Number</th>
<th>Population (Million)</th>
<th>% share of population</th>
</tr>
</thead>
<tbody>
<tr>
<td>Category-1 (0.1-0.5 Million)</td>
<td>372</td>
<td>73.93</td>
<td>27.91</td>
</tr>
<tr>
<td>Category-2 (0.5-1 Million)</td>
<td>43</td>
<td>30.23</td>
<td>11.41</td>
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<td>Category-3 (1-2 Million)</td>
<td>34</td>
<td>46.68</td>
<td>17.62</td>
</tr>
<tr>
<td>Category-4 (2-4 Million)</td>
<td>10</td>
<td>24.26</td>
<td>9.16</td>
</tr>
<tr>
<td>Category-5 (4-8 Million)</td>
<td>4</td>
<td>23.73</td>
<td>8.96</td>
</tr>
<tr>
<td>Category-6 (Above 8 Million)</td>
<td>5</td>
<td>66.03</td>
<td>24.93</td>
</tr>
</tbody>
</table>

As per the 2011 census the Urban agglomerations and cities with 0.1 million population is 264.86 million. It is evident from the Table above that the category 1 cities have the highest share of population followed by category 6 cities.
Annexure 4: Model Description

The Objective

The objective of the model is to estimate *intra-city urban passenger transport* demand in Indian cities with population of 0.1 million and above, and its impact on energy consumption and emissions for various category cities.

**Base Year:** 2011

**Horizon years:** 2021 and 2031

The Model

a. Urban Population

Different urban agglomeration and cities in India with a population greater than or equal to 0.1 million as per the 2011 census were classified under 6 categories. The number of cities, population and share of population per each category of cities are mentioned in the table below (Table 1).

<table>
<thead>
<tr>
<th>Range</th>
<th>Number of cities</th>
<th>Population (Million)</th>
<th>% share of population</th>
</tr>
</thead>
<tbody>
<tr>
<td>Category-1(0.1-0.5 Million)</td>
<td>372</td>
<td>73.93</td>
<td>27.91</td>
</tr>
<tr>
<td>Category-2(0.5-1 Million)</td>
<td>43</td>
<td>30.23</td>
<td>11.41</td>
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<td>46.68</td>
<td>17.62</td>
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<td>Category-4(2-4 Million)</td>
<td>10</td>
<td>24.26</td>
<td>9.16</td>
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<tr>
<td>Category-5(4-8 Million)</td>
<td>4</td>
<td>23.73</td>
<td>8.96</td>
</tr>
<tr>
<td>Category-6(Above 8 Million)</td>
<td>5</td>
<td>66.03</td>
<td>24.9</td>
</tr>
</tbody>
</table>

Source: Census 2011

b. Estimated Outputs

Estimated urban passenger transport demand is expressed in terms of passenger kilometres (PKMS) and its impact on energy consumption/crude oil in million barrels of oil equivalent (MBOE)/million barrels (MB) and emissions of CO2 in million tonnes (MT).

c. The model flow

The average *Per Capita Trip Rate* (PCTR), *Motorised Per Capita Trip Rate* (MPCTR), and mode share was calculated category wise from a sample of 58 cities (The cities considered are given in Table 4 below). The model flow is shown in Figure 1.
The detailed methodology is discussed in following sections.

d. The Inputs

In the urban transport sector, intra urban passenger transport was considered for the analysis. In the public transport category and intermediate public transport category, bus and auto rickshaw was considered. The motorised modes of transport and the fuel type considered for the analysis are given below:

Figure Transport modes and fuel type

The different parameters used in the model are as follows:

Table: Parameters and calculations

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<tr>
<th>S. No.</th>
<th>Parameter</th>
<th>Calculation</th>
</tr>
</thead>
<tbody>
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<td>1</td>
<td>Daily Trips</td>
<td>Population * Per Capita Trip Rate (PCTR)</td>
</tr>
<tr>
<td>2</td>
<td>Daily Motorised Trips</td>
<td>Population * Motorised Per Capita Trip Rate (PCTR)</td>
</tr>
<tr>
<td>3</td>
<td>Mode wise Daily Passenger</td>
<td>Mode wise trip length * Motorised mode share * daily motorised</td>
</tr>
</tbody>
</table>
The data availability of urban passenger transport at city level is not readily available. The methodology used above is based on this limitation. The primary data required for the analysis are mentioned in Table 3. The urban passenger transport demand was estimated for 2011, 2021 and 2031 years, where 2011 is the base year.

**Table: Data Requirements**

<table>
<thead>
<tr>
<th>S. No.</th>
<th>Parameter</th>
<th>Data</th>
<th>Data Table</th>
</tr>
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<td>1</td>
<td>Population</td>
<td>Census Data (2011)</td>
<td>Table Population Sample Cities</td>
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<td>2</td>
<td>Per Capita Trip Rate (PCTR)</td>
<td>Study on Traffic and Transportation Policies and Strategies in Urban Areas in India, 2008, and several Comprehensive Mobility Plans</td>
<td>Table Parameter Values- category wise</td>
</tr>
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<tr>
<td>4</td>
<td>Mode share &amp; Motorised mode share</td>
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<td></td>
</tr>
<tr>
<td>5</td>
<td>Trip Length</td>
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<td></td>
</tr>
<tr>
<td>6</td>
<td>Vehicle category wise energy consumption</td>
<td>Urban Emissions Info &amp; Automotive Research Association of India (ARAI)</td>
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</tr>
<tr>
<td>7</td>
<td>Vehicle category wise emission factor</td>
<td>Registrar General India &amp; Comprehensive Mobility Plans &amp; Comprehensive Traffic and Transportation Studies</td>
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</tr>
<tr>
<td>8</td>
<td>Projected population</td>
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</table>

**f. Data used from sample cities**

The data from the 58 sample cities (from various studies as indicated in Table 3), are given below. Table 4 shows the population of the sample cities, and Table 5 gives the average PCTR, MPCTR, NMT trip length (km), motorised trip length (km), private vehicle (PV) trip length (km) and public transit (PT) trip length (km).
<table>
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<th>Population (Million)</th>
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<td>Bathinda</td>
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</tr>
<tr>
<td>6</td>
<td>Latur</td>
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<td>0.3580</td>
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<td>Mumbai</td>
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### Table: Sample cities –Base line information- Other data

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<th>Category</th>
<th>Avg. PCTR</th>
<th>Avg. MPCTR</th>
<th>Avg. NMT Trip Length (KM)</th>
<th>Avg. Motorised Trip Length (KM)</th>
<th>Avg. PV Trip Length (KM)</th>
<th>Avg. PT Trip Length (KM)</th>
<th>Motorised Mode Share</th>
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<td>Scooter / MC</td>
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<td></td>
<td>Car / Van / Jeep</td>
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<td>3.23</td>
<td>3.65</td>
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<tr>
<td>Category-2(5-10 lakhs)</td>
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<td>0.65</td>
<td>1.95</td>
<td>4.27</td>
<td>4.64</td>
<td>5.55</td>
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<tr>
<td>Category-3(10-20 lakhs)</td>
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<td>0.90</td>
<td>2.01</td>
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</tr>
<tr>
<td>Category-6(Above 80 lakhs)</td>
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<td>3.37</td>
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<td>12.62</td>
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<td></td>
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<td>3.94</td>
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<td>24.88</td>
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<tr>
<td>Category-2(5-10 lakhs)</td>
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<td>5.17</td>
<td>5.61</td>
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<td>16.87</td>
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<td>Category-3(10-20 lakhs)</td>
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<td>1.26</td>
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<td>8.47</td>
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<td>16.88</td>
</tr>
<tr>
<td>Category-4(20-40 lakhs)</td>
<td>1.23</td>
<td>1.10</td>
<td>2.18</td>
<td>6.65</td>
<td>9.07</td>
<td>7.79</td>
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<td>15.47</td>
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<tr>
<td>Category-5(40-80 lakhs)</td>
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<td>18.87</td>
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<tr>
<td>Category-6(Above 80 lakhs)</td>
<td>1.54</td>
<td>1.33</td>
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</table>
## Review of Urban Transport in India

### Summary of Results

<table>
<thead>
<tr>
<th>Category</th>
<th>Avg. PCTR</th>
<th>Avg. MPCTR</th>
<th>Avg. NMT Trip Length (KM)</th>
<th>Avg. Motorised Trip Length (KM)</th>
<th>Avg. PV Trip Length (KM)</th>
<th>Avg. PT Trip Length (KM)</th>
<th>Motorised Mode Share</th>
</tr>
</thead>
<tbody>
<tr>
<td>Category-1(1-5 lakhs)</td>
<td>1.17</td>
<td>1.05</td>
<td>1.61</td>
<td>4.85</td>
<td>5.44</td>
<td>5.30</td>
<td>53.24</td>
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<tr>
<td>Category-2 (5-10 lakhs)</td>
<td>1.15</td>
<td>1.13</td>
<td>1.95</td>
<td>6.41</td>
<td>6.83</td>
<td>8.32</td>
<td>64.04</td>
</tr>
<tr>
<td>Category-3 (10-20 lakhs)</td>
<td>1.61</td>
<td>1.40</td>
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<td>9.93</td>
<td>10.29</td>
<td>14.32</td>
<td>49.91</td>
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<tr>
<td>Category-4 (20-40 lakhs)</td>
<td>1.40</td>
<td>1.22</td>
<td>2.18</td>
<td>8.24</td>
<td>11.00</td>
<td>9.62</td>
<td>57.88</td>
</tr>
<tr>
<td>Category-5 (40-80 lakhs)</td>
<td>1.59</td>
<td>1.44</td>
<td>2.64</td>
<td>11.55</td>
<td>12.30</td>
<td>17.02</td>
<td>41.30</td>
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<tr>
<td>Category-6 (Above 80 lakhs)</td>
<td>1.71</td>
<td>1.48</td>
<td>3.37</td>
<td>16.50</td>
<td>17.47</td>
<td>23.61</td>
<td>20.82</td>
</tr>
</tbody>
</table>

Source: MOUD Study, various CMPs and CSTEP analysis
Scenario Development

a. Policy Interventions considered for scenario building

The following policy interventions are considered as conditions for building various scenarios using the model.

- **Increase in non-motorised transport**

The focus of investment patterns in urban transport is still at improving mobility of motorized vehicles rather than people, although cars and 2 wheelers account for only 29% of the trips while they constitute 86% of the total vehicular population. Non-motorised, slow moving vehicles such as bicycles and rickshaws have not been given priority compared to other motorised transport modes. This NMT strategy has several benefits, including financial (far cheaper), environmental (far cleaner, lower emissions), and health (more walking, less pollution, better health). In the overall mission of creating low carbon cities, various strategies are available. Public transit strategy is one of the most important strategies in this aspect, and NMT strategies should be a critical component of this strategy. Improved accessibility to public transport has a direct effect on the ridership patterns, and the quality of the public system, making this low-carbon transport option a mode of choice for all. Thus the first and last mile connectivity to the transit system becomes inherently tied to the ridership of the public system and NMT alternatives provide this vital accessibility. Smaller cities provide alternatives to the unsustainable urbanisation patterns and therefore have serious consequences for the long-term socio-economic future of the country.

There is thus an urgent need for a concerted effort to “retain and improve” the NMT modal share, by “improving” the conditions of the NMT users. In terms of creating NMT facilities (cycling tracks and footpaths), since these form part of the road infrastructure, the 12th schedule mandates that their construction and maintenance lies with the urban local body – which is the municipal body. But these cities have low resources (capital and human) to take initiatives in this direction. There is a lack of capacity in implementation of these strategies along with realistic sustainable financing strategies. Thus there is need for “hand-holding” the Urban Local Body (ULBs) in this effort.

- **Increase in share of public transport**

Public transit strategy is one of the most important strategies in promoting low carbon cities. The first/last mile connectivity, the physical access to the bus stations, bus information, how conducive it is to pedestrians and other non-motorized transport to have access to the public system and how integrated the bus system is to the land use becomes as important part of the public transit strategy.
The share of public transport has declined over the years against personal vehicles and intermediate transit modes. One of the low carbon scenarios assumes expansion of public transport that can be feasible emissions mitigation options for the transport sector. Accordingly, it is assumed that the share of passenger movement by public transit in total passenger movement is assumed to increase.

- Improving efficiency of vehicles

Another key component to GHG emission reduction is efficiency in fuel usage. This has a huge impact on both energy consumption as well as emissions. Bureau of Energy Efficiency (BEE) has recently embarked on a strategy to accelerate the reduction in average fuel consumption of new cars introduced in the Indian market ("BEE," 2011)

- Medium and Long term fuel efficiency standards for new cars which would provide a regulatory signal to manufacturers to continuously reduce the average fuel consumption of cars sold by them over the next 10 year period.
- Labelling of new cars that are sold in the market with the labels providing the consumers with information on fuel consumption of the car model and the relative fuel consumption of the model compared to other models in the same weight class.”

This strategy which combines a “supply push” with a “demand pull” could enable a large scale transformation in the automobile market ("BEE," 2011)

Another key component to GHG emission reduction is fuel use monitoring. This includes strict enforcement of comprehensive inspection and certification system for on-road vehicles, fuel quality improvement (e.g., benzene and aromatics in petrol, reduction of sulphur in diesel), leapfrogging to higher standards and enforcement of emission norms, and checking fuel adulteration. Keeping these in mind the efficiency of vehicles in road transport sector is accordingly expected to improve every year in the low carbon scenario.

- Development of compact cities

The city form and mobility patterns in and around a city are closely interlinked, each influencing the other in many different ways. The land use and development control regulations (DCR) are the two most powerful forces dictating peoples need for travel and direction of travel. On the other hand, establishing a major transit corridor is bound to influence city land use, forcing the plan making bodies to respond suitably by incorporating changes in the land use plan and the DCR. Land use planning provides opportunities for transport mode choice and travel demand management. Although a measurable equation between urban form and mobility or energy saving has not been decisively reached by scientific studies in this subject, the relationship between the two has been undoubtedly recognised by planners and researchers.
Compact cities are often viewed as the most sustainable form of urban living. In the context of the need for shortening trip lengths within the city and the number of trips made it, form of the city could play a pivotal role. A compact city is characterised by infilling of the core city areas and thus maximising benefits from premium urban land parcels, allowing for high-density and mixed use development supported by adequate housing and quality of life facilities within each city node. However, effective land use–transport integration including transit oriented development (TOD) assume critical significance in achieving desired efficiency levels from a compact city. The city form when supported by a well-designed mobility network combining public transit, non-motorised and private transport facilities could generate an efficient mobility pattern for the city by minimising number of motorised trips generated as well as shortening trip lengths.

**b. Assumptions on energy and emission factors**

<table>
<thead>
<tr>
<th>Table: Energy and Emissions Factors</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Operational Energy Consumption (KJ/PKMS)</strong></td>
</tr>
<tr>
<td>Petrol</td>
</tr>
<tr>
<td>---</td>
</tr>
<tr>
<td><strong>Scooter/motorcycle</strong></td>
</tr>
<tr>
<td><strong>Public transport</strong></td>
</tr>
<tr>
<td><strong>Auto rickshaw</strong></td>
</tr>
<tr>
<td><strong>Car</strong></td>
</tr>
</tbody>
</table>

Source: Figure 9, 10 -Life cycle analysis of transport modes: Executive Summary, NTDPC

**Note:** Energy consumption by auto rickshaws is 1.25 that of scooter/motorcycle while emission factors are 2.3 times (based on Specific energy consumption, and emission factors by ARAI)

A congestion factor of 1.2 was assumed over and above the factors in Table 7, for both energy and emissions.

<table>
<thead>
<tr>
<th>Table: Efficiency factors (based on Specific energy consumption)-used for Scenarios 4, 5 and 7</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Specific Energy Consumption</strong></td>
</tr>
<tr>
<td>---</td>
</tr>
<tr>
<td>Passenger</td>
</tr>
<tr>
<td>Cars &amp; Jeeps</td>
</tr>
<tr>
<td>2W</td>
</tr>
<tr>
<td>Taxis</td>
</tr>
<tr>
<td>3W</td>
</tr>
<tr>
<td>Bus</td>
</tr>
<tr>
<td>Omni-Bus</td>
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<tr>
<td>Rail</td>
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<tr>
<td>Air</td>
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</table>

Table: Derived Energy Factors

<table>
<thead>
<tr>
<th>Year</th>
<th>SCOOTER/MC</th>
<th>CAR/VAN/JEEP (Petrol)</th>
<th>CAR/VAN/JEEP (Diesel)</th>
<th>AUTO</th>
<th>PT</th>
</tr>
</thead>
<tbody>
<tr>
<td>2011</td>
<td>561.00</td>
<td>2244.00</td>
<td>2811.60</td>
<td>701.25</td>
<td>333.22</td>
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<tr>
<td>2021</td>
<td>530.65</td>
<td>2209.53</td>
<td>2768.41</td>
<td>646.16</td>
<td>329.41</td>
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<td>2031</td>
<td>501.41</td>
<td>2178.51</td>
<td>2729.54</td>
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Table: Derived Emission Factors (Co2 gms)

<table>
<thead>
<tr>
<th>Year</th>
<th>SCOOTER/MC</th>
<th>CAR/VAN/JEEP (Petrol)</th>
<th>CAR/VAN/JEEP (Diesel)</th>
<th>AUTO</th>
<th>PT</th>
</tr>
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<tbody>
<tr>
<td>2011</td>
<td>43.80</td>
<td>175.20</td>
<td>226.32</td>
<td>100.74</td>
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<td>2021</td>
<td>41.43</td>
<td>172.51</td>
<td>222.84</td>
<td>92.83</td>
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<td>2031</td>
<td>39.15</td>
<td>156.59</td>
<td>202.28</td>
<td>88.50</td>
<td>21.11</td>
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Table: Share of Petrol and Diesel Cars in India

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<tr>
<th>Year</th>
<th>Petrol</th>
<th>Diesel</th>
</tr>
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<tbody>
<tr>
<td>2008</td>
<td>81%</td>
<td>19%</td>
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<tr>
<td>2010</td>
<td>75%</td>
<td>25%</td>
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<tr>
<td>2011</td>
<td>69%</td>
<td>31%</td>
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<tr>
<td>2012</td>
<td>58%</td>
<td>42%</td>
</tr>
<tr>
<td>2013</td>
<td>54%</td>
<td>46%</td>
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Table: Assumptions on Average Occupancy of Vehicles

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<thead>
<tr>
<th>Vehicle Type</th>
<th>Occupation</th>
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<tr>
<td>Scooter/MC</td>
<td>1</td>
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<tr>
<td>Car/Van/Jeep</td>
<td>1.5</td>
</tr>
<tr>
<td>Auto</td>
<td>2</td>
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<tr>
<td>Public Transport</td>
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</table>

d. Assumptions on Price of Crude Oil

<table>
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<th>Year</th>
<th>Price of Crude Oil</th>
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<tbody>
<tr>
<td>2011</td>
<td>$108/barrel</td>
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<tr>
<td>2021</td>
<td>$100/barrel</td>
</tr>
<tr>
<td>2031</td>
<td>$100/barrel</td>
</tr>
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</table>

e. Description of Scenarios

The above baseline data (Table 5) was used to develop different scenarios, based on certain assumptions as follows:

<table>
<thead>
<tr>
<th>Scenario</th>
<th>Overview</th>
<th>Details</th>
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<tbody>
<tr>
<td>1</td>
<td>Business as usual (BAU)</td>
<td>This scenario will represent the future based on the existing trends (Assumptions in Table X)</td>
</tr>
<tr>
<td>2</td>
<td>Promoting NMT</td>
<td>The scenario considers improvement in NMT infrastructure with</td>
</tr>
</tbody>
</table>
Alternative Scenarios | Overview | Details |
--- | --- | --- |
**Scenario 3** | Promoting Public Transit Ridership | This scenario presumes an increase in the public transport mode share, as follows through improvements in public transport systems will focus on:  
| Category of City | 2021 (over 2011 share) | 2031 (over 2011 share) |
| | | |
| 1 | 3 times | 4 times |
| 2 | 3 times | 4 times |
| 3 | 2 times | 2.5 times |
| 4 | 3 times | 4 times |
| 5 | 1.5 times | 2 times |
| 6 | 1.25 times | 1.25 times |

2. Of the PT share (for category 5 and 6 cities) - 50% will be served by Metro/Rail traction in 2021 and 2031. |

**Scenario 2+3** | Promoting Public Transit (PT) Ridership and Non-motorized transport | This scenario will be a combination of scenarios 2 and 3 above |

**Scenario 4** | Clean Technology-focus on personal vehicles | 3. Focus on increased energy efficiency  
4. Electric vehicle penetration: Penetration levels over BAU scenario: Two – wheelers-10% (2021), 15% (2031) and cars – 5% (2021), 10% (2031). |

**Scenario 5** | Clean Technology-focus on electric traction for public transit (buses) | 15% of the BPKMS is travelled by electric buses in 2021 and 30% by 2031. |

**Scenario 4+5** | Clean Technology-focus on electric traction for public transit (buses) and personal vehicles | This is a combination of scenarios 4 & 5. |

**Scenario 6** | Improving Urban Structure | The focus of this scenario will be development of compact cities with high density and multi-nuclei development, resulting in BAU trip lengths (i.e. no increase in trip lengths compared to the BAU scenario)  
3. Motorised trip lengths same as 2011 for 2021 and 2031  
4. NMT mode share remains constant as of 2011 (does not decrease) |

**Scenario 6A** | Aggressive Urban Structure and Form Control | This is a more aggressive policy regime compared to Scenario 6, focussing on compact cities that induces NMT trips with:  
3. With reduced motorised trip lengths by 5% and 10% for 2021 and 2031 respectively  
4. Enhanced NMT shares (over 2011) by 5% (2021) and 10% (2031) |

**Scenario 7** | A multi-pronged approach | This is a combination of scenarios 2, 3, 4, 5 and 6A |
The outputs of the model are as follows:

### Scenario 1

<table>
<thead>
<tr>
<th>Category-1 (0.1-0.5 Million)</th>
<th>BPKMS</th>
<th>VKT</th>
<th>Energy Use (MB)</th>
<th>Emissions (CO2 MMT)</th>
</tr>
</thead>
<tbody>
<tr>
<td>2011</td>
<td>66</td>
<td>50</td>
<td>11</td>
<td>6</td>
</tr>
<tr>
<td>2021</td>
<td>146</td>
<td>113</td>
<td>25</td>
<td>13</td>
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<tr>
<td>2031</td>
<td>240</td>
<td>190</td>
<td>44</td>
<td>21</td>
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</table>

<table>
<thead>
<tr>
<th>Category-2 (0.5-1 Million)</th>
<th>BPKMS</th>
<th>VKT</th>
<th>Energy Use (MB)</th>
<th>Emissions (CO2 MMT)</th>
</tr>
</thead>
<tbody>
<tr>
<td>2011</td>
<td>34</td>
<td>26</td>
<td>5</td>
<td>2</td>
</tr>
<tr>
<td>2021</td>
<td>82</td>
<td>66</td>
<td>12</td>
<td>6</td>
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<tr>
<td>2031</td>
<td>134</td>
<td>110</td>
<td>21</td>
<td>10</td>
</tr>
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</table>

<table>
<thead>
<tr>
<th>Category-3 (1-2 Million)</th>
<th>BPKMS</th>
<th>VKT</th>
<th>Energy Use (MB)</th>
<th>Emissions (CO2 MMT)</th>
</tr>
</thead>
<tbody>
<tr>
<td>2011</td>
<td>116</td>
<td>67</td>
<td>15</td>
<td>8</td>
</tr>
<tr>
<td>2021</td>
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<tr>
<td>2031</td>
<td>405</td>
<td>270</td>
<td>60</td>
<td>29</td>
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</tbody>
</table>

<table>
<thead>
<tr>
<th>Category-4 (2-4 Million)</th>
<th>BPKMS</th>
<th>VKT</th>
<th>Energy Use (MB)</th>
<th>Emissions (CO2 MMT)</th>
</tr>
</thead>
<tbody>
<tr>
<td>2011</td>
<td>49</td>
<td>37</td>
<td>7</td>
<td>4</td>
</tr>
<tr>
<td>2021</td>
<td>112</td>
<td>86</td>
<td>16</td>
<td>8</td>
</tr>
<tr>
<td>2031</td>
<td>183</td>
<td>143</td>
<td>27</td>
<td>14</td>
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</tbody>
</table>

<table>
<thead>
<tr>
<th>Category-5 (4-8 Million)</th>
<th>BPKMS</th>
<th>VKT</th>
<th>Energy Use (MB)</th>
<th>Emissions (CO2 MMT)</th>
</tr>
</thead>
<tbody>
<tr>
<td>2011</td>
<td>73</td>
<td>38</td>
<td>10</td>
<td>5</td>
</tr>
<tr>
<td>2021</td>
<td>163</td>
<td>89</td>
<td>22</td>
<td>11</td>
</tr>
<tr>
<td>2031</td>
<td>264</td>
<td>146</td>
<td>38</td>
<td>18</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Category-6 (Above 8 Million)</th>
<th>BPKMS</th>
<th>VKT</th>
<th>Energy Use (MB)</th>
<th>Emissions (CO2 MMT)</th>
</tr>
</thead>
<tbody>
<tr>
<td>2011</td>
<td>333</td>
<td>89</td>
<td>41</td>
<td>19</td>
</tr>
<tr>
<td>2021</td>
<td>671</td>
<td>305</td>
<td>90</td>
<td>43</td>
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<tr>
<td>2031</td>
<td>1448</td>
<td>778</td>
<td>210</td>
<td>105</td>
</tr>
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</table>

<table>
<thead>
<tr>
<th>Category-1 (0.1-0.5 Million)</th>
<th>BPKMS</th>
<th>VKT</th>
<th>Energy Use (MB)</th>
<th>Emissions (CO2 MMT)</th>
</tr>
</thead>
<tbody>
<tr>
<td>2011</td>
<td>66</td>
<td>50</td>
<td>11</td>
<td>6</td>
</tr>
<tr>
<td>2021</td>
<td>146</td>
<td>113</td>
<td>25</td>
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</tr>
<tr>
<td>2031</td>
<td>240</td>
<td>190</td>
<td>44</td>
<td>21</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Category-2 (0.5-1 Million)</th>
<th>BPKMS</th>
<th>VKT</th>
<th>Energy Use (MB)</th>
<th>Emissions (CO2 MMT)</th>
</tr>
</thead>
<tbody>
<tr>
<td>2011</td>
<td>34</td>
<td>26</td>
<td>5</td>
<td>2</td>
</tr>
<tr>
<td>2021</td>
<td>82</td>
<td>66</td>
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<td>6</td>
</tr>
<tr>
<td>2031</td>
<td>134</td>
<td>110</td>
<td>21</td>
<td>10</td>
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<th>Emissions (CO2 MMT)</th>
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<th>Emissions (CO2 MMT)</th>
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<th>Emissions MMT</th>
<th>(CO2)</th>
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<th>Emissions MMT</th>
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## Review of Urban Transport in India

Institute of Urban Transport (India)                                Center for Study of Science, Technology and Policy

### Table 1

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<td>48</td>
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<td>5</td>
<td></td>
</tr>
<tr>
<td>Category-5 (4-8 Million)</td>
<td>89</td>
<td>50</td>
<td>13</td>
<td>6</td>
<td></td>
</tr>
<tr>
<td>Category-6 (Above 8 Million)</td>
<td>420</td>
<td>165</td>
<td>67</td>
<td>31</td>
<td></td>
</tr>
<tr>
<td></td>
<td>843</td>
<td>452</td>
<td>132</td>
<td>62</td>
<td></td>
</tr>
</tbody>
</table>

(2031)

<table>
<thead>
<tr>
<th>Category</th>
<th>BPKMS</th>
<th>VKT</th>
<th>Energy Use (MB)</th>
<th>Emissions (CO2 MMT)</th>
<th>(CO2)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Category-1 (0.1-0.5 Million)</td>
<td>104</td>
<td>82</td>
<td>17</td>
<td>9</td>
<td></td>
</tr>
</tbody>
</table>
### BPKMS, VKT, Energy Use (MB), Emissions (CO2 MMT)

#### Category-2 (0.5-1 Million)
- BPKMS: 51
- VKT: 42
- Energy Use (MB): 8
- Emissions (CO2 MMT): 4

#### Category-3 (1-2 Million)
- BPKMS: 165
- VKT: 110
- Energy Use (MB): 24
- Emissions (CO2 MMT): 12

#### Category-4 (2-4 Million)
- BPKMS: 77
- VKT: 60
- Energy Use (MB): 12
- Emissions (CO2 MMT): 6

#### Category-5 (4-8 Million)
- BPKMS: 109
- VKT: 62
- Energy Use (MB): 14
- Emissions (CO2 MMT): 8

#### Category-6 (Above 8 Million)
- BPKMS: 500
- VKT: 225
- Energy Use (MB): 72
- Emissions (CO2 MMT): 41

---

### Scenario 7

#### BPKMS, VKT, Energy Use (MB), Emissions (CO2 MMT)

#### (2021)

- Category-1 (0.1-0.5 Million)
  - BPKMS: 77
  - VKT: 49
  - Energy Use (MB): 12
  - Emissions (CO2 MMT): 6

- Category-2 (0.5-1 Million)
  - BPKMS: 29
  - VKT: 25
  - Energy Use (MB): 4
  - Emissions (CO2 MMT): 2

- Category-3 (1-2 Million)
  - BPKMS: 129
  - VKT: 55
  - Energy Use (MB): 14
  - Emissions (CO2 MMT): 6

- Category-4 (2-4 Million)
  - BPKMS: 56
  - VKT: 31
  - Energy Use (MB): 6
  - Emissions (CO2 MMT): 3

- Category-5 (4-8 Million)
  - BPKMS: 80
  - VKT: 33
  - Energy Use (MB): 8
  - Emissions (CO2 MMT): 4

- Category-6 (Above 8 Million)
  - BPKMS: 383
  - VKT: 60
  - Energy Use (MB): 33
  - Emissions (CO2 MMT): 15

#### (2031)

- Category-1 (0.1-0.5 Million)
  - BPKMS: 95
  - VKT: 56
  - Energy Use (MB): 13
  - Emissions (CO2 MMT): 6

- Category-2 (0.5-1 Million)
  - BPKMS: 47
  - VKT: 27
  - Energy Use (MB): 5
  - Emissions (CO2 MMT): 2

- Category-3 (1-2 Million)
  - BPKMS: 153
  - VKT: 51
  - Energy Use (MB): 14
  - Emissions (CO2 MMT): 7

- Category-4 (2-4 Million)
  - BPKMS: 71
  - VKT: 31
  - Energy Use (MB): 7
  - Emissions (CO2 MMT): 3

- Category-5 (4-8 Million)
  - BPKMS: 99
  - VKT: 27
  - Energy Use (MB): 7
  - Emissions (CO2 MMT): 3

- Category-6 (Above 8 Million)
  - BPKMS: 450
  - VKT: 64
  - Energy Use (MB): 33
  - Emissions (CO2 MMT): 16

- Category-6 (Above 8 Million)
  - BPKMS: 915
  - VKT: 256
  - Energy Use (MB): 80
  - Emissions (CO2 MMT): 38
Annexure 5: List of MRTS Projects in India in the Last 15 years

- **BRTS**
  - Ahmedabad
  - Delhi
  - Indore
  - Jaipur
  - Pune
  - Rajkot
  - Surat
  - Vijaywada
  - Bhopal
  - Bhubaneshwar
  - Hubli-Dharwad
  - Mumbai
  - Pimpri Chinchwad
  - Vishakhapatnam
  - Bangalore
  - Mysore

- **Metro Rail**
  - Kolkata
  - Delhi
  - Chennai
  - Bangalore
  - Gurgaon
  - Mumbai
  - Jaipur
  - Hyderabad
  - Kochi
  - Lucknow
  - Ahmedabad & Gandhinagar

- **Monorail**
  - Mumbai
  - Kozhikode
  - Chennai
  - Thiruvananthpuram
Annexure 6: Sector-Wise Break-up of Funds Allocated under JnNURM

<table>
<thead>
<tr>
<th>Sector</th>
<th>No of Projects approved</th>
<th>Approved Cost</th>
</tr>
</thead>
<tbody>
<tr>
<td>Drainage / Storm Water Drains</td>
<td>154</td>
<td>930352</td>
</tr>
<tr>
<td>Roads / Flyovers / RoB</td>
<td>325</td>
<td>1064742</td>
</tr>
<tr>
<td>Water Supply</td>
<td>783</td>
<td>3712822</td>
</tr>
<tr>
<td>Urban Renewal</td>
<td>20</td>
<td>51695</td>
</tr>
<tr>
<td>Sewerage</td>
<td>278</td>
<td>2379239</td>
</tr>
<tr>
<td>Other Urban Transport</td>
<td>17</td>
<td>79065</td>
</tr>
<tr>
<td>Mass Rapid Transport System</td>
<td>22</td>
<td>552980</td>
</tr>
<tr>
<td>Solid Waste Management</td>
<td>113</td>
<td>262086</td>
</tr>
<tr>
<td>Parking lots and spaces on PPP basis</td>
<td>6</td>
<td>86079</td>
</tr>
<tr>
<td>Development of Heritage Areas</td>
<td>8</td>
<td>24308</td>
</tr>
<tr>
<td>Preservation of water bodies</td>
<td>17</td>
<td>23919</td>
</tr>
<tr>
<td>Soil Erosion</td>
<td>4</td>
<td>2647</td>
</tr>
<tr>
<td>Total</td>
<td>1747</td>
<td>9169935</td>
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</table>

Break-up of Funds for Urban Transport Sector

<table>
<thead>
<tr>
<th>Sector</th>
<th>No of Projects approved</th>
<th>Approved Cost</th>
<th>% Approved Cost</th>
</tr>
</thead>
<tbody>
<tr>
<td>Roads / Flyovers / RoB</td>
<td>325</td>
<td>1064741.66</td>
<td>59.7</td>
</tr>
<tr>
<td>Other Urban Transport</td>
<td>17</td>
<td>79064.82</td>
<td>4.4</td>
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<tr>
<td>Mass Rapid Transport System</td>
<td>22</td>
<td>552980.04</td>
<td>31.0</td>
</tr>
<tr>
<td>Parking lots and spaces on PPP basis</td>
<td>6</td>
<td>86079.43</td>
<td>4.8</td>
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<tr>
<td>Total</td>
<td>370</td>
<td>1782865.95</td>
<td>100</td>
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Review of Urban Transport in India
The Future of Urban Mobility 2.0

Imperatives to shape extended Mobility Ecosystems of tomorrow

https://www.uitp.org/.../140124%20Arthur%20D.%20Little%20%26%20UITP_Future...

The Arthur D. Little study “The Future of Urban Mobility”
Content

Forewords 3

1. Executive summary 5

2. Plotting the trend – Urban mobility systems are on their way to breakdown 9

3. Where are we now? Arthur D. Little Urban Mobility Index 2.0 11

4. What is holding back changes? Business models archetypes for urban mobility 22

5. Shaping the future – Strategic directions and imperatives for cities 27

6. Case studies of cities demonstrating good practices 51

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The Urban Mobility Index 2.0 was developed by Arthur D. Little; the UITP is independent of this index, which does not necessarily reflect its opinion. Strategic imperatives for cities have been developed together with the UITP.
Forewords

Mobility has significantly evolved in the past, under the influence of industrial evolutions. Following the first industrial revolution enabled by the invention of steam powered technology, the railway industry emerged. The second industrial revolution with mass production enabled the emergence of the automobile industry and, closer to us, the third industrial revolution with digitalization enabled the emergence of computer-aided travelling (for example GPS in a car). Today we are 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. This evolution is particularly noticeable over past years in network industries (such as telecommunication and media, utilities and the mobility industry) as well as in B2C industries (such as retail and healthcare) where, driven by evolving customer needs and enabled by rapidly evolving technology, business models are continuously evolving.

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 products generation to market. To be successful and meet evolving customer’ needs, they need to adapt to this new 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, linking strategy, technology and innovation, 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 tackle 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. Our Mobility Lab initiative has reached a new dimension in 2013, with the signature of an exclusive partnering agreement with the International Association of Public Transport (UITP) for the co-development of future of urban mobility studies; which in our view constitutes the ideal partner due to its global representation amongst mobility actors and the depth of expertise of its practitioners in the field of mobility.

With the release of this second edition of the Future of Urban Mobility study, our aim is to provide mobility decision-makers and stakeholders with reflections and guidance on devising sustainable strategies that are meeting current and future evolving mobility challenges. We hope you will find this report useful and we would be pleased to discuss its conclusions and the implications for your organization.

Sincerely

Ignacio Garcia-Alves
Arthur D. Little Global CEO

François-Joseph Van Audenhove
Partner
The Arthur D. Little study “The Future of Urban Mobility – Towards networked, multimodal cities of 2050” had triggered the interest and attention of UITP when it was released in 2011; and for us it was natural to feature it in the main plenary session of our World Congress last May.

When we were approached by Arthur D. Little to work together on a second edition of the study, the UITP immediately saw a great opportunity to further convey its own messages developed since 2009 in our PTx2 strategy, later labeled “Grow with public transport.”

This strategy for the public transport sector sets out the ambitious aim to double the market share of public transport worldwide by 2025 and pinpoints the key areas where action is urgently needed.

Current trends indicate that more people will choose to use private motorized transport, leading to a staggering 6.2 billion private motorized trips every day in cities of the world. If the world fails to change its mobility habits, the future of our planet looks decidedly bleak. By 2025, worldwide transport-related greenhouse gas emissions will be 30% higher than 2005 levels. Transport energy bills will also skyrocket and higher levels of energy consumption could pose a threat to global energy security. Traffic congestion will bring cities worldwide to a standstill. Most alarmingly, half a million people will be killed in road traffic accidents every year.

Thankfully, more and improved public transport offers a route to a better future. By doubling the market share of public transport worldwide by 2025, cities will be able to boost growth, help fight climate change and create pleasant urban environments where people and businesses can thrive. Doubling the market share of public transport will enable the stabilization of urban transport greenhouse gas emissions and energy consumption despite overall mobility increase. In 2025, 60,000 lives will be saved, as a more balanced mobility mix will lead to fewer urban traffic fatalities. Doubling the market share of public transport would also create seven million green, local jobs.

We took the city ranking proposed by Arthur D. Little as a starting point to perform and refine our analysis of today’s mobility situation in view of tomorrow’s requirements. Cities are clustered around their development stage and are given a series of strategic recommendations to overcome current limitations to achieve the objective of “networked mobility.”

I would like to thank Arthur D. Little for their fruitful cooperation and welcome this joint effort by two prestigious and reputable organizations. I hope that our joint study will inspire and help many decision-makers and readers.

Sincerely

Alain Flausch
UITP Secretary General
Arthur D. Little, the Global Management Consultancy, launched its “Future of Urban Mobility” lab in 2010 and in 2011 released its first global study highlighting the mobility challenges cities face on a worldwide basis. This report introduced the first Arthur D. Little Urban Mobility Index, which assessed the mobility maturity and performance of 66 cities worldwide, and triggered high interest within the mobility industry and in the media on a global scale.

January 2014 sees Arthur D. Little release the second version of the “Future of Urban Mobility” study, including an updated version of the Urban Mobility Index, with an extended scope of 84 cities worldwide as well as an extended set of criteria. The index finds most cities are still badly equipped to cope with the challenges ahead indicating there is still significant potential for improvement.

Arthur D. Little highlights what is holding cities back, and, together with its partner the UITP – the International Association of Public Transport – identifies three strategic directions for cities to better shape the future of urban mobility. The study also describes 25 imperatives to consider when defining sustainable urban mobility policies and case studies of cities demonstrating good practice.
1.1. Arthur D. Little Urban Mobility Index 2.0 – The most comprehensive global urban mobility benchmarking study

Plotting the trend

Urban mobility is one of the toughest challenges that cities face today as existing mobility systems are close to breakdown.

The world’s population is increasingly city-based. 53% of the population currently lives in urban areas and by 2050 this number is expected to reach 67%. Today, 64% of all travel made is within urban environments and the total amount of urban kilometers travelled is expected to triple by 2050. Delivering urban mobility to cope with this increasing demand will thus require massive investment in the future.

In addition to the increasing demand for urban mobility, mobility needs are evolving. Changing travel habits, demand for services to increase convenience, speed and predictability, as well as evolving customer expectations toward individualization and sustainability will require mobility services portfolio extension as well as business model transformation, while specialized players from other sectors are assessing opportunities to play a role in the extended mobility ecosystem.

Moreover, in order to reach UITP’s objective of “doubling the market share of public transport worldwide by 2025” compared to the 2005 level, public transport stakeholders are working hard to improve attractiveness, capacity and efficiency of mobility systems despite growing limitations of public financing, demonstrating the need for system level innovation.

Methodology

Using 19 criteria Arthur D. Little assessed the mobility maturity and performance of 84 cities worldwide. 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, Arthur D. Little has reviewed policy initiatives undertaken by cities to improve the performance of urban mobility systems.

Where are we now?

The overall results find most cities are still badly equipped to cope with the challenges ahead. The global average score is 43.9 points, meaning that, on average, the 84 cities achieve less than half of the potential that could be reached today if applying best practices across all operations.

Only 11 cities score above 52 points (the top 20% of the score range). The highest score (58.2 points) went to Hong Kong followed closely by Stockholm (57.4 points) and Amsterdam (57.2 points), still indicating potential for improvement.

There are big differences between the top- and low-end performers in various regions:

- Europe achieves the highest average score of the six world regions surveyed, with an average of 49.8 points (51.5 points for Western Europe and 45.2 for (South)-Eastern Europe) and nine out of the 26 analyzed European cities scoring above 52 points. European urban mobility systems are the most mature ones as of today and lead the way in mobility performance. Stockholm (57.4), Amsterdam (57.2) and Copenhagen (56.4 points) head the table – while Athens (40.0 points), Rome (40.9 points) and Lisbon (41.3) are the worst European cities in the sample.

- Latin American and Asian Pacific cities show slightly below average performance. The continents’ average scores are well below Western Europe (43.9 and 42.8 points respectively) but outperform other regions in public transport-related criteria (financial attractiveness of PT, share of modal split, smart cards). Most cities in Latin America show an average performance of between 40 and 47 points, while Asian Pacific cities show the broadest range in performance, from Hong Kong and Singapore with scores of 58.2 and 55.6 respectively – sitting at the top of the global table – down to Hanoi with 30.9 points.

- The USA/Canada shows average performance with 39.5 points. Given their orientation towards cars, USA/Canadian cities rank bottom worldwide in terms of maturity. In terms of performance, they perform above average overall, but show poor results with regard to number of cars per capita and CO2 emissions. New York leads the way with 45.6 points, followed closely by Montreal with 45.4 points.

- Africa and the Middle East are the lowest performing regions with respective average point totals of 37.1 and 34.1. Whilst urban mobility systems in Africa perform well on several criteria due to the lower number of cars, they are still at an evolving stage and haven’t reached sufficient maturity yet. Middle East cities have high levels of cars per capita and are expected to invest in development of environmental modes of transport in the mid-term perspective.

What is holding back change?

A comprehensive review of technologies and urban mobility business models reveals sufficient availability of solutions to address the mobility challenges. In its 2011 study1, Arthur D. Little identified three long-term business models archetypes

1 Arthur D. Little, “Future of Urban Mobility: Towards Networked, Multimodal Cities of 2050,” 2011
for mobility suppliers (the “Amazon”, “Apple” and “Dell” of urban mobility). Those business models still hold true today and each have interesting development potential. However, these solutions and archetypes are currently not being applied comprehensively.

There is a clear trend towards shared mobility: in complement to conventional public transport, more cars and bikes are being shared in cities, both via peer-to-peer and business-to-consumer models, but many of those concepts haven’t yet managed to take off as providers are still testing different business models. Why is the innovation potential not being unleashed? There is a key reason: the management of urban mobility operates in an environment that is too fragmented and hostile to innovation. Our urban management systems do not allow market players to compete and establish business models that bring demand and supply into a natural balance. It is one of the toughest system-level challenges facing actors of the mobility ecosystems. There are plenty of solutions and business models available, but very few have managed to smartly integrate them to unleash their full business potential. What is needed is system-level collaboration between all stakeholders of the mobility ecosystem to come up with innovative and integrated business models.

Moreover, many mature cities do not yet have a clear vision and strategy on how their mobility systems should look in the future. The lack of synergies between isolated initiatives leads to a sub-optimal outcome in terms of mobility performance, which calls for a more holistic approach. At a different level, integration between regional mobility systems still remains very low in comparison to other parts of the economy as transport infrastructures were historically designed to serve regional rather than supra-regional goals. In that context, there is a need for stronger alignment between regional mobility strategies while respecting each-others accountabilities and ensuring solutions are adapted to local contexts.

1.2. Strategic imperatives for cities to shape extended mobility systems of tomorrow

Three strategic directions for cities

To meet the urban mobility challenge, cities need to implement one of the following three strategies dependent on their maturity and the share of sustainable transport in their modal split:

**Rethink the System:** Cities in mature countries with a high proportion of motorized individual transport need to shape political agendas to fundamentally redesign their mobility systems so that they become more orientated towards public transport and sustainability. The majority of cities in the index (53 out of 84) belong to this group.

**Network the System:** For mature cities with a high share of sustainable transport modes, the next step must be to fully integrate the travel value chain to foster seamless, multimodal mobility while ensuring “one face to the customer” and to increase the overall attractiveness of public transport by service extension. This group contains the majority of cities in Europe as well as Hong Kong, Singapore, Seoul, Tokyo, Toronto and Buenos Aires.

**Establish Sustainable Core:** For cities in emerging countries with partly underdeveloped mobility systems, the aim must be to establish a sustainable mobility core that can satisfy short term demand at a reasonable cost without replicating mistakes from developed countries. With access to emerging transport infrastructure and technologies, these cities have the opportunity to become the test-bed and breeding ground for tomorrow’s urban mobility systems.

Four dimensions for cities to consider when defining sustainable urban mobility policies

**Visionary Strategy and Ecosystem:** Establishing sustainable urban mobility policies requires cities to develop a political vision and urban mobility objectives based on strategic alignment between all key public and private stakeholders of the extended mobility ecosystem. This should inform a visionary urban mobility strategy (priorities and investments to achieve mobility objectives), which ensures the right balance between stretch and achievability.

**Mobility Supply (solutions and lifestyles):** Responding to increasing demand for urban mobility and to consumer and business needs for seamless, multimodal urban mobility requires cities to extend their public transport offering and adapt it from “delivering transport” to “delivering solutions.” This transformation can be achieved through a combination of quality improvements to the current public transport offering and an increase of customer experience via service offering extension through partnerships and alliances with third parties.

**Mobility Demand Management:** The limited capacity of current mobility systems and the level of investment required for the development of transport infrastructure means mobility service extension must also be complemented with measures to manage the demand side. Mobility demand management is a delicate discipline which can easily meet strong resistance if not properly planned and executed. However, a number of measures exist and some of these have already derived clear benefits, the relevance of which should be assessed by cities against the local context.
Public Transport Financing: Devising the right funding mix for public transport is a critical priority for cities to ensure its financial viability, particularly given that funding needs are increasing significantly due to growing supply, rising quality expectations and the rising 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 pressure on public resources, transport authorities and operators need to assess opportunities to derive additional revenues from aggregation of third party services and to perceive charges from indirect beneficiaries of public transport.

A system-level approach across these four dimensions is critical: sustainable improvements of a city’s mobility performance requires simultaneous improvement on each of the four dimensions as the weakest link will influence overall mobility performance.

In this study Arthur D. Little and the UITP elaborate further on those dimensions and identify 25 imperatives for cities to consider when defining sustainable urban mobility policies. The study also includes case studies of cities demonstrating good practice.
All around the globe people are flocking to cities. In 2007, UN population figures showed that more than a half of the world’s population for the first time lived in urban areas. That proportion is set to rise to 60% by 2030 and 67% by 2050.

This mushrooming in urban population will be accompanied by a massive growth in the number of individual journeys taken on a daily basis. Today, 64% of all travel kilometers are made in urban environments but the number of urban kilometers travelled is expected to treble by 2050. Such an explosion in the growth of urban mobility systems will present new challenges on a number of different fronts (see Figure 1).

**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 raises the specter of a vast rise in air and noise pollution and CO₂ 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.

**People:** An inevitable consequence of an unreformed and under-invested urban mobility system is gridlock. By 2050, the average time an urban dweller will spend in traffic jams will be 106 hours per year, twice the current rate, with all that entails for the quality of life of the average citizen.

**Profit:** Unless far-sighted decisions relating to service expansion and innovation are made now, the cities of the future stand to sleepwalk into a situation where 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.

Meanwhile, mobility needs are evolving all over the world. 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, transport providers will have to satisfy demand for services that are increasingly convenient, fast and predictable. At the same time, consumers are becoming more concerned about the sustainability of their mode of travel and some are prepared to sacrifice individual forms of transport in furtherance.

**Figure 1: The future of earth will be urban…**

<table>
<thead>
<tr>
<th>The world is becoming increasingly urban</th>
<th>Urban mobility demand explodes</th>
<th>Cities are confronted with new challenges</th>
</tr>
</thead>
<tbody>
<tr>
<td>Urban and rural population, 2010-2050 [m people; %]</td>
<td>Urban mobility demand, 2010-2050 [trillions pkm p.a.; %]</td>
<td>Planet</td>
</tr>
<tr>
<td>6,896</td>
<td>8,321</td>
<td>9,306</td>
</tr>
<tr>
<td>52%</td>
<td>60%</td>
<td>67%</td>
</tr>
<tr>
<td>48%</td>
<td>40%</td>
<td>33%</td>
</tr>
<tr>
<td>2010</td>
<td>2030</td>
<td>2050</td>
</tr>
<tr>
<td>Air pollution</td>
<td>CO₂ emissions</td>
<td>Noise</td>
</tr>
<tr>
<td>Increasing ecological footprint</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Traffic chaos</td>
<td>Traffic security</td>
<td>Traffic jam</td>
</tr>
<tr>
<td>Decreasing quality of life and convenience</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Overloaded infrastructures</td>
<td>Insufficient public transport capacities</td>
<td>Increasing motorization</td>
</tr>
<tr>
<td>Limited parking places</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

of that cause, leading to the successful introduction and rapid penetration of new mobility services such as car sharing and bike sharing.

Due to limits on public financing, however, public transport stakeholders are struggling to improve the attractiveness, capacity and efficiency of public transport and system innovation may be the only answer. At the same time, specialized players from other sectors – notably automotive OEMs, financial institutions/payment providers and internet businesses – are assessing opportunities to play a role in the extended mobility ecosystems of tomorrow. All this raises the question: what will the future business model(s) of urban mobility be?

The good news is that people are beginning to get the message. The Siemens Megacity Challenges Study found that mobility was cited as the most important issue for cities when it came to attracting investment, with 27% of respondents mentioning it, three times more than the second mentioned factor, security (see Figure 2).

When the above study asked which sectors had the highest need for investment in cities, no less than 86% of the sample opted for mobility as the number one priority, with education and the environment tying in second place with 77%. That said, the scale of investment required to cope with the mobility challenge is immense. In 2010, the global investment in urban mobility amounted to 324 bn EUR. By 2050, it is forecast that 829 bn EUR a year will be required.
3.1. Index design: scope and methodology

The reform of urban mobility systems is one of the biggest challenges confronting policymakers, stakeholders and users today, and to do it justice the urban mobility index required a commensurately ambitious approach. Arthur D Little’s researchers worked on seven geographical areas across six continents to study the status quo, and this year’s index is more comprehensive than ever, with 18 more cities scrutinized than for the last report (see Figure 3).

The largest group of cities in the index was the Megacity group of the C40 Climate Leadership Group, a network of the world’s cities committed to addressing climate change. The next biggest group was the 24-strong group of cities selected on the basis that they represent the largest metropolises determined by GDP share of region and population, which are not members of the C40 group. This included no fewer than six cities in China and four in India. The final group was made up of smaller cities with good practices, which are useful as role models for others. Europe dominated this group with 14 of the 20 places.

The Mobility Index assessed cities on the basis of 19 criteria. 11 of these were related to how mature the city under examination was in terms of its existing infrastructure, from public transport’s share of the modal split to smart card penetration. These indicators made up 58 possible points of the maximum of 100 available. The other 42 points were awarded on the basis of performance, with categories including the level of transport-related CO2 emissions and the mean travel time to work (see Figure 4 overleaf).

<table>
<thead>
<tr>
<th>„Megacities“ - cluster of C40 Cities Climate Leadership Group</th>
<th>Americas</th>
<th>22</th>
<th>Europe, Middle East &amp; Africa</th>
<th>33</th>
<th>Asia Pacific</th>
<th>29</th>
</tr>
</thead>
<tbody>
<tr>
<td>World’s largest cities determined by GDP share</td>
<td>40</td>
<td></td>
<td>33</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>USA/Canada: Atlanta, Boston, Dallas, Miami</td>
<td>Europe: Barcelona, Lisbon, Stockholm, Brussels, Frankfurt, Prague, Stuttgart, Munich, Zurich</td>
<td>Middle East: Baghdad, Tehran, Dubai, Kuala Lumpur</td>
<td>Asia Pacific:</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Smaller cities with good practices</td>
<td>20</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>USA/Canada: Portland, Montreal</td>
<td>Latin America: Curitiba, Santiago de Chile</td>
<td></td>
<td>Europe, Middle East &amp; Africa: Amsterdam, Copenhagen, Frankfurt, Prague, Stuttgart, Brussels, Munich, Stockholm, Vienna, Zurich</td>
<td>Asia Pacific: Kuala Lumpur, Singapore</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Source: Arthur D. Little Urban Mobility Index 2.0; 1) not included into group 1 (C40 Megacities)
The selection of the criteria used to measure the maturity and performance of the cities under examination was governed by a desire 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. The selection of the measurement criteria was also driven by the ability to obtain data in all the territories covered, which proved impossible in some cases (e.g. measurement of accessibility by the number of public transport stops per square kilometer) as certain statistics are not collected in some regions of the world. We trust however that, taken as a whole, the 19 criteria make for a representative and comprehensive view of cities’ mobility.

When it came to weighting the criteria, it was decided to award a number of them a lower maximum weighting than others. This has been done to avoid penalizing cities unfairly. When it comes to urban agglomeration density, for example, a densely populated city such as Tokyo would rate highly for public transport provision over the much less densely populated Atlanta, where such a solution might not be the answer. The authors of the report were also keen not to penalize mature cities with long established road densities, for example, on the basis that this was an indicator over which they had little if any influence (see Figure 5 overleaf).
### Arthur D. Little Urban Mobility Index 2.0 – Assessment criteria

<table>
<thead>
<tr>
<th>Criteria</th>
<th>Weight1</th>
<th>Definition</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Financial attractiveness of public transport</td>
<td>4</td>
<td>Ratio between the price of a 5 km journey with private means of transport and the price of a 5 km journey with public transport within the agglomeration area. Private means of transport: car or motorcycle, depending on what vehicle type dominates in modal split. Cost of journey with motorized individual transport: fuel cost only, based on fuel consumption and fuel price including taxes; average for gasoline and diesel cost taken. Cost of public transport journey: ticket cost for a 5 km distance trip.</td>
</tr>
<tr>
<td>2. Share of public transport in modal split</td>
<td>6</td>
<td>Percentage of the total number of person trips which are made with public transport in the last available measurement. Modal split definition: trips made by residents of the urban agglomeration; both motorized and non-motorized trips; trips for all purposes; trips on both working days and weekends.</td>
</tr>
<tr>
<td>3. Share of zero-emission in modal split</td>
<td>6</td>
<td>Percentage of the total number of person trips which are made by bicycle and walking in the last available measurement.</td>
</tr>
<tr>
<td>4. Roads density</td>
<td>4</td>
<td>Ratio between the total road length in an urban agglomeration and the urbanized surface area. Total road length definition: all roads open to public traffic (both paved and non-paved) incl. motorway network and excl. farmland, forest and private roads located within the urban agglomeration borders. Measured as a deviation from an optimum value. Optimum value for road density according to Fei (2011) is: average for core city 11.0 km/km², average for suburbs 3.7 km/km², average for mixed territories 7.35 km/km².</td>
</tr>
<tr>
<td>5. Cycle path network density</td>
<td>6</td>
<td>Ratio between the total length of cycle lanes and cycle paths in an urban agglomeration and the urbanized surface area of this urban agglomeration. Cycle lane: A lane marked on a road with a cycle symbol, which can be used by cyclists only. Cycle path: An off-road path for cycling incl. exclusive cycle paths (for cyclists only), shared-use paths (for both cyclists and pedestrians), and separated paths (where section for cyclists’ use is separated from the pedestrians’ section).</td>
</tr>
<tr>
<td>6. Urban agglomeration density</td>
<td>2</td>
<td>Ratio between the population of an urban agglomeration and its urbanized surface area. Urban agglomerations taken as defined by the United Nations’ in World Urbanization Prospects. Urbanized surface area doesn’t include sea, lakes, waterways, woods, forests etc. and refers to the build-up land surface only.</td>
</tr>
<tr>
<td>7. Smart card penetration</td>
<td>6</td>
<td>Ratio between the total number of transit smart cards in circulation in an urban agglomeration area and the population of this area. Cards are only considered if they are issued and/or accepted by public transport authorities of public transport operators.</td>
</tr>
<tr>
<td>8. Bike sharing performance</td>
<td>6</td>
<td>Ratio between the total number of bikes in bike sharing systems in an urban agglomeration area and the population of this area. Only bikes in business-to-consumer (B2C) and administration-to-citizen (A2C) schemes are considered. Peer-to-peer (P2P) sharing is excluded.</td>
</tr>
<tr>
<td>9. Car sharing performance</td>
<td>6</td>
<td>Ratio between the total number of cars in car sharing systems in an urban agglomeration area and the population of this area. Only cars in business-to-consumer (B2C) and administration-to-citizen (A2C) schemes are considered. Peer-to-peer (P2P) sharing is excluded. Both free floating and station based models are considered.</td>
</tr>
<tr>
<td>10. Public transport frequency</td>
<td>6</td>
<td>Frequency of the busiest public transport line in an urban agglomeration. Frequency of the busiest metro line taken; if metro not available – then frequency of the busiest bus line considered.</td>
</tr>
<tr>
<td>11. Initiatives of public sector</td>
<td>6</td>
<td>Qualitative evaluation of strategy and actions of public sector with regard to urban mobility along 5 dimensions: General sustainability and restrictions; Alternative engines; Multimodality; Infrastructure; Incentives.</td>
</tr>
</tbody>
</table>

### Performance

<table>
<thead>
<tr>
<th>Criteria</th>
<th>Weight1</th>
<th>Definition</th>
</tr>
</thead>
<tbody>
<tr>
<td>12. Transport related CO₂ emissions</td>
<td>4</td>
<td>Ratio between the total amount of carbon dioxide emitted by the agglomeration area p.a. as a consequence of its transport activities and its population. The data considers carbon dioxide emissions from the burning of fossil fuels in transportation only (sectorial approach).</td>
</tr>
<tr>
<td>13. NO₂ concentration</td>
<td>4</td>
<td>Annual arithmetic average of the daily concentrations of NO₂ recorded at all monitoring stations within the agglomeration area.</td>
</tr>
<tr>
<td>14. PM₁₀ concentration</td>
<td>4</td>
<td>Annual arithmetic average of the daily concentrations of PM₁₀ recorded at all monitoring stations within the agglomeration area.</td>
</tr>
<tr>
<td>15. Traffic related fatalities</td>
<td>6</td>
<td>Number of deaths related to transport i.e. an annual number of people killed as a result of transport accidents that occurred in an urban agglomeration area p.a. Fatalities is counted if it occurs during a period of 30 days after the accident.</td>
</tr>
<tr>
<td>16. Increase of share of public transport in modal split</td>
<td>6</td>
<td>Increase of the percentage of the total trips which are made daily by public transport in the last available measurement compared to its share in the last but one measurement.</td>
</tr>
<tr>
<td>17. Increase of share of zero-emission in modal split</td>
<td>6</td>
<td>Increase of the percentage of the total trips which are made daily by bicycle and walking in the last available measurement compared to its share in the last but one measurement.</td>
</tr>
<tr>
<td>18. Mean travel time to work</td>
<td>6</td>
<td>Total number of minutes that it usually takes the person to get from home to work each day during the reference week. The elapsed time includes time spent waiting for public transport, picking up passengers in carparks, and time spent in other activities related to getting to work.</td>
</tr>
<tr>
<td>19. Density of vehicles registered</td>
<td>6</td>
<td>The ratio between the total number of passenger motorized vehicles (incl. cars, motorcycles, taxis) within the urban agglomeration and its population. Non-active vehicles (“scrap”) excluded from the calculation.</td>
</tr>
</tbody>
</table>

1) Maximum number of points achievable
3) United Nations, Department of Economic and Social Affairs, Population Division, Population Estimates and Projections Section, World Urbanization Prospects
3.2. Ranking of urban mobility systems

The results of the Urban Mobility Index 2.0 report make grim reading as it finds most cities are badly equipped to cope with the challenges ahead. The global average score is 43.9 points, meaning that, on average, the 84 cities achieve less than half of the potential that could be reached today when applying best practice across all operations (see Figure 6).

Only 11 cities score above 52 points (top 20% of the score range). The highest score (58.2 points) went to Hong Kong followed closely by Stockholm (57.4 points) and Amsterdam (57.2 points), still indicating potential for improvement.

16 of the cities surveyed were below average. While most of these were in developing economies, four were in the US – Atlanta, Dallas, Houston and Miami – fresh evidence that the Americans’ addiction to cheap gas is impeding the development of sustainable mobility models. At the opposite end of the spectrum, among the cities with above average scores, all but two were in Europe. Exceptions in this group are Hong Kong, the city with the world’s most well integrated and sustainable mobility ecosystem, and Singapore.

Perhaps surprisingly, the cities of the C40 Climate Leadership Group perform slightly worse, than all 84 cities in the sample, with an average of 42.6 points against a global average of 43.9.

There are big differences between the top- and low-end performers in various regions:

Europe achieves the highest average score of all the regions surveyed. With an average of 49.8 points (51.5 points for Western Europe and 45.2 for (South-)Eastern Europe) and nine out of the 26 analyzed European cities scoring above 52 points, European urban mobility systems are the most mature ones as of today and lead the way in mobility performance. It is a clear leader in three categories in the Maturity bucket: cycle path network, car sharing and bike sharing. Stockholm (57.4), Amsterdam (57.2) and Copenhagen (66.4 points) head the table – while Athens (40.0 points), Rome (40.9 points) and Lisbon (41.3) are the worst scoring European cities in the sample (see Figure 7 overleaf).

Latin American and Asian Pacific cities show slightly below average performance. The continents’ average scores are well below Western Europe (43.9 and 42.8 points respectively) but outperform other regions in public transport-related criteria: fares are financially attractive, services are frequent, smart card use is well developed and public transport represents a dominant part of the modal split. Most cities in Latin America show average performance of between 40 and 47 points while Asian Pacific cities show the broadest range in performance, from Hong Kong and Singapore with scores of 58.2 and 55.6.
respectively – sitting at the top of the global table – down to Hanoi with 30.9 points. USA/Canada shows average performance with 39.5 points. Given their orientation towards cars, USA/Canadian cities rank bottom worldwide in terms of maturity. In terms of performance, they perform above average overall, but show poor results with regard to number of cars per capita and CO₂ emissions. New York leads the way with 45.6 points, closely followed by Montreal with 45.4 points.

Africa and the Middle East are the lowest performing regions with respective average point totals of 37.1 and 34.1. While urban mobility systems in Africa perform well on several criteria due to the relatively low number of cars per capita and the large number of journeys made on foot, they are still evolving and lack maturity. Middle East cities have high levels of cars per capita and are expected to invest in development of environmental modes of transport in the mid-term perspective. War-torn Baghdad came bottom of the class overall, perhaps for obvious reasons.

None of the urban mobility systems in the above regions, except Western Europe, reaches 50% of potential maturity, showing that all the world’s cities have a long way to go in terms of developing their travel networks. It was a slightly more encouraging story when it came to performance, with Europe leading the way with a score of 24.8 out of 42 (59%).

Eleven cities belong to the above average group worldwide

Hong Kong – study winner: 58.2 points, 1 out of 84 worldwide, 1 out of 28 in Asia Pacific

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 64% of the modal split, the number of vehicles registered per capita is amongst the lowest in the survey, and smart card penetration stands at 3.1 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 with a low 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 (see Figure 8 overleaf).

Stockholm: 57.4 points, 2 out of 84 worldwide, 1 out of 19 in Western Europe

The Swedish capital stands out for having one of the best-developed networks of cycle paths: its bike lane network is the third most dense in the world, with 4,041 km of lanes per 1,000 sq km. It has a high rate of public sector initiatives, and its multi-modal SL-Access smart card has a penetration of 0.64 cards per capita. As a result of this forward-thinking approach, it ranks above average for transport-related emissions, with one of the lowest concentrations of nitrogen dioxide and particulates (NO₂ and PM10) in the air in the world. What’s more, its traffic-related death rate is amongst the lowest in the survey.

Amsterdam: 57.2 points, 3 out of 84 worldwide, 2 out of 19 in Western Europe

There is a car for only one in three citizens in Amsterdam, which makes it well below the Western European average of 0.45 vehicles per capita. Cycling on the other hand has a very high share of the modal split (33%) thanks partly to a
dense cycling lanes network occupying 3,502 km per 1,000 sq km. Add to this, the second best car-sharing performance worldwide (1,219 shared cars per million citizens) and it’s no surprise to hear that transport-related CO2 emissions are significantly lower than the Western European average (844 kg per capita per annum in Amsterdam compared to an average of 1,330 kg in Western Europe as a whole).

**Copenhagen:** 56.4 points, 4 out of 84 worldwide, 3 out of 19 in Western Europe
The Danish capital has the safest urban mobility system in the world, with 4.1 traffic deaths per million citizens. It also has the lowest penetration rate of cars in Western Europe at 0.24 per capita, and the use of individual transport is on the decrease. This coupled with the fact it has a dense cycle-lane network, helps explain why its transport-related CO2 emissions are significantly below the European average at 812 kg per capita, compared to a Western European average of 1,330 kg.

**Vienna:** 56.0 points, 5 out of 84 worldwide, 4 out of 19 in Western Europe
Alongside Zurich, Vienna’s public transport system has the highest share of journeys in Western Europe, with 39% of trips made on its services. It has pioneered the use of a new generation of Liquefied Petroleum Gas (LPG)-powered engines in its bus fleet, whose emissions fall more than 50% below the EU-5 standard. It also has a below average number of private cars per capita and encourages cycling. One innovative initiative in this regard is Bike City, a housing estate equipped with extra-large lifts to accommodate bicycles and limited space for car parking. The combined effect of all this is clean air, with a particularly low concentration of NO2 and PM10.

**Singapore:** 55.6 points, 6 out of 84 worldwide, 2 out of 28 in Asia Pacific
With a population density of 7,300 inhabitants per square kilometer, Singapore’s public transport is highly developed; accounting for no less than 48% of the modal split, and mobility card penetration is at 2.9 cards per capita. Thanks, at least in part, to high taxes and duties, car ownership has been reduced to 0.18 cars per capita and car-use is also

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**Figure 8: Top 11 cities with above average mobility score**

| Source: Arthur D. Little Urban Mobility Index 2.0 |
| Maturity indicators | Performance indicators |
| Fin. attract. of PT (cost of 5 km PT/cost of 5 km car) | Transport related CO2 emissions per million citizens |
| Share of public transport in modal split [%] | Annual average NOx concentration [mcg/m³] |
| Urban agglomeration density [citizens/km²] | Annual average PM10 concentration [mcg/m³] |
| Road density deviation from optimum [km/km²] | Traffic related fatalities per million citizens |
| Cycle path network density [km/ths km²] | Dynamics of share public transport in modal split [%] |
| Bike sharing performance [shared bikes/million citizens] | Dynamics of share zero-emission modes in modal split [%] |
| Car sharing performance [shared cars/million citizens] | Mean travel time to work [minutes] |
| Roads density (deviation from optimum) [km/km²] | Initiatives of public sector (0 to 10 scale) |
| Cycle path network density [km/ths km²] | Density of vehicles registered [vehicles/capita] |

Hong Kong 1.7 55% 38% 2.0 187 6.5 3.1 0 0 0.07 324 10 776 50.0 50.0 16.2 +20% 0% 36.6 58.2
Stockholm 6.7 33% 34% 0.5 4,041 3.7 0.6 852 400 0.40 212 10 1,348 12.5 16.7 9.4 -7% +89% 33.7 57.4
Amsterdam 3.0 8% 50% 1.7 3,502 3.2 0.7 527 1,219 0.32 130 10 844 30.0 24.7 19.5 +12% +13% 35.5 57.2
Copenhagen 4.8 27% 33% 2.7 3,977 2.7 0.1 1,025 248 0.24 238 10 812 56.0 28.0 4.1 +123% -15% 29.7 56.4
Vienna 3.9 39% 34% 0.6 2,948 3.8 0.0 692 415 0.39 277 10 1,111 21.7 21.5 16.1 +15% +13% 29.3 56.0
Singapore 2.6 48% 23% 2.6 280 7.3 2.9 19 57 0.18 233 9 1,381 22.0 29.0 32.5 +17% +64% 36.8 55.6
Paris 2.9 34% 50% 8.8 3,520 3.8 0.6 2,224 219 0.46 267 10 1,163 39.2 38.0 23.9 +7% 0% 38.6 55.4
Zurich 3.8 39% 31% 0.7 3,700 4.2 0.0 232 1,064 0.54 149 10 1,200 30.1 19.1 15.4 +15% +3% 30.4 54.7
London 3.9 34% 26% 10.8 254 5.6 3.1 1,012 253 0.39 468 10 1,050 37.0 22.9 26.6 +10% +4% 44.1 53.2
Helsinki 3.6 27% 40% 2.1 4,678 2.3 0.9 0 70 0.48 246 10 1,228 28.0 20.2 13.9 -16% +8% 28.5 53.2
Munich 4.6 21% 42% 0.1 3,862 3.0 0.0 727 640 0.56 210 10 1,351 35.3 21.7 15.3 0% +11% 30.1 53.0

Source: Arthur D. Little Urban Mobility Index 2.0
discouraged via congestion pricing, which charges drivers more for using roads during the rush hour.

**Paris**: 55.4 points, 7 out of 84 worldwide, 5 out of 19 in Western Europe
In addition to the outstanding performance of its extensive rail network, the French capital boasts the third best bike-sharing performance in the world after Wuhan and Brussels, with 2,224 shared bikes per million citizens. Its cycle-lane network is also well advanced, accounting for 3,520 km per thousand square kilometers. An innovative car sharing scheme has proved highly successful too, with 2,000 electric Bluecars attracting more than 100,000 registered subscribers. On the commercial front, a grouped goods delivery system, Distripolis, uses low-emission vehicles to reduce transport-related pollution.

**Zurich**: 54.7 points, 8 out of 84 worldwide, 6 out of 19 in Western Europe
The Swiss banking center saw public transport’s share of the modal mix increase by five percentage points between 2005 and 2010 to 39%, putting Zurich alongside Vienna as the best-performing city in Western Europe. Its ‘good practice’ urban mobility strategy has led to a dense cycle-lane network (~3,700 km per thousand square kilometers) and the world’s third best car sharing performance after Stuttgart and Amsterdam, with 1,064 shared cars per million citizens.

**London**: 53.2 points, 9 out of 84 worldwide (ex aequo with Helsinki), 7 out of 19 in Western Europe
Like Hong Kong, London’s smart card penetration rate is at saturation level and it boasts dynamic and efficient public transport sector operators. Despite having a far from optimum level of road density, its rate of traffic-related fatalities is below average and its level of harmful emissions is average or below average. But while it has frequent services on public transport, its mean travel time to work is below average.

**Helsinki**: 53.2 points, 9 out of 84 worldwide (ex aequo with London), 7 out of 19 in Western Europe
The world’s most dense cycle-lane network can be found in Helsinki, which has a total of 1,000 km of segregated bike lanes, or 4,678km per thousand square kilometers of city area. One innovation, the 1.3 km Baana pathway for cyclists and pedestrians, was used by 320,000 cyclists in one six-month period in 2012. The city also boasts a high penetration of its HSL Travel Card at 0.9 cards per capita, with the result that Helsinki has a low concentration of both NO₂ and PM₁₀.

**Munich**: 53 points, 11 out of 84 worldwide, 9 out of 19 in Western Europe
The level of zero-emission modes in the capital of Bavaria’s modal split is an impressive 42%. A significant contributor to this has been Munich’s Cycle Capital Campaign, which has a vision of turning Munich into Germany’s most bicycle-friendly large city. Between 2002 and 2012, cycling’s share of the modal split rose from 10% to 17%, aided by the creation of a dense network of cycle lanes that now stretches to 3,862 km per thousand square kilometers. Munich is also enjoying a dense and high quality multimodal public transport system, especially by rail (tram, metro, S-bahn) (see Figure 9 overleaf).

**Trends towards shared mobility**
An important finding of the study is that progress is being made in the field of shared mobility. With every year that passes, more and more cars and bikes are being shared than ever before. In 2011, Arthur D. Little found that in the 66 cities surveyed in the context of the first edition of the urban mobility index, an average of 89 cars were shared per million citizens. In 2013 – just two years later – in the 84 cities surveyed, 115 cars per million were shared – that represents a global compounded annual growth rate of +14% per annum. On a like-for-like basis, the increase was almost identical: +13% p.a. It was a similar story when it came to bike use. The number of bikes shared per million citizens increased from 344 to 383 (+6% p.a.) between the two studies. On a like-for-like basis, the increase was even more impressive: +12% p.a.

**Integrated mobility platforms**
Smart card use is also on the increase, pointing to a growth in the integration of services worldwide. In 2011, the average penetration of smart cards was 0.34 cards per capita in the 66 cities surveyed. In 2013, in the 84 cities surveyed, this had increased to 0.44 cards per capita (+14% p.a.). On a like-for-like basis, penetration was up +21% p.a. It should be noted that most of this growth is being driven by developing cities such as Dubai, Buenos Aires, Delhi, Kuala Lumpur and Tehran, while, in contrast, smart card penetration is stagnating in developed cities.

There are some very good examples of successfully integrated mobility platform initiatives at local level, of which probably the most well-known one is the Octopus card launched by Hong Kong in 1997.

Other successful initiatives worth mentioning include SMILE (Vienna), Trafiken.nu (Stockholm), Path2Go (San Francisco Bay Area), and Goroo (Chicago Metropolitan Region). In Germany, Stuttgart and Berlin, recently received major subsidies from the central government to speed up implementation and are good examples of strong integration between several actors of different plumages:

**SMILE (Smart Mobility Information and ticketing system Leading the way for Effective e-mobility services)** is a prototype of the multimodal mobility platform of the City of
Figure 9: Urban Mobility Index by regions and cities

<table>
<thead>
<tr>
<th>Western Europe</th>
<th>(South-)Eastern Europe</th>
<th>USA/Canada</th>
</tr>
</thead>
<tbody>
<tr>
<td>Average</td>
<td>51.5</td>
<td>Average</td>
</tr>
<tr>
<td>Stockholm</td>
<td>57.4</td>
<td>New York</td>
</tr>
<tr>
<td>Amsterdam</td>
<td>57.2</td>
<td>Montreal</td>
</tr>
<tr>
<td>Copenhagen</td>
<td>56.4</td>
<td>Toronto</td>
</tr>
<tr>
<td>Vienna</td>
<td>56.0</td>
<td>Washington</td>
</tr>
<tr>
<td>Paris</td>
<td>55.4</td>
<td>(D.C.)</td>
</tr>
<tr>
<td>Zurich</td>
<td>54.7</td>
<td>Boston</td>
</tr>
<tr>
<td>London</td>
<td>53.2</td>
<td>Philadelphia</td>
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<tr>
<td>Helsinki</td>
<td>53.2</td>
<td>Chicago</td>
</tr>
<tr>
<td>Munich</td>
<td>53.0</td>
<td>Los Angeles</td>
</tr>
<tr>
<td>Stuttgart</td>
<td>51.9</td>
<td>Portland</td>
</tr>
<tr>
<td>Berlin</td>
<td>51.7</td>
<td>Miami</td>
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<tr>
<td>Madrid</td>
<td>50.3</td>
<td>Houston</td>
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<td>50.1</td>
<td>Dallas</td>
</tr>
<tr>
<td>Brussels</td>
<td>49.7</td>
<td>Atlanta</td>
</tr>
<tr>
<td>Barcelona</td>
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<td></td>
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<tr>
<td>Frankfurt</td>
<td>48.8</td>
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<tr>
<td>Nantes</td>
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<tr>
<td>Lisbon</td>
<td>41.3</td>
<td></td>
</tr>
<tr>
<td>Rome</td>
<td>40.9</td>
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<td></td>
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<td>Average</td>
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<td>Prague</td>
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</tr>
<tr>
<td>Warsaw</td>
<td>47.8</td>
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Vienna. This smartphone-based platform was developed with public transport as a backbone. It integrates diverse mobility offerings into multiple unified travel options taking into account unique customer needs. SMILE provides intelligent customer information, and enables electronic booking and payment. It is open to third-parties and is expected to develop into a nation-wide platform for Austria in the medium term.

Trafiken.nu is a multimodal planning tool that was piloted in Stockholm (a joint initiative of the local PTO, PTA, city administration and road building authority) and financed via toll revenue. It was later rolled out in other areas, such as the Gothenburg Region and Skane Country. This tool compares different multimodal chains door-to-door with regard to cost, time and climate impact. However, innovative mobility services, such as car or bike sharing, are not integrated so far.

Path2go is a trip-planning tool for the San Francisco Bay Area that combines real-time information on transit, traffic and parking in order to provide personalized intermodal chains for travelers. The platform also includes en-route incident alerts and navigation to connect with transit. Tool roll out in Los Angeles is planned in the short term. Reservation and ticket-purchasing functionalities are not yet available however.

Goroo, a multimodal journey planner in the Chicago Metropolitan Region was developed by the local PTA in collaboration with PTOs, the traffic authority, the tourism bureau, the parking services provider, the regional transportation department and other stakeholders. Apart from urban mobility the platform also offers entertainment, shopping, sport, recreation, gastronomy and other value-added services.

Stuttgart Services Mobility Platform is a prototype system that provides real-time intermodal information and can be used as a booking and reservation system. The platform provides real-time information for all modes of transport. Routes can be planned according to the availability of transport means (for car and bike sharing) and the actual traffic situation. Users can obtain the most suitable mobility solution in each specific situation.

While we are yet to discover any example of best practice when it comes to integrated mobility platforms at supra-regional level, private companies such as Daimler, Citroen, Google, Nokia and the German Railway are making interesting attempts to establish platforms integrating multiple local players:

Daimler's moovel is focused on its captive car sharing service car2go as well as other third-party mobility services, including taxis, public transport, bike sharing, carpooling etc. It covers five German agglomerations – Stuttgart, Berlin, Rhine-Ruhr, Nuremberg and Munich. Expansion to other cities, regions and continents, as well as aggregation of further mobility providers, is expected.

Citroen’s Multicity has integrated carsharing, flights, railway, hotels and other tourist services, but, at this stage, is active only in Germany and France.

Google Now is an intelligent personal assistant with voice recognition that makes mobility-related recommendations for users based on their location, calendar entries etc. Besides traffic, transit, flight and hotel information, the platform assists users with car rentals, event tickets and reminders.

Nokia Here provides public transport information for 700 cities across 50 countries. Modes covered include bus, train, ferry, tram and walking. The system also provides navigation for car drivers in 94 countries including real-time information on congestion, accidents, and road-works. Unlike its competitor Google Now, Nokia Here doesn’t offer bicycling directions.

German Railway’s Qixxit platform is open to third parties. It is currently available only as a beta-version and aggregates railway, long-distance buses, airlines, taxis, car rental, car sharing, bike sharing and local public transport in Germany.

Platforms currently being created globally around Visa PayWave and Mastercard PayPass are also worth mentioning.

The integrator type of business models are expected to change their core. While transit smart cards have been at the core of such business models until now and smart cards penetration continues to increase, we expect that over the next five to ten years smartphone-based mobility platforms will become increasingly important for mobility integrators and will constitute major revenue generators.

3.3. Overall conclusions

It is clear that no city has a perfect urban mobility system. Overall, only 11 cities are performing “above average” – the top 20% of the score range. Even the city with the highest score – Hong Kong with 58.2 out of 100 – still has significant potential for improvement. On average, less than half of the potential of urban mobility systems is unleashed today. Action is needed, and fast.

Out of seven regions surveyed, Western Europe ranks top followed by (South-) Eastern Europe and Latin America: Not only are European urban mobility systems the most mature ones as of today, they also lead the way in mobility performance. USA/Canadian cities rank bottom worldwide in terms of maturity.
given their orientation towards cars. Developing regions, on the other hand, perform well on several criteria due to the low number of cars and the share of individual motorized transport in the modal mix so far.

Significant progress has been made in certain sectors since we published our previous urban mobility index in 2011. In terms of the trend towards shared mobility, more cars and bikes are being shared in cities, via both peer-to-peer and business-to-consumer models. Integrated mobility platforms are also gaining traction: the penetration of mobility smart cards is increasing, driven by developing cities, and there is a growing number of examples of good practice in integrated mobility platforms at the local level. There is currently no good example of best practice for a supra-regional integrated mobility platform.

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. Even among the cities that score highest, the scope for improving toward the maximum score of 100 is still significant:

- Hong Kong, for example, scores very high in terms of modal split, smart card penetration and vehicles per capita but lags in terms of car and bike sharing.
- Amsterdam is a cycling oriented city with a good cycling network, car and bike sharing systems, but public transport has a poor share of the modal split (only 8%).
- Vienna and Zurich have safe mobility systems with well-balanced modal splits, but have no mobility card so far, etc.

What would a city that would perform well across all criteria look like? A hypothetical best-in-class urban mobility system would:

- Be as affordable as Hong Kong, with a similar modal split and level of smart-card acceptance. It would also have as few vehicles as Hong Kong.
- Ensure air is as pure as Stockholm's
- Promote cycling like Amsterdam
- Be as safe as Copenhagen
- Have best-in-class bike sharing as demonstrated in Brussels and Paris
- Have a public transport service as frequent as the London Tube
- Have best-in-class car sharing as demonstrated in Stuttgart
- Have as minor an impact on climate as in Wuhan
- Ensure travel times as short as they are in Nantes
4. What is holding back changes?
Business model archetypes for urban mobility

Confronting the challenges of the future will often require the adoption of new technology and business models. A comprehensive review of technologies and urban mobility business models reveals that the majority of them are at the growth or maturity stage. However, there are sufficient solutions available to address the mobility challenges. In its 2011 study, Arthur D. Little identified three long-term sustainable business models for the future of urban mobility, which it dubbed the “Amazon”, “Apple” and “Dell” models of urban mobility (see Figure 10).

The Amazon model: So-called because – like the online retailer – it is an aggregator of third-party services. It relies on a single point of access for mobile and supplementary services, including information, planning, booking and payment/billing functions. These are largely virtual services, with little physical infrastructure required, which form a one-stop shop. Examples of this model in the public transport sphere include German Railway’s Qixxit, Daimler’s moovel or Vienna’s SMILE. Car rental variants include Check 24, carrentals.com and eBookers, while examples in the hotel market include HRS, Expedia, Opodo and TripAdvisor. However, market research shows that no one is currently operating a truly integrated intermodal routing and compilation of travel chains, e.g. taxi-rail-rental-car-hotel, in both directions of travel. A fully implemented service of this sort has the potential to attract significant volume.

The Apple model: Like the desktop-to-smartphone giant, the key to this model is deep vertical integration of services. The goal here is a completely seamless user experience of the sort epitomized by car hire company Avis’s acquisition of car-sharing firm ZipCar and Sixt’s car-and-driver service MyDriver and its car-sharing joint venture with BMW, DriveNow. Other examples of the Apple business model archetype are German Railway, offering also car sharing (“Flinkster”) and bike sharing (“call-a-bike”) services or Transdev operating train, tram-train, metro, light rail, coach, bus, BRT, paratransit, ferry, taxi, car-sharing, shared-ride airport shuttle and bicycle sharing.

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Footnote:
The Dell model: While others diversified in response to excess supply and deteriorating margins in the PC market of the mid-90s, US PC manufacturer Dell thrived by concentrating on online sales and supply chain excellence. In the urban mobility context, this model refers to single mode specialists such as local public transport (e.g. Transport for London), car and bike sharing providers (e.g. Volkswagen’s Quicar), car pooling platforms (e.g. carpooling.com), taxi and limo services. All these sectors are expected to enjoy rapid growth over the next few years. Bike sharing in the US, for example, is expected to grow 51% p.a. between 2013 and 2016. B2C car-sharing is expected to mushroom too. In Europe it is tipped to increase by 43% p.a. between 2013 and 2016 and in Japan by 64% p.a. in the same period.

These models need not stand alone. The Amazon and Apple archetypes can be combined, whereby a mobility provider could integrate its own services with those of third parties and provide “one face to the customer”. Figure 11 shows how this could work from the perspective respectively of an automotive OEM and a PTA/PTO.

Those three business model archetypes still hold true today and each has interesting development potential. However, these solutions and archetypes are currently not being applied comprehensively and only a few players have managed to smartly integrate them to unleash their full business potential.

Figure 11: Combined “Amazon” and “Apple” business models (“Total Mobility Provider”)

Note: SU=Suburban, LD = Long-Distance, HW = Hardware, SW = Software
Source: Arthur D. Little
Car sharing 3.0 – What is the next lever that will turn car sharing into a mass market?

There is a clear trend toward shared mobility: more cars and bikes are being shared in cities, both via peer-to-peer and business-to-consumer models.

Car sharing is one mobility mode set to become much more ubiquitous in the next few years. The strongest growth is expected to be seen in regions with mature urban mobility systems, such as Western Europe, North America and some Asian Pacific cities, because they are easier to target due to their existing infrastructure and an openness on the part of economically and environmentally conscious consumers to embrace options that are cheaper and more sustainable (see Figure 12).

Car sharing has evolved from a community-based, collaborative exercise between eco- and/or cost-oriented customers with an average age of 40 (car sharing 1.0), to a big business which has attracted some of the world’s major car manufacturers, and a younger customer base thanks, in part, to the need for them to be app-savvy (car sharing 2.0). Currently operators are looking for the next levers that will turn car sharing into a mass market 3.0 business model. Depending on the type of operator, Arthur D. Little has identified four business model archetypes in the car sharing sector: Traditionalists, Citizen Networkers, Mobility Integrators and Innovative OEMs.

**Traditionalists:** These service providers offer a broad range of unusually low-cost cars3 stationed in dedicated parking spaces around the city or region they serve. This type of operator may well be established on a not-for-profit or co-operative basis and thus offer comparatively low usage fees. Because the reservation of cars is usually possible without smartphone usage, the older generation find this type of car sharing user friendly.

The German car-sharing company Greenwheels/StatAuto is one of the pioneers in this. Its members can reserve a car at any time over the phone or online, with the driver accessing the car or key-deposit box with a chip card and pin code. At the end of a trip, the member returns the car to the distribution station and fills out a short driving report.

The disadvantages of such operations are that the cars can be found at defined stations only4 (and the network of such stations is sometimes insufficiently dense) and customer processes can be relatively complex. Other examples of operators in this area include Stadtmobil, Communauto, etc. (see Figure 13)

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3 Still a minor share of premium cars is also being offered, e.g. Stadtmobil has Mercedes, BMW and Audi in its fleet.
4 But Traditionalists also start to penetrate the free-floating operating model, e.g. Auto-mobile car sharing service of Communauto in Montreal.

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**Citizen Networkers:** Unlike the Traditionalists, Citizen Networkers connect private car owners and people looking to rent their vehicles for short periods of time. P2P car sharing is a comparatively new business model, having emerged in 2001 in Germany with the establishment of the RentMyCar platform. In the US this business model was first piloted by RelayRides in 2010 in San Francisco. The advantages of this model is that it tends to offer cheaper rides than any other car-based system, insurance is built in and there is no need for anyone to invest in a fleet.

The down side is that it does not become an effective and reliable option until a critical mass of car owners has been established. They also tend to be neighbourhood schemes with limited geographic scope and sometimes car theft problems can arise. Examples include Tamyca, Jolly Wheels, Getaround, etc.

**Mobility Integrators:** Entrepreneurial public transport operators have increasingly developed a clear vision of becoming integrated mobility providers. Thus they have started offering car sharing and other services in addition to their core business. These operators belong to the “Apple of Mobility” business model archetype.

These operators can leverage their existing customer base to reach the critical mass of users needed for a profitable car sharing business more quickly. Captive users of such PTOs can also use the same mobility cards to access shared cars and same smartphone apps designed to reserve and pay for shared cars.

There are no additional disadvantages for users if the car sharing service is being provided by a Mobility Integrator, rather than, for example, a Traditionalist. As station based car sharing is currently the only operating model being offered by Mobility Integrators, the disadvantages on this model apply.

Examples include Deutsche Bahn’s Flinkster (countrywide in Germany plus in Austria’s capital Vienna), Transdev’s Autobleue (in Nice) and Keolis’ Autocool, Lilas, Auto’Tao, IDElib’ (in Bordeaux, Lille, Orléans and Pau respectively).

**Innovative OEMs:** This model relies on providers offering middle segment or premium cars to urban communities who typically identify available vehicles and their locations via a smartphone app.

The advantage this free-floating model has over other car sharing options is that users are not restricted to picking up cars from fixed points and can hire a car at a moment’s notice. Just intermodal apps are available and (same as in other archetypes) customers often have the choice of an electric car as well as a conventional petrol or diesel-powered. Such
services do, however, command higher usage fees, rely on smartphone skills and do not allow the reserving of a car in advance (orders tend to be taken only 15 or 30 minutes beforehand). Examples include BMW’s DriveNow, Daimler’s car2go, Volkswagen’s Quicar, Citroen’s Multicity, etc.

While growth will be rapid in this sector, it is from a low base and providers are currently still assessing long term profitability of different business models. Very few examples boast a significant number of members or users and the challenge is to find a way to turn car sharing from the province of a relatively small number of early adopters into a mass-market option.

Levers for potential growth exist in four main areas: geographical expansion, developing the sales platform, creating or extending a partner network and fostering loyalty by becoming more locally responsive.

**Figure 12: Car sharing innovation curves**

<table>
<thead>
<tr>
<th>Demand</th>
<th>Car sharing 1.0: Eco niche</th>
<th>Car sharing 2.0: OEMs get on</th>
<th>Car sharing 3.0: Mass market</th>
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<tr>
<td><strong>1948</strong></td>
<td>Station based model</td>
<td>Free floating &amp; private P2P models</td>
<td>Is it about community?</td>
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<td><strong>2008</strong></td>
<td>Complicated customer processes: reservation, information provisioning</td>
<td>Smart phone based</td>
<td>Is it about seamless and integrated solutions?</td>
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<tr>
<td><strong>2012-2015</strong></td>
<td>Target group – Eco-oriented customers</td>
<td>Premium cars pilots</td>
<td>Is it about convenience?</td>
</tr>
</tbody>
</table>

**Features**
- Station based model
- Complicated customer processes: reservation, information provisioning
- Target group – Eco-oriented customers

**Figure 13: Car sharing business model archetypes**

**Unique Selling Proposition**
- **Traditionalists**
  - Mainly low-cost cars
  - Full service model
  - Broad range of vehicle types
- **Citizen networkers**
  - “Virtual” feet made up of vehicles from participating owners
  - Usually large selection of cars
- **Mobility integrators**
  - PTOs enlarging their service portfolio in order to offer door-to-door mobility
  - Strong PTO brand
- **Innovative OEMs**
  - Premium cars also
  - User communities
  - Value add location based services
  - Strong OEM brand

**Advantages**
- Lower usage fees
- Booking possible without smartphone usage skills
- Appropriate for older customer groups
- Insurance included
- Cheaper compared to car sharing
- Suitable for less density populated areas
- Critical mass decisive
- Car theft issues
- Neighborhood based geographic scope
- No full service model
- Mainly station based services
- Less flexibility
- Sometimes complicated processes for customers
- Higher usage fees
- Smartphone usage skills needed
- Booking in advance (> 30 minutes before) not possible

**Disadvantages**
- Mainly station based services
- Less flexibility
- Sometimes complicated processes for customers
- Mainly station based services
- Less flexibility
- Sometimes complicated processes for customers
- Mainly free floating
- Spontaneous hire
- Intermodal apps (e.g. moovel)
- Usually minute based charging

**Examples**
- Traditionalists: Greenwheels/StattAuto, Stadtmobil, Communauto
- Citizen networkers: Witkar, Tamyca, Jolly Wheels, RelayRides, Getaround
- Mobility integrators: Deutsche Bahn – Flinkster, Voella Transdev – Autobleue, Keolis – Autocool, LiaT, IDElib
- Innovative OEMs: BMW DriveNow, Daimler car2go, Volkswagen Quicar, Citroen Multicity

Source: Arthur D. Little

1) Except Quicar
4.2. What is holding back changes?

Given the scale of the looming crisis in urban mobility and the fact that the solutions to it are already available, it is reasonable to ask: why has the potential for innovation not been unleashed?

The answer is that the management of urban mobility operates in an environment that is too fragmented and hostile to innovation. Our urban management systems do not allow market players to compete and establish business models that bring demand and supply into a natural balance. 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.

Moreover, a lot of mature cities do not yet have a clear vision and strategy on how their mobility systems should look in the future. In all too many cases, urban mobility plans look like “Christmas wish lists” with no clear reflection of the synergies or incompatibilities between the initiatives, too limited integration between the different modes of transportation and no convincing explanation of how desired results should be achieved by allotting responsibilities, setting deadlines, and instituting monitoring procedures. This lack of synergies between isolated initiatives leads to a sub-optimal outcome in terms of mobility performance, which calls for a more holistic approach.

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 CO₂ emissions, it should ask what contribution transport should make to achieve this goal.

Finally, decisions are often mainly based on “public sector actions” and do not sufficiently address interfaces with the private sector and what contribution it could make to the achievement of urban mobility goals. The private sector needs to be involved in the goal-setting process.

At a different level, integration between regional mobility systems still remains very low in comparison to other parts of the economy as transport infrastructures were historically designed to serve regional rather than supra-regional goals. In that context, there is a need for stronger alignment between regional mobility strategies while respecting each-others accountabilities and ensuring solutions are adapted to local contexts.

Urban mobility is one of the toughest system-level challenges facing actors of the mobility ecosystems. In the future, innovative mobility services will be driven less by improvements in single transport modes than by integration. What is needed is system-level collaboration between all stakeholders of the mobility ecosystem to come up with innovative and integrated business models.
5. Shaping the future: Strategic directions and imperatives for cities

5.1. Three strategic directions for cities

The urban mobility study was conducted in 84 cities around the globe, a sample consisting of the largest cities in the world as measured by GDP share, C40 members, and a group of smaller cities, which had demonstrated some level of good practice with regards to mobility.

We tried to put the index results in perspective by looking at city characteristics and analyzing their correlation with the mobility scores of cities. We looked more specifically at the following city characteristics:

Prosperity: This was determined by the GDP per capita as of 2012, with those having a GDP per capita of more than 25,000 USD being defined as ‘mature’ and those below that level defined as ‘emerging’.

Modal split: This criterion was applied by assessing the respective shares of individual motorized mobility, public transport and walking/cycling in the modal split. Cities with less than 50% of individual motorized transport in the modal split were categorized as ‘public mobility-oriented cities’. The others were categorized as ‘individual mobility cities’.

City size: This was determined by the population of the city agglomerations as of 2012. Cities with more than five million residents were defined as ‘large’ and those below defined as ‘small’.

The analysis revealed wildly divergent performances but allowed for a number of interesting conclusions:

City size does not matter – City size does not have a significant influence on the mobility score. However, the two other city characteristics that we studied, namely city prosperity and the prevalence of public transport, do have a significant influence on the mobility score: the richer the city and the lower the share of individual transport, the higher the score.

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 very same problems of poor modal split, high carbon emissions and low travel speed.

Innovation is key – One thing all cities have in common is that they need to innovate to improve their performance.

We can distinguish three typical city clusters depending on urban mobility system positioning on the evolutionary curve:

### Figure 14: City clusters of urban mobility and their performance with regards to triple bottom line

<table>
<thead>
<tr>
<th>Cluster</th>
<th>Challenges and opportunities associated with current performance level</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Public</strong></td>
<td>Planet</td>
</tr>
<tr>
<td>Mature cities with high share of public transport/walking &amp; cycling</td>
<td>Sustainability - often a goal of master plans; public transport less environmentally harmful</td>
</tr>
<tr>
<td><strong>Individual</strong></td>
<td></td>
</tr>
<tr>
<td>Mature cities with high share of individual transport in modals split</td>
<td>Often most dirtiest cities in the world (mobility related impact), e.g., 7 t CO₂/capita</td>
</tr>
<tr>
<td><strong>Emerging</strong></td>
<td></td>
</tr>
<tr>
<td>Emerging cities with partly underdeveloped mobility systems</td>
<td>Weak environmental impact due to underdevelopment of infrastructure</td>
</tr>
</tbody>
</table>

Source: Arthur D. Little Mobility Index
public, individual and emerging, each of them with specific opportunities and challenges to address and overcome (see Figure 14 overleaf):

“Public” city cluster: The key here is to further improve performance in terms of sustainability and smart infrastructure – both targets which would benefit from networking of the mobility system and other efforts to reduce still further the role of individual motorized transport in the modal split.

“Individual” city cluster: 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” city cluster: Cities in this cluster have underdeveloped infrastructure and the resources to change this are scarce. 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 these city clusters requires a different approach to make them fit for the future, as illustrated in Figure 15:

Rethink the System (for the “individual” city cluster): Cities in mature countries with a high proportion of motorized individual transport need to shape political agendas to fundamentally redesign their mobility systems so that they become more orientated towards public transport and sustainability. The majority of cities in the index (53 out of 84) belong to this group.

Network the System (for the “public” city cluster): For mature cities with a high share of sustainable transport modes, the next step must be to fully integrate the travel value chain to foster seamless, multimodal mobility while ensuring “one face to the customer” and to increase the overall attractiveness of public transport by service extension. This group contains the majority of cities in Europe as well as Hong Kong, Singapore, Seoul, Tokyo, Toronto and Buenos Aires.

Establish Sustainable Core (for the “emerging” city cluster): For cities in emerging countries with partly underdeveloped mobility systems, the aim must be to establish a sustainable mobility core that can satisfy short term demand at a reasonable cost without replicating mistakes from developed countries. With access to emerging transport infrastructure and technologies, these cities have the opportunity to become the test-bed and breeding ground for tomorrow’s urban mobility systems.

That said, different strategic directions can be combined. In addition to rethinking their mobility system, cities in the “individual” cluster can initiate action to network the system. But these initiatives will only bring significant benefits if sustainable modes of transport make up a sufficient percentage

Figure 15: Three strategic directions for cities

Establish your own way (do not replicate)
Establish Sustainable Core: Invest in sustainable urban mobility infrastructure
Rethink the System: Shape political agenda towards shift to public & sustainability
Network the System: Integration of different market players and networking of citizens
Prerequisite
Way forward
Emerging
Emerging cities with partly underdeveloped mobility systems
Individual
Mature cities with high share of individual transport in modals split
Public
Mature cities with high share of public transport/ walking & cycling
Networked mobility
Integration of all modes to reduce share of individual motorized transport

Features:
- Innovative thinking
- Seamless integration with “one key” for citizens
- High convenience
- Sharing concepts

Source: Arthur D. Little
of the modal split. Hence “rethinking the system” is a prerequisite to obtaining the full benefits of “Network the System.” Similarly, cities in the “emerging” city cluster should undertake the right set of actions in order not to be forced to rethink the system in a second stage, and once the basic elements of a sustainable mobility system are in place, start introducing initiatives to network the system.

5.2. Four dimensions for cities to consider when defining sustainable urban mobility systems

Improving urban mobility is a challenge of epic proportions. As 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 policy.

Arthur D. Little and the UITP have identified four key dimensions to be considered by mobility actors in cities seeking to put in place sustainable urban mobility systems (see Figure 16):

- Visionary Strategy and Ecosystem
- Mobility Supply (solutions and lifestyles)
- Mobility Demand Management
- Public Transport Financing

If an urban mobility policy based on implementing the above four dimensions is to succeed in achieving its aims, it is vital that all four dimensions are improved simultaneously as the overall results will be influenced by the performance of the weakest link.

In this context, 25 imperatives should be carefully assessed by cities as a basis for setting up sustainable urban mobility policies and converted into a concrete set of actions. The relevance of the imperatives to each city will vary depending on the urban mobility city cluster to which they belong (see Figure 17 overleaf).

5.2.1 First dimension of sustainable urban mobility systems: Visionary Strategy and Ecosystem

Establishing sustainable urban mobility policies requires cities to develop a political vision and a set of urban mobility objectives based on a strategic alignment between all key public and private stakeholders of the extended mobility ecosystem. This should forge a visionary urban mobility strategy, in which priorities – and the investments required to achieve them – are identified, in a way that strikes the right balance between stretch and achievability.

The time has come for mobility actors to step up and to drive innovation in urban mobility as there is now a real window of opportunity. In order to exploit this, public transport authorities and operators will need to open their minds and take a much more holistic view on public transport than they have done up to now. They will need to work closely with each other, and the new market players, to deliver creative and entrepreneurial mobility solutions guided by a strategic vision of how cities and regions can be planned and organized.

The establishment of a visionary urban mobility strategy involves addressing seven key imperatives:

**Imperative 1: Establish a transparent, viable and stable regulatory framework for public transport, integrating national and regional mobility powers, and ensuring a clear allocation of roles and responsibilities**

An unstable regulatory framework is the enemy of strategic planning in both private and public sectors. Constant changes to the legal and organizational framework are a particular problem for the public transport sector.

In such a context it is vital that transparent rules are developed to allocate roles among the system’s stakeholders, with risks and responsibilities clearly split between authorities, operators, as well as private actors and associations alike.
### Mobility Demand Management

<table>
<thead>
<tr>
<th>Vision and objectives</th>
<th>Cities in emerging countries with partly underdeveloped mobility systems:</th>
<th>Cities with high maturity and low share of public transport, walking, cycling:</th>
<th>Cities with high maturity and high share of PT, walking, cycling:</th>
</tr>
</thead>
<tbody>
<tr>
<td>Core PT offering</td>
<td>1. Establish a transparent, viable and stable regulatory framework for PT, integrating national and regional mobility prerogatives and ensuring clear allocation of roles and responsibilities</td>
<td>2. Professionalize PTO and formalize public transport</td>
<td>3. Develop a political vision and urban mobility objectives based on strategic alignment between all key stakeholders</td>
</tr>
<tr>
<td>Offering characteristics</td>
<td>4. Develop a visionary urban mobility strategy and master plan ensuring the right balance between stretch and achievability and shift focus from “supply oriented” to “demand oriented” measures</td>
<td>5. Ensure coordination of transport planning with other policies</td>
<td>6. Develop an integrated approach for transport planning and other urban policies to shift from isolated decision-making toward integrated urban management</td>
</tr>
<tr>
<td>Value-Added Services</td>
<td>8. Invest to establish a sustainable mobility offering and do not replicate mistakes of developed cities</td>
<td>9. Develop competitive position of public transport by evolving from “transport provider” to “solution provider” via introduction of innovative business models and partnerships</td>
<td>7. Initiate fair competition between modes and business models</td>
</tr>
<tr>
<td>Integrated mobility</td>
<td>11. Further improve customer experience via service offering extension through partnerships and alliances with third parties</td>
<td>12. Encourage interoperability and develop multi-modal packages</td>
<td>13. Integrate the travel value chain via development of integrated mobility platforms</td>
</tr>
<tr>
<td>Awareness creation</td>
<td>14. Engage with citizens and business community to encourage pragmatic, well-informed and sustainable travel and location choices</td>
<td>15. Introduce traffic calming measures to optimize streets usage conditions and increase quality of life for residents and businesses</td>
<td>16. Introduce pricing measures to steer mobility demand through financial incentives and better synchronize supply and demand</td>
</tr>
<tr>
<td>MDM measures to influence behavior of individuals</td>
<td>17. Introduce and enforce parking policy as a critical instrument to steer mobility choices, while gradually increasing sophistication of fee and regulation structure</td>
<td>18. Define appropriate land-use policies to influence long-term mobility patterns and encourage transit-oriented development</td>
<td>19. Encourage businesses to develop active corporate mobility strategy to improve mobility of individuals and goods while minimizing costs</td>
</tr>
<tr>
<td>MDM measures to influence behavior of businesses</td>
<td>20. Drive demand for public transport to maximize fare revenue by focusing on gradual increase of service offering quality and ensure transparency of fare adjustments</td>
<td>21. Further individualize mobility offering by providing bundles of services targeting different customer groups at different prices</td>
<td>22. Assess opportunities to exploit PT assets to derive additional revenues through aggregation of third party services</td>
</tr>
<tr>
<td>Fare revenue</td>
<td>23. Prioritize public funding for capital investments into projects with sound business cases demonstrating policy benefits and long term viability</td>
<td>24. Explore opportunities to perceive charges from indirect beneficiaries of PT and earmark them for PT financing</td>
<td>25. Further stimulate partnerships with private investors while focusing on preserving business model solidity over short term funding opportunities</td>
</tr>
<tr>
<td>Additional revenues</td>
<td>26. Prioritize public funding for capital investments into projects with sound business cases demonstrating policy benefits and long term viability</td>
<td>27. Explore opportunities to perceive charges from indirect beneficiaries of PT and earmark them for PT financing</td>
<td></td>
</tr>
<tr>
<td>Public funding</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Earmarked charges</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Private funding</td>
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</tr>
</tbody>
</table>
In order to optimize performance it is important that operators are governed by a system of incentives and penalties to encourage them to conduct their business in a way that leads to achievement of strategic system-level goals.

Overall, the regulatory framework should be geared towards creating a transparent, high quality and economically efficient transport sector.

**Imperative 2: Professionalize Public Transport Operators (PTOs) and formalize public transport**

In many countries, informal forms of public transport make up an unacceptably high proportion of the total. Unregulated private-sector operators carrying passengers on a diverse combination of minibuses, cars, and motorcycles are a prominent feature of the modal mix.

In cities where such operators predominately tend to suffer from congestion, delays, environmental degradation and poor safety records, the only way to solve these problems is to regulate the operators via a competent public transport authority.

This might involve the creation of a register of minibus-taxi associations, owners and their vehicles; the formulation of a code of conduct for operators; training of operators and drivers; legislation to regulate minibus-taxi operations; and the recapitalizing of ageing vehicles.

**Imperative 3: Develop a political vision and urban mobility objectives based on strategic alignment between all key stakeholders**

No revamp of a city’s mobility system can succeed without a political vision that outlines a range of urban mobility objectives and wins the support of all key public and private mobility stakeholders. The resulting mobility vision must embody the goals of the three main stakeholders – the city administration, the private sector and the citizens – and lay out the purpose and objectives of the system.

In addition to getting all the relevant stakeholders involved, a good vision should capture the imagination of the public by addressing them in plain and simple language. It must also carry a sense of urgency if it is to create momentum in building and sustaining commitment to the city’s overall objectives.

If a clear and widely accepted vision for a mobility system exists, it ensures that:

- Future success will be systematically managed
- Expectations of different stakeholders will be prioritized
- All related activities will be channeled in one direction
- The city will take a proactive instead of reactive role in the development of its mobility system

**Imperative 4: Develop a visionary urban mobility strategy and master plan ensuring the right balance between stretch and achievability**

A successful urban mobility strategy consists of an integrated set of actions designed to produce a sustainable competitive advantage for a city and its transportation system.

It should be based on clear, simple and consistent goals; a profound understanding of the challenges thrown up by the environment under discussion plus the actions needed to overcome them; and an objective appraisal of the resources and abilities available. Effective implementation of such a plan will also rely on ensuring the right balance between stretch and achievability.

The maturity level of a city will dictate to what extent it concentrates action on the demand-side (mobility demand management) and the supply-side (provision of services and infrastructure). Cities in the “Establish Sustainable Core” cluster, for example, should devote about 80% of measures to the supply-side, with 20% to the demand-side. At the other end of the spectrum, cities in the “Network the System” cluster should reverse those percentages.

**Imperative 5: Ensure coordination of transport planning with other urban policies**

The provision of an efficient urban mobility system cannot take place in a vacuum. When planning improvements to the transport system, it is vital to ensure co-ordination among as wide a range of stakeholders as possible, including bodies responsible for land-use planning, energy and environmental planning, social policy, etc.

Different approaches are required by cities at different stages of evolution. Those that are at a point where they need to “Rethink the System” or “Network the System” need to integrate urban policies (see Imperative 6 below). While for those at the “Develop Sustainable Core” stage, initiating co-operation between transport planning and other urban policy is an initial step in the right direction. It is often desirable to foster co-operation between such bodies by promoting joint projects. If a greenfield site is being developed, for example, priority should be given to public transport, pedestrian routes and cycle paths, with roads designed for private cars treated as a secondary issue.
Dimensions to be considered when defining an urban mobility 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 citizen and increases the competitiveness of a country or region.

Ensuring this goal is achieved, however, involves a rigorous multi-stakeholder approach that takes in consultations between government and local authorities, public transport operators and other mobility providers, businesses, as well as community organizations like trade unions and NGOs, cycling associations and the media.

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 18 overleaf.

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 inform 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.

While 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.

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 amongst 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.
Imperative 6: Develop an integrated approach for transport planning and other urban policies to shift from isolated decision-making toward integrated urban management

As mentioned above, more mature cities must ensure that transport planning is not treated in isolation from other elements of urban policies. Integrated urban management might call for mobility strategy to be aligned with the regional sustainability strategy, for example, to make a ‘greening’ of the modal split a cornerstone of mobility policy. Harmful emissions can be reduced by establishing environmental zones for cars and zones with speed limits to ensure traffic calming, together with the pedestrianization of city centers.

Cities should make ‘Urban density increase’ a priority when it comes to land-use planning in order to decrease travel distances and the need for individual transport thus making commuter destinations more accessible. Investment in public transport should go hand-in-hand with this to ensure that citizens are not forced to resort to using their cars due to a lack of public transport solutions.

Imperative 7: Initiate fair competition between transport modes and business models

Fair competition in the transport sector is a prerequisite for innovation and efficiency. As public sector monopolies may not always have motivation to perform at peak efficiency, opportunities to gradually replace or complement them by systems that involve private and public operators operating in competition should be explored. This can not only maximize the efficiency of the service operators but will lead to the right mix of services and customer experiences, as well as an improvement in standards across the board.

Indeed, it is not overstating the case to say that initiating fair competition between different transport modes and transport business models is a prerequisite for networking the system.
5.2.2. Second dimension of sustainable urban mobility systems: Mobility Supply (solutions and lifestyle)

Responding to increasing demand for urban mobility and to consumer and business needs for seamless, multimodal urban mobility requires cities to extend their public transport offering and adapt it from “delivering transport” to “delivering solutions.” This transformation can be achieved through a combination of quality improvements to the current public transport offering and an increase of customer experience via service offering extension through partnerships and alliances with third parties.

Mobility supply can be articulated into three main categories, of which the two first constitute core mobility services (see Figure 19):

- Supply and operations of infrastructure and modes of transportation
- Offering characteristics: quality, safety, security, convenience, sustainability, affordability
- Development of additional value-added services next to core mobility services

Developing appropriate mobility supply policy – providing the right response to consumer and business need for seamless, multi-modal urban mobility – involves addressing six key imperatives:

- Imperative 8: Invest to establish a sustainable mobility offering and do not replicate mistakes of developed countries

Many of the biggest cities in the emerging economies – such as Tehran, Beijing and Sao Paolo (to name a few) – made the mistake of prioritizing roads for private cars when they were establishing their mobility systems, with the result that they are now plagued by congestion, air pollution and road safety issues.

Today’s cities in the “Establish Sustainable Core” cluster have the opportunity to avoid the mistakes of the past by making public transport the priority in designing their mobility systems. This means investing in the establishment and development of:

- Rail lines and stations optimized to serve as multi-modal interchange points
- Heavy (metro and suburban) rail, light rail services, and trams
- Bus rapid transit services, etc.

Planners should never lose sight of the need to progressively increase the geographical coverage of the public transport network and the frequency of services. The earlier cities start thinking about environmentally sustainable modes of transport, the fewer problems they will have to deal with in the future.

![Figure 19: Key components of public mobility services](source: Arthur D. Little)
Imperative 9: Develop competitive position of public transport by evolving from “transport provider” to “solution provider” via introduction of innovative business models and partnerships in order to foster sustainable transport

Public transport operators need to evolve from “transport provider” to “integrated solution provider”, who offer a broad range of sustainable mobility services, and thus create strong alternatives to the use of individual motorized modes of transportation in favor of sustainable transport modes.

This can for instance be achieved via the establishment of inter-modal strategic partnerships and alliances with taxi, bike and car sharing providers, operators of parking facilities and major mobility generators such as business parks. Public administrators can assist PTOs in this challenging task by providing:

- Segregated infrastructure for tramways and buses
- Urban traffic control systems giving priority to public transport at traffic lights
- Park and Ride facilities that allow car drivers to avoid congestion by completing the inner-urban part of their journey by rail or public transport, etc.

In order to encourage the bike sharing industry, the city administration should also take care of segregated cycle lanes – that help promote cycling as a safe activity – and bike parking facilities.

Another aim should be to make private modes of transport more “public” (e.g. through the introduction of car sharing or pooling) and public modes more “private” (e.g. through the introduction of personalized journey planners). This will enable customers to benefit from the advantages of both private and public models while simultaneously travelling with sustainable modes of transport.

Imperative 10: Shift public transport operator culture from “fleet manager” mindset toward customer-centric culture and progressively enhance quality of public transport offering while improving customer experience

In the not too distant past, public transport operators sometimes saw themselves as administering logistics rather than serving customers. In this service-conscious age, public transport operators need to evolve toward a more customer-focused culture (see Figure 20).

This evolution should be achieved by putting the interests of the customer at the heart of decision-making, leading to quality enhancement of service offering characteristics, such as:

- Improving quality of static and real-time information (e.g. through the introduction of contextual journey planners, with online booking and real-time travel information, to ease seamless travel across the various public and private transport modes)
- Improving punctuality and regularity of services
- Improving security and perception of security, etc.

Public transport operators that have excelled in progressively building a superior customer experience have approached such programs in three steps:

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**Figure 20: At the end of the day, the emotional experience is what makes the difference**

<table>
<thead>
<tr>
<th>The Essence of Superior Customer Experience</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>The Basics ...</strong></td>
</tr>
<tr>
<td><strong>Physical Experience</strong></td>
</tr>
<tr>
<td><em>Price, product features, location, time to serve, channels, …</em></td>
</tr>
</tbody>
</table>

| **... and what makes the Difference!**   |
| **Emotional Experience**                |
| *Senses stimulated and emotions evoked (Smell, sight, hearing, touch, taste)* |

| **Best Practice – turning Customers into Fans** |
| *People buy based on emotions* |
| *Customers give their money* |
| *Customers complain* |

**People buy based on emotions** |

| **... and justify with logic!** |
| **... but fans give their hearts!** |
| **... but fans forgive** |

Source: Arthur D. Little
Eliminate major drivers of customer dissatisfaction

Ensure a consistent approach towards passengers across the whole journey

Exceed passenger expectations at selected touch points to create moments of memory and a “wow effect”

As a first step in this direction, public transport operators need to identify passenger expectations by customer segment and assess the current level of customer experience for each attribute of the offering along the customer journey, thereby allowing for the identification of priority areas of improvement.

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 impact. Improvement can be achieved through a combination of smart actions of different nature 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.

**Imperative 11: Further increase customer experience via commercial offering extension through partnerships and alliances with third parties**

The development of a coherent commercial offer within subway and railway stations, transforming stations from being purely transport providers to destination locations for consumers can significantly improve customer experience while maximizing revenues from existing assets.

Historically, infrastructure operators have had some difficulty in setting up an optimal and value creating commercial offer. Airports, and to a lesser extent railway stations, are now at an advanced stage of their commercial activity redesign as a key element of customer experience and a key lever of value creation, whereas local public transport operators still have major room for improvement.

The introduction of complementary value-added services to the core public transport offering can come in two forms:

- Through improving the existing retail, food & beverage and advertising offerings in stations
- Through the development of additional business, convenience and leisure services

Of particular importance in this context is the definition of the most appropriate industrial models for the operations of commercial activities. These can be a combination of direct operation, plus concessions and/or partnerships with third parties. In most cases, public transport operators would benefit from assessing opportunities to collaborate with commercial operators for some part of their commercial operations, in order to benefit from their experience and economies of scale in managing such types of activities. Early integration of such partners into new infrastructure development or infrastructure renovation projects can also enable their participation in more global investment schemes and can accelerate renovation.
Walk through a modern airport these days and you are treated to an assault on the senses. Advertising, whether in the form of video, posters, or point-of-sale, vies for the attention of travelers at every turn. Restaurants, bars, and coffee shops offer tempting diversions. And fashion boutiques, newsagents, and a wide range of other retail outlets aggressively promote their wares. It is no surprise to learn that, next to contributing to superior customer experience, such activities generate valuable supplementary income to their host’s core business.

Airports, and to a lesser extent railway stations, have led the way in this regard, with such activity now a key element in the customer experience and a significant lever of value creation. Among local public transport operators, however, there is still massive potential for growth in this area.

Railway and subway stations however share many of the characteristics of airports. Both have excess floor space, large volumes of people traffic, waiting areas, network coverage and numerous employees. They also have one attribute airports lack: they are often in downtown locations. And yet, with the exception of a handful of forward-thinking operators such as MTR in Hong Kong, which initiated a comprehensive redesign of its commercial strategy several years ago leading to superior customer experience and substantial value creation (reaching an average of 3,800 EUR of revenue per commercial sqm), and London’s newly renovated King’s Cross station (to name but two), railway and subway stations operators all too often fail to fully capitalize on their captive market of passengers, tourists, staff and nearby residents.

The presence of shops, food & beverage outlets and business and convenience services can drastically improve customer experience by developing a coherent and warm atmosphere within and around the stations and is a key lever of value creation for infrastructure operators (see Figure 21).

The failure of subway operators and, to a lesser extent, railway companies to develop profitable commercial offerings as the airports have done can be traced to a number of factors. Infrastructure networks are usually heterogeneous and smaller stations may not be in a position to support commercial activities due to their more limited passenger flows as well as constraints related to access and sanitary standards, requiring potential commercial operators to take this extra level of complexity into account. But all too often the failure to generate a vibrant commercial offering lies in a complacent acceptance of the status quo, characterized – amongst other elements – by a lack of internal processes and capabilities to support commercial activity development and operations that typically fall outside the core business of most transport operators or by long-term relationships with outdated retail operators blocking the introduction of more innovative concepts.
This is a big mistake. With public sector budgets under strain as never before and over-loaded mobility systems in desperate need of expansion, infrastructure operators can no longer afford to allow such a potentially lucrative resource to go unexploited.

A number of dimensions should be considered by public transport operators in order to develop a coherent commercial offering for subway and railway stations, as illustrated in Figure 22.

A first step is to understand the “playing field” as a requirement for the definition of appropriate ambitions for each commercial activity that can include retail, food & beverage, and advertising, as well as different types of business, convenience and leisure services. This can be done through the identification of the (unmet) needs of different target groups – passengers, tourists, staff, nearby residents – combined with an assessment of the extent to which available competitive offerings are fulfilling those needs. Internal and external constraints, such as fit with the corporate strategy and the scope of activities under accountabilities, should also be taken into account.

The commercial strategy definition should include the identification of:

- The scope and mix of commercial offering(s) to be developed per station category as well as the key principles of commercial zone development
- The most appropriate industrial model for each commercial activity, which can be a combination of direct operation, and concessions or partnerships with third-party operators

As the process gets under way, several scenarios should be kept open as the outcome of some of them will depend to a great extent on the outcome of negotiations with potential partners.

A great deal of attention should be devoted to the elaboration of well-grounded business cases for each of the potential scenarios (scope of activities and industrial models combination), which will allow for validation of the ambitions set and for evaluation of the impacts of different contractual terms during negotiations with third parties.

The development of a detailed roadmap is also of critical importance in avoiding common pitfalls during implementation. Apart from the definition of the activities required for the development of the offerings, the roadmap should also include actions to manage the required internal transformation, both in terms of organization and processes (for direct operations and follow-up of activities performed by third parties), as well as in terms of the building up of internal capabilities.

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### Figure 22: Dimensions to be considered to develop a coherent commercial offering for subway and railway stations

| 1 | Customer needs | Profiling of target segments: passengers, tourists, staff, nearby residents |
| 2 | Competitive intensity | Profiling of competitive offerings per commercial activity/geographical zone |
| 3 | Ambition | Definition of target positioning per commercial activity (retail, F&B, advertising, services, etc.) taking into account internal/external constraints |
| 4 | Offering strategy | Definition of commercial offering strategy: scope and mix of activity per station category, key principles of commercial zones development, etc. |
| 5 | Industrial strategy | Profiling of potential partners and definition of appropriate industrial model per activity (direct operation, concession, financial and/or operational JV, etc.) |
| 6 | Business cases | Development of business cases (Revenue, Capex, Opex, NPV) taking into account different scenarios as well as financial and operational constraints |
| 7 | Roadmap | Establishment of implementation roadmap per zone and commercial activity, incl. required internal transformation (organization, processes, capabilities) |
| 8 | Governance | Definition of negotiation tactics and contractual terms with third parties |

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*Source: Arthur D. Little*
Imperative 12: Encourage interoperability and develop multi-modal packages

Integrated mobility means seamless travelling across different modes of transport and includes:

- Easy access to all means of transport: integrated payment combined with real-time information on availability, time and place of means of transport
- Support and facilitation through smartphone apps, online platforms, pricing schemes, discounts, loyalty programs
- Provision of innovative mobility services – car and bike sharing, etc.

From the customer perspective, integrated mobility supply has clear added value as it enables them to:

- Choose from an exhaustive set of public transport modes across diverse mobility providers
- Plan and book the whole trip across all transport modes in just one click
- Use all mobility forms with one single authorization
- Buy only one ticket and pay one bill for the whole trip
- React in real time to changing customer needs, travel obstacles and opportunities (traffic jams, weather, meeting delays, rebates), etc.

Such interoperability can be achieved by integration of fares, ticketing, timetables, transport modes, information and booking processes, the establishment of technical interfaces and the development of a unified medium for customers. All this enables provision of integrated mobility offerings or so-called multi-modal packages.

The realization of this multi-modal mobility vision requires strong cooperation between urban public transport operators and other local mobility operators such as rail companies, taxi services providers, sharing and rental companies, as well as public transport operators in other regions. The latter should be encouraged by public authorities. Experience shows that the strong support of a city’s top management is critical for the establishment of broad partner ecosystems and thus the successful implementation of integrated urban mobility offerings and multi-modal packages.

Imperative 13: Integrate the travel value chain via development of integrated mobility platforms

It was not that long ago that every single journey on public transport required a separate ticket purchase from the transport operator of the vehicle you were due to travel in. Then smart cards arrived and in many cities everything became a lot more straightforward as passengers could travel on bus, metro and railway services using one prepaid travel card.

As there is a strong customer need to enjoy mobility that is more convenient, faster and easier, in the near future, innovative mobility services will be much less driven by separate improvements in different transport modes and system-level innovation will be required to make the difference and respond to consumer and business needs for seamless and integrated mobility. That is why in several cities belonging to the “Network the System” city cluster, mobility service operators (public and private), together with other actors such as connectivity providers, payment providers and internet businesses, are working together to devise integrated mobility concepts, often referred to as between integrated mobility platforms. This is where the Amazon and Apple business model archetypes of urban mobility (as introduced in section 4 above) come into their own.

Integrated mobility platforms involve:

- Provision of an integrated mobility concept through seamless integration of own mobility services and aggregation of services offered by third-party providers
- Offering of service for own account, while managing planning, booking, payment and billing, thereby ensuring “one face to the traveler”

The demand is there. There are new business models and there is urgency. However, devising integrated mobility platforms with a sound business case requires careful consideration of a number of dimensions (as further detailed below). Turning the mobility paradigm towards full integration will take vision, creativity and entrepreneurship among those players who take up the challenge as integrated mobility platform operators, but they will have a tremendous market potential to address.
Developing integrated mobility platforms requires the negotiation of a complex web of relationships with the relevant public and private stakeholders in the extended mobility ecosystem (see Figure 23):

- Mobility service operators (motorized-individual, public individual, public, non-motorized and stationary)
- System integration providers
- Connectivity providers
- Data provision providers
- End-user equipment providers
- Value added service providers

In this integrated ecosystem, a critical role is the one of “integrated mobility platform operator”, responsible for planning, booking, payment and billing, thereby ensuring “one face to the traveler.”

The integrated mobility platform operator should be able to:

1. Act as a single point of contact for travelers and as a full service provider, a role that involves:
   - Bundling of third-party services and selling them on
   - Responsibility for delivery of third-party services and associated risks
   - Collection of payments and management of security and fraud

2. Aggregate services of all mobility providers across all modes of transport, a role that involves:
   - Design and management of partner ecosystems
   - Penetration of new areas through contracts with local mobility providers
   - Reaching all mobility providers to keep the promise of total mobility

3. Offer tailored solutions considering customer preferences, lifestyle and budget, a role that involves:
   - Customer profiling
   - Achieving a balance between requirements on data security and the need for transparency

The establishment of integrated mobility platforms requires careful consideration of a number of dimensions to ensure the development of a robust concept with a balanced business case, as illustrated in Figure 24 overleaf.

**Figure 23: Integration of relevant public and private stakeholders within the extended mobility ecosystem**

<table>
<thead>
<tr>
<th>System integration</th>
<th>Connectivity</th>
<th>Data provision</th>
<th>End-user equipment</th>
<th>Tour operation</th>
<th>Mobility services</th>
<th>Value added services</th>
<th>Marketing &amp; sales channels</th>
</tr>
</thead>
<tbody>
<tr>
<td>Techno platforms</td>
<td>Fixed</td>
<td>Maps</td>
<td>Mobile handsets</td>
<td>Planning</td>
<td>Modes of transport</td>
<td>Retail</td>
<td>B2B</td>
</tr>
<tr>
<td>Apps</td>
<td>Mobile</td>
<td>Congestion info</td>
<td>Smart cards</td>
<td>Booking</td>
<td></td>
<td>Culture</td>
<td>B2C</td>
</tr>
<tr>
<td>Merchant terminals</td>
<td>NFC</td>
<td>Time schedules</td>
<td>Chips</td>
<td>Payment</td>
<td></td>
<td>Sport</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Etc.</td>
<td></td>
<td>Billing</td>
<td></td>
<td>Food &amp; beverages</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Tourism</td>
<td></td>
</tr>
</tbody>
</table>

**Integrate mobility platform operator**

Source: Arthur D. Little

Note: CS = car sharing, BS = bike sharing, SU = suburban, LD = long-distance
### Key challenges encountered while setting up integrated mobility platforms are typically related to three aspects: stakeholder management, business case and technology.

1. **Extended ecosystem stakeholder management**

   Finding the right set of partners to close all competency gaps along the value chain while ensuring a positive business case for each partner.

   Alignment between public and private stakeholders, requiring strong will for change from both sides and implying lengthy negotiations over vision alignments and business model definitions.

   Finding the right (legal and operational) structure for the operating company.

2. **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 constitutes a vital part of arriving at a balanced business case. Given the low margin level, local public transport authorities or operators are likely to take the role of integrated mobility platform operator.

3. **Technology**

   While the necessary technologies are available to address the needs of integrated mobility platforms, the technological interfacing of different transport modes and infrastructures and the seamless integration of technology (and underlying management mechanisms) can be challenging.

---

**Figure 24: Dimensions to be considered when developing integrated mobility platforms**

<table>
<thead>
<tr>
<th>1 Customer groups</th>
<th>Offering tailored to customers needs</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Customer segmentation; value proposition per customer groups</td>
</tr>
<tr>
<td></td>
<td>Quantification of market potential starting with customer demand</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>2 Offering portfolio</th>
<th>Ecosystem and business case</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Business model choice and detailing</td>
</tr>
<tr>
<td></td>
<td>Definition of services to be integrated and aggregated</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>3 Extended ecosystem</th>
<th>Technology</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Definition of to-be positioning along the value chain</td>
</tr>
<tr>
<td></td>
<td>Build-up of partner ecosystem to cover non-core competencies</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>4 Revenue drivers</th>
<th>Organization &amp; roll-out</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Pricing model, financing options, profit pool distribution</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>5 Cost drivers</th>
<th>Offering tailored to customers needs</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Quantitative structure, CapEx, OpEx, profitability scenarios</td>
</tr>
<tr>
<td></td>
<td>Financial model, profitability sensitivities</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>6 Technology</th>
<th>Offering tailored to customers needs</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Specification of front-end and back-end technology</td>
</tr>
<tr>
<td></td>
<td>Processes for planning, booking, payment and billing</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>7 Organization</th>
<th>Offering tailored to customers needs</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Construction of internal and external organizational frameworks</td>
</tr>
<tr>
<td></td>
<td>Assessment of legal feasibility and establishment of operating company</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>8 Roll-out plan</th>
<th>Offering tailored to customers needs</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Detailing of possible development paths and time sequence for roll-out</td>
</tr>
<tr>
<td></td>
<td>Assessment of implementation feasibility &amp; risks, planning of activities</td>
</tr>
</tbody>
</table>

*Source: Arthur D. Little*
5.2.3. Third dimension of sustainable urban mobility systems: Mobility Demand Management

While the supply of infrastructure, 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 is a particularly vital issue to be addressed by the transport authorities of cities belonging to the “Rethink the System” and “Network the System” city clusters.

Mobility Demand Management (MDM) strategy typically includes a cocktail of incentives and penalties aimed at encouraging durable changes in mobility behavior. This makes it a delicate discipline, which can easily meet strong resistance if not properly managed, as it can be perceived as working against the principles of freedom of movement.

While some MDM measures have already demonstrated clear benefits, the relevance and acceptability of each individual measure must be assessed against local contexts and based on the existence of viable alternatives to motorized individual transport. This prerequisite of viable and sufficient alternative travel options is a reason for the relative predominance of MDM approaches in cities in the “Rethink the System” or “Network the System” clusters. Communication is key and authorities should open up a dialogue with key stakeholders, including citizens, businesses and the real-estate community.

Apart from the introduction of measures to influence the travel behavior of individuals, urban logistics measures, such as the introduction of innovative distribution models, schedules, and road freight fleet management systems, are also of critical importance to better manage the movement of goods.

Six key imperatives should be considered while developing a comprehensive mobility demand management policy mix (see Figure 25):

**Imperative 14: Engage with citizens and the business community to encourage pragmatic, well informed and sustainable travel and location choices**

MDM requires dialogue with key stakeholders via various communication channels to make citizens and businesses aware of the consequences of their mobility choices and encourage them to make pragmatic and sustainable travel choices. Effective and clear communication is of paramount importance to raise the acceptance level of MDM measures, which can easily be tagged as “anti-democratic” and “restricting personal freedom.”

To this end, campaigns incorporating messages such as pollution, congestion, health, safety and affordability should work to raise awareness of the advantages of a smarter mobility choice. By positioning the use of sustainable travel modes as a lifestyle choice, customers can be converted into loyal community members.

### Figure 25: Set of measures to consider when defining the right Mobility Demand Management mix

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

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
Four particular audiences should be targeted by these campaigns:

School children: Targeting this group has the effect of influencing the mental patterns of both the younger and older generations, as young people nowadays are exerting powerful behavioural influence on their parents.

New residents: Proactively offer them personalised advice ideally coupled with a “trial voucher” before they become car-addicts. In Munich, all new residents receive mobility information when they apply to open electricity, gas and water accounts. In addition, a specially designed website offers long-term comparisons between central and suburban housing options. These show that a more expensive central rent or mortgage will largely be offset by a less expensive mobility budget over the years.

Non-users: Information is critical to foster a behavioural change of non-users and often requires to provide them with a “one-stop-shop” for all combinations of public transport options. Developing virtual journey planners (“travel companions”) as well as providing attractive discount for new users can be an effective incentive to encourage a switch from individual motorized transport modes.

Large businesses: This segment includes real estate developers, shopping malls, hospitals, etc. As these are rarely well-informed about the mobility impact of their location choice, a well-timed intervention can bring about a change of heart.

Imperative 15: Introduce traffic-calming measures to optimize street-usage conditions and improve quality of life for residents and businesses

While traffic-calming measures are generally seen as being linked to improving the quality of life of local residents, they can be a potent weapon in the hands of a mobility authority looking to encourage people to switch from being exclusive car-users to using a variety of more sustainable transport options.

The truth is that any measure that leads to restrictions on the convenience of car use improves the overall competitiveness of alternative options. Options include:

Street design – can be geared to decreasing speed (humps, chicanes, traffic loops), or redistributing space to non-traffic functions (playing areas, street furniture, vegetation), or soft mobility (pavements, cycle paths).

Speed limits – apart from speed limits themselves, road humps and “chicanes” perform a similar function.

Traffic limitation and green zones – areas with limited access and restrictions of (more) polluting vehicles.

Bans on through-transit traffic – perhaps targeting heavy-duty vehicles.

Shared spaces – zones where street markings or signs are suppressed, thus encouraging prudent behaviour by car drivers who are in close proximity to pedestrians.

Restrictions on vehicle ownership or use, by imposing an annual quota on the sale of new cars or restricting access to the town centre by plate number (odd or even), can also contribute to mode migration.

These measures show that an integrated mobility agency – not only in charge of public transport provision, but also of street management as is the case in London – is a major asset in promoting policy consistency and mutual reinforcement.

Imperative 16: Introduce pricing measures to steer mobility demand through financial incentives and better synchronize supply and demand

One sure way of reducing congestion in the inner city is to hit the driver where it hurts most: the wallet. Access to congested areas can be influenced by pricing:

To reduce bottlenecks in rush hours, differentiate fares according to time of the day. This will flatten the hyper peaks, the points at which the marginal cost of extra supply is most expensive.

Introduce an urban toll (or congestion charge) on commuters to combat congestion and harmful emissions. Modulable fee can also be introduced according to time of the day.

The latter type of instrument is generally used with one of two ends in view – to ease congestion and emissions, or to raise cash (in the latter case, it is important to devote the fees raised to mobility improvements). However, in practice, they tend to serve both purposes. The experiences of London, Milan, Singapore or Stockholm in the past decade have shown that such apparently unpopular measures do work and can be accepted without driving all businesses outside of the cities.

Another option, however, is to change the cost structure of car ownership so that variable costs become a bigger proportion of the average driver’s outlay. As things stand, drivers tend to pay a series of fixed costs on items such as car tax, fuel tax, and insurance premiums, and then use their cars as much as they can, regardless of the circumstances and traffic conditions. Revamping the fiscal regime of company cars is another option worth looking at. Membership of a car sharing scheme can be offered as an alternative.

A transformation of this structure is recommended so that these fixed costs become variable, with resultant benefits for the lighter user. Smart insurance schemes can be introduced, for example, under which lower mileage users or owners of public transport season tickets are rewarded with lower premiums.
Imperative 17: Introduce and enforce parking policy as a critical instrument to steer mobility choices, while gradually increasing sophistication of fee and regulation structure

Although frequently under-estimated, parking is a critical factor in individual mobility choice. Motorists are willing to accept low commuting speeds and congestion if they are confident of getting easy and cheap parking facilities at their destination. For cities, however, commuter parking can represent a waste of a useful and precious community space.

Fortunately, municipal authorities have a number of weapons in their armory to deter car parkers. The introduction of fees for on-street parking has been shown to be a key influence on transport choice and long-term commuter full-day parking should be disincentivized in favor of residents and shorter parking slots for visitors and consumers.

Fees should be set at a minimum level during the start phase and increased gradually as alternative travel options are made available. Fees can be modulated according to place and time and with the availability of new technologies for payment, their structure can become more sophisticated in time.

Caps on parking provision in and around large developments, such as offices, housing estates and shopping centers, can also be a powerful tool. The number of parking places in a development’s car park can be set at a particular rate per square meter it occupies or the number of inhabitants or employees it houses.

In more mature cities, the Access Contingent Model is a promising strategy to reduce the traffic impact of big sites such as shopping centers or sports stadiums. The idea is to agree on a maximum number of car-trips to the site by defining a contingent that may not be exceeded. The sanctions to be applied in case of non-compliance are fixed by a contract between the developer and the local authority as part of the building permission. This model commits the developers to achieving results, not just setting up the means.

Imperative 18: Define appropriate land-use policies to influence long-term mobility patterns and encourage transit-oriented development

The widespread use of the private car all too often stems from the way a city was laid out in the first place. A corollary of this fact is that if you can design your city or district in such a way that smart transport options are available from day one then no corrective measures will be required.

It follows, therefore, that urban and land-use planning are of paramount importance. The key aims of land-use consideration should be to control urban sprawl and to support transit-oriented development. The integration of mobility management and land-use planning can be addressed both in the plan-making process and in the site-related building permission process:

- At the macro level, authorities should institute land-use measures and policies to concentrate housing, jobs and services in close proximity to major public transport hubs to avoid uncontrolled sprawl.
- At the micro level, authorities should require any developer to include mobility analysis and impact assessment in their project submissions. It is also recommended that development in areas insufficiently served by existing public transport should be authorized only if the developer contributes to the capital or operating expenditure of the desired services to access its facilities.

Imperative 19: Encourage businesses to develop an active corporate mobility strategy to improve mobility of individuals and goods while minimizing costs

Managers of businesses can be a powerful partner in promoting sustainable urban mobility and easing congestion. They should be encouraged to develop a corporate mobility plan and appoint a mobility manager. The former will identify the travel habits of their staff, so that a series of tailor-made solutions can be offered. The latter will be in charge of advising company management of mobility impact of daily or longer-term strategic decisions.

In this context, the following measures introduced by businesses have already demonstrated clear benefits in positively influencing mobility behaviors of employees:

- Introducing flexi-time work schedules allowing employees to choose a less congested commuting time.
- Encouraging tele-working to avoid some commute trips.
- Encouraging smart commuting by offering free or discounted season tickets to staff or by promoting car pooling, possibly alongside the development of company tools to support it.

Similarly, the identification, in conjunction with retailers and logistics operators, of measures to foster the emergence of more virtuous urban logistic schemes can lead to a reduction in the negative effects of moving goods in the city, while limiting cost and business impacts. Among the measures in this field currently under scrutiny are the establishment of urban distribution centres (within or outside of cities), the development of exclusivity zones and the transport of deliveries via alternative (greener) transportation modes, as further explained below.
The need to rethink and rationalize urban logistics is being pushed on the front scene by the boom of the number of shipments (exacerbated by the online shopping growth) as well as the growing sensitivity by the general public of the negative environmental and societal impact of fuel driven deliveries in saturated urban centers.

However urban logistics is a difficult issue to apprehend as it encompasses several levels of complexity: next to the heterogeneity of the goods transported and of 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 and most of which will – in most cases – lack a shared understanding of the status quo, the priorities and the most appropriate action levers. While local authorities will be interested by opportunities to reduce congestion, pollution and noise, transportation companies and shippers – even if willing to contribute to urban mobility objectives, thereby improving their image – will be mainly triggered by keeping costs under control while maintaining or increasing service level. This complexity may very often lead to partial, sub-optimal or even counterproductive decisions/solutions being enforced.

The establishment of a well-grounded urban logistic scheme strategy requires careful consideration of a number of dimensions.

First of all, if a reform of urban logistics is to succeed, authorities need to set their priorities before selecting the most appropriate levers to achieve their objectives. After all, while they may be tempted to impose restrictions on trucks entering the city, they do not want to be blamed for harming the economy by raising the shippers’ costs and reducing service levels. These measures need to be developed in a concerted way with the transportation companies, as well as the shippers/recipients around a shared series of objectives. They should provide both positive incentives to the behaviors supporting these objectives, as well as negative ones to the stakeholders not accepting to play by these rules.

### Dimensions to be considered when devising urban logistics strategy

The need to rethink and rationalize urban logistics is being pushed on the front scene by the boom of the number of shipments (exacerbated by the online shopping growth) as well as the growing sensitivity by the general public of the negative environmental and societal impact of fuel driven deliveries in saturated urban centers.

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### Figure 26: Levers to consider when defining appropriate urban logistic schemes

<table>
<thead>
<tr>
<th>Lever</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Urban Distribution Center (UDC) out of town</td>
<td>- Massified delivery to Urban Distribution Center upstream of city&lt;br&gt;- Delivery route preparation in UDC&lt;br&gt;- Often coupled with Exclusivity zone and/or greener trucks</td>
</tr>
<tr>
<td>Direct injection</td>
<td>- Preparation of delivery routes in containers&lt;br&gt;- Transport of containers by massified transportation means (train, boat) and transfer to another mode for last mile transportation</td>
</tr>
<tr>
<td>Urban Distribution Center (UDC) in town</td>
<td>- Massified delivery to urban distribution center within city core&lt;br&gt;- Delivery route preparation in Urban Distribution Center&lt;br&gt;- Often combined with Exclusivity zone and/or Greener trucks</td>
</tr>
<tr>
<td>Exclusivity area</td>
<td>- Exclusivity (usually city core) to a single transportation company&lt;br&gt;- Can be limited to some truck sizes and/or time slots</td>
</tr>
<tr>
<td>Traffic lane/drop off space reservation</td>
<td>- Booking of dedicated stopping spaces/traffic lanes</td>
</tr>
<tr>
<td>Time slots</td>
<td>- Opening/shutting of specific times slots for some types of trucks</td>
</tr>
<tr>
<td>Greener trucks</td>
<td>- Usage of “greener” trucks (Euro NCAP 5, gas, electric)&lt;br&gt;- Often combined with restrictions</td>
</tr>
<tr>
<td>Alternative transportation means</td>
<td>- Delivery by alternative vehicles (bicycles, etc.) with a smaller capacity and range&lt;br&gt;- Usually combined with Direct injection or UDC in town</td>
</tr>
<tr>
<td>Congestion charge</td>
<td>- Implementation of congestion charges&lt;br&gt;- Can foster development of UDC at congestion charge border</td>
</tr>
</tbody>
</table>

Lever efficiency strongly depends on transport authority’s ability to enforce rules.
A urban logistic strategy can typically contribute to several goals, each of which can be influenced by different factors and some of which may be conflicting with each other, thereby requiring careful prioritization:

- **Urban congestion reduction**, influenced by distance travelled, vehicle capacity & length, and easiness to stop
- **Reduction of number of trucks in the city**, influenced by vehicle capacity, vehicle filling ratio and congestion level
- **Pollution reduction (i.e. CO₂/NOₓ and PM)**, influenced by vehicle type, distance travelled and congestion level
- **Noise reduction**, influenced by vehicle type, distance travelled and congestion level
- **Development of local economy**, influenced by solution costs, impact on service quality (speed, delivery time slots, flexibility/reactivity, etc.)
- **Contribution to housing policy (increasing housing space within city limits)**, influenced by inner city logistics platform footprint.

To achieve these objectives, city authorities and transportation companies can typically apply a combination of levers – please refer to Figure 26 overlay for a list of the most common ones – the applicability and relevance of which should be assessed against the local contexts.

In order to select the most appropriate set of levers, there needs to be a shared understanding of their impact to the local contexts as well as their contribution to the defined objectives, taking into account each of the geographical area and goods category. The activation of a specific lever can positively influence one objective, while negatively influencing another objective: for example due to their smaller load (for a given length) switching all deliveries to electrical trucks would imply a reduction of noise and CO₂/NOₓ and PM emissions, but could simultaneously increase congestion level, as well as negatively impact overall logistics costs (see Figure 27).

Taking these elements into account, the key to success for the development of an appropriate urban logistics strategy lies in performing a careful cost-benefits analysis of each lever individually and in combination with other levers (allowing to assess synergies as well as conflicting impacts) and devising the right set of regulations/incentives to put in place in order to foster their deployment. Finally, once an agreement has been reached about the most appropriate urban logistic scheme, it should be first tested via pilots in restricted areas before full implementation.

**Figure 27: Assessment of levers’ ability to influence urban logistic objectives**

<table>
<thead>
<tr>
<th>Lever</th>
<th>Main decision maker</th>
<th>Impact on objectives</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>L.A.</td>
<td>Transport</td>
</tr>
<tr>
<td>UDC out of town</td>
<td>✓✓</td>
<td>-</td>
</tr>
<tr>
<td>Direct injection</td>
<td>✓✓</td>
<td>+</td>
</tr>
<tr>
<td>UDC in town</td>
<td>✓✓</td>
<td>+</td>
</tr>
<tr>
<td>Exclusivity area</td>
<td>✓✓</td>
<td>=/+</td>
</tr>
<tr>
<td>Traffic lane/drop off space</td>
<td>✓✓</td>
<td>++</td>
</tr>
<tr>
<td>Time slots</td>
<td>✓✓</td>
<td>++</td>
</tr>
<tr>
<td>Greener trucks</td>
<td>✓✓</td>
<td>=/-</td>
</tr>
<tr>
<td>Alternative transportation means</td>
<td>✓✓</td>
<td>++</td>
</tr>
<tr>
<td>Congestion charge</td>
<td>✓✓</td>
<td>=/+</td>
</tr>
</tbody>
</table>

Source: Arthur D. Little; UDC: Urban Distribution Center, LA: Local Authority, Transport: Transportation company. * Excluding congestion impact
5.2.4. Fourth dimension of sustainable urban mobility systems: Public Transport Financing

Just at the time when urban mobility is approaching crisis point in many cities around the world, local authority budgets are under great pressure. Securing adequate funding for public transport in such a context means thinking outside the box. Capital and operational expenditures are increasing significantly due to growing supply, rising quality expectations and the increasing cost of production factors. As fare revenues do not always evolve in line with costs, transport authorities and operators need to devise alternative funding streams.

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:

- 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 to perceiving charges from indirect beneficiaries of public transport
- Ensuring the right prioritization of public funding for capital investments while exploring opportunities of partnership development with private investors.

Six key imperatives need to be considered and combined to achieve a resilient funding mix for public transport (see Figure 28):

**Imperative 20: Drive demand for public transport to maximize fare revenue by focusing on a gradual improvement in service offering quality and ensure transparency of fare adjustments**

There is conclusive evidence that service improvements, rather than fare reductions, are most effective in increasing public transport patronage and revenue as this is win-win situation for everyone: the customers, the authorities, and the operators.

Good fare regulation and adjustment help generate the necessary margins to innovate and to invest in order to meet the needs of the future, notably by providing high quality services and achieving productivity improvements. Transparency and dependability of income are also key conditions to a successful engagement with potential investors.

All stakeholders involved in the funding mix should be consulted in the fare decision-making process so as to match the vision of mobility with its actual implementation. Fare reviews should be regular – ideally annual – and very progressive. In case of brutal

**Figure 28: The public transport funding equation**

<table>
<thead>
<tr>
<th>Imperative</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Transparent fare regulation</td>
</tr>
<tr>
<td>2</td>
<td>Smart fare revenue management</td>
</tr>
<tr>
<td>3</td>
<td>Revenue diversification via additional services</td>
</tr>
<tr>
<td>4</td>
<td>Public funding with sound business cases</td>
</tr>
<tr>
<td>5</td>
<td>Earmarking from beneficiaries</td>
</tr>
<tr>
<td>6</td>
<td>Stimulation of clever private funding</td>
</tr>
<tr>
<td>7</td>
<td>…while improving effectiveness &amp; efficiency of operations</td>
</tr>
</tbody>
</table>

Source: Arthur D. Little & UITP FUM 2.0
and steep fare increases, the elasticity of demand is likely to be much higher and the drop in ridership could be significant.

The successful use of a fare adjustment formula in public transport lies in striking a balance between transparency (keeping it simple) and flexibility (in case of changing circumstances).

**Imperative 21: Further individualize mobility offering by providing bundles of services targeting different customer groups at different prices**

Smart price discrimination and product differentiation have the potential to reduce public transport operating costs and to increase fare revenues. Technological innovation facilitates the design of more sophisticated fare structures and the provision of the right service to the right customer at the right price.

Innovative revenue management practices may involve:

- Time of day-pricing, including peak pricing
- Distance-based pricing
- Level of service-based pricing (e.g. premium services)
- Usage-based pricing and loyalty schemes (based on “miles” earned).

In practice however, public transport operators currently tend to provide a single type of service at a flat fare. In spite of the widespread use of electronic fare collection, the potential of revenue management is largely underexploited. The establishment of detailed databases on customer demand is an essential step in implementing efficient revenue management schemes, and a number of public transport networks, notably in Asia, have shown the way forward.

**Imperative 22: Assess opportunities to exploit public transport assets to derive additional revenues through aggregation of third-party services**

Public transport operators could increase their margins significantly by capitalizing on their assets and know-how.

Operators’ assets include their infrastructure and property, advertising space, information and telecommunication systems as well as their company’s brand. Public transport know-how, meanwhile, ranges from technical expertise to planning and project management.

In the extended mobility ecosystem of tomorrow, public transport operators can extract significant value by further developing their commercial offering through the introduction of complementary value-added services within subway and railways stations (see Imperative 11) or by acting as integrated mobility platform operators, aggregating and offering services to the customer that are provided by third party providers, thereby strengthening the profile of public transport as the backbone of urban mobility while simultaneously generating additional revenue (see Imperative 13).

Every opportunity to derive additional revenues should be diligently assessed and exploited as soon as it is suitably incorporated into the company’s strategy. Some operators even sell station or line-naming rights. In the context of the development of electric vehicles, metro and tramway operators may also provide facilities for the re-charging of electric vehicles.

**Imperative 23: Prioritize public funding for capital investments into projects with sound business cases demonstrating policy benefits and long-term viability**

The appraisal of public transport schemes is critical as it is central to comparing their worth against possible alternative solutions and against local, regional and national policy goals. The insights gained via the appraisal process also helps to develop and prioritize transport strategies and policy packages.

The ongoing scrutiny of such appraisals serves to monitor the outcomes of individual schemes and broader transport strategy implementation and increases public acceptance by making the decision-making process transparent.

The problem with current appraisal methodologies is that they often don’t do justice to the full benefits that public transport schemes can provide to the wider public. Recent research has therefore sought to broaden the scope of impacts that can be quantified in transport appraisals to include wider economic, environmental and social issues. Some notable examples include:

- Improving personal security
- Improving economic productivity
- A high quality urban realm
- Regeneration, social inclusion and additional economic vitality
- Supporting population growth
- Contributing to a healthier society
- A more reliable transport system.
Imperative 24: Explore opportunities to perceiving charges from indirect beneficiaries of public transport

Passengers are not the only beneficiaries of public transport systems. Car users, employers, retailers and real-estate owners often benefit too. By levying a charge on indirect beneficiaries of public transport, city authorities can create another funding stream for their increasingly stretched urban mobility budgets.

A number of different categories of indirect beneficiaries may be identified, and different schemes implemented to raise cash in each case.

As the number of travelers using public transport increases, traffic conditions on the road improve and it becomes easier to find parking spaces. Car users thus benefit indirectly from public transport and they could be required to contribute to funding its provision and improvement. Contributions could take the form of fuel taxes, urban tolls or parking fees, to be allocated directly to the public transport budget.

Improved access to workplaces and businesses thanks to public transport, represents a benefit for employers in terms of increased efficiency and attractiveness. Against this background, employers and businesses could contribute to the cost of providing public transport (e.g. versement transport in France, a business rate supplement in London, and a workplace parking levy in Nottingham).

The development of public transport also benefits property owners and developers as the value of their property may increase thanks the better connectivity created by public transport. Different mechanisms may be implemented to capture part of this increment and reallocate it to the funding of public transport.

Imperative 25: Further stimulate partnerships with private investors while focusing on preserving business model solidity over short-term funding opportunities

Engaging with private investors may provide benefits to public transport that go far beyond new capital for investment and growth. While the need to reduce costs and maximize revenue has been at the top of the agenda of most public transport projects for many years, such good practice can be reinforced by regular interaction with private sector partners. Their managerial and value-creation approach and strong focus on operational efficiency offer an opportunity to create value through improved management practices. The sophistication of their risk analysis and their service contract management skills tend to be second to none too.

That said, engaging with private investors requires the proper identification, allocation and management of risks between public transport undertakings, private investors and suppliers. With political interference among the main deterrents to private investors, it is vital to strike the right balance between public interest and management autonomy.
6. Case studies of cities demonstrating good practices

As we have seen, there is no single miracle cure when it comes to addressing the problem of creating a sustainable urban mobility system. Each city should reflect on the 25 imperatives outlined above and identify on this basis the most appropriate actions to be taken in their local context. However, a number of cities have introduced some interesting practices that may well be a source of inspiration for others.

In the following pages, we showcase a (non-exhaustive) selection of these practices via eight case studies. In arriving at the selection of cities below, we have looked to include, as illustrated in Figure 29:

Case studies of cities that are situated in each of the three urban mobility city clusters that we identified: “Rethink the System”, “Network the System” and “Establish Sustainable Core”.

Illustrations of good practice in each of the four dimensions to be addressed by cities when developing sustainable mobility strategies: “Visionary Strategy and Ecosystem”, “Mobility Supply (solutions and lifestyles)”, “Mobility Demand Management” and “Public Transport Financing”.

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**Figure 29: Overview of case studies**

<table>
<thead>
<tr>
<th>Case studies</th>
<th>“Develop Sustainable Core”</th>
<th>“Rethink the System”</th>
<th>“Network the System”</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lagos (Nigeria)</td>
<td>1</td>
<td>2 3 4 5</td>
<td>6 7 8</td>
</tr>
<tr>
<td>Lima (Peru)</td>
<td>1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Tehran (Iran)</td>
<td>1</td>
<td>2 3 4 5</td>
<td>6 7 8</td>
</tr>
<tr>
<td>Istanbul (Turkey)</td>
<td>1</td>
<td>2 3 4 5</td>
<td>6 7 8</td>
</tr>
<tr>
<td>Stuttgart (Germany)</td>
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<td>London (UK)</td>
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<td>Stockholm (Sweden)</td>
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<td></td>
<td></td>
</tr>
<tr>
<td>Hong Kong</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Source: Arthur D. Little & UITP FUM 2.0

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Case Study 1: Lagos
Rank 72 of 84 worldwide
Rank 3 of 5 in Africa

Background
Lagos, Nigeria’s commercial Capital, is the most populous city in Sub-Saharan Africa with a population of around 17 million, which is expected to reach 25 million by 2025.

Transport is chaotic and features an inadequate and highly congested road network, old and polluting vehicle fleets, a high rate of accidents etc. “Public transport” is delivered informally by unregistered private cars, two-wheeler taxis and danfo vans, the latter of which are organized by two influential transport unions. Users are faced with overcrowding, high fares, poor quality, breakdowns, long journey times and often violence.

Performance on Urban Mobility Index
Lagos is the only case-study city from the “Establish Sustainable Core” cluster. Its mobility system is characterized by the third longest travel time to work (52 minutes; after Dhaka and Addis Ababa), a marginal, but increasing, share of formal PT (3%), low financial attractiveness of PT in contrast to individual mobility (compared to other emerging economy cities), poor air quality, but high agglomeration density and only 33 officially registered vehicles per 1,000 citizens. Innovative mobility services as well as cycling infrastructure are absent. An electronic ticketing initiative is in its infancy and smart card penetration is thus marginal.

Governance, vision and master plan
Against a background of improving political stability and with the support of the World Bank, the Lagos Metropolitan Area Transport Authority (LAMATA) was established in 2003 and tasked with transforming and regulating the sector. It developed a Strategic Transport Master Plan (STMP) for 2020/2030 with the aim of creating a modern multi-modal, integrated, safe, quality transport system. Key tenets of the STMP are: integration, quality and affordable fares. The investment program includes Bus Rapid Transport projects, rail and water transport and strategic roads.

Figure 30: Lagos

Lagos: Rank 72 out of 84 worldwide; Rank 3 of 5 in Africa

<table>
<thead>
<tr>
<th>Maturity</th>
<th>Worst value of 84</th>
<th>Best value of 84</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fin. attract. of PT (cost of 5 km PT/cost of 5 km car)</td>
<td>5.7</td>
<td>0.2</td>
</tr>
<tr>
<td>Share of PT in modal split [%]</td>
<td>1%</td>
<td>64%</td>
</tr>
<tr>
<td>Share of zero-emission modes in modal split [%]</td>
<td>5%</td>
<td>75%</td>
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<tr>
<td>Roads density (deviation from optimum) [km/km²]</td>
<td>12.6</td>
<td>0.1</td>
</tr>
<tr>
<td>Cycle path network density [km/ths km²]</td>
<td>0</td>
<td>4,678</td>
</tr>
<tr>
<td>Urban agglomeration density [ths citizens/km²]</td>
<td>0.7</td>
<td>17.8</td>
</tr>
<tr>
<td>Smart card penetration [cards/capita]</td>
<td>0</td>
<td>1.312</td>
</tr>
<tr>
<td>Bike sharing performance [bikes/million citizens]</td>
<td>0</td>
<td>2,384</td>
</tr>
<tr>
<td>Car sharing performance [cars/million citizens]</td>
<td>0</td>
<td>1.312</td>
</tr>
<tr>
<td>Density of vehicles registered [vehicles/capita]</td>
<td>0.69</td>
<td>0.03</td>
</tr>
<tr>
<td>Frequency of the busiest PT line [times/day]</td>
<td>32</td>
<td>515</td>
</tr>
<tr>
<td>Initiatives of public sector (0 to 10 scale)</td>
<td>3</td>
<td>10</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Performance</th>
<th>Worst value of 84</th>
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</tr>
</thead>
<tbody>
<tr>
<td>Transport related CO₂ emissions [kg/capita]</td>
<td>7,390</td>
<td>55</td>
</tr>
<tr>
<td>Annual average NO₂ concentration [mcg/m³]</td>
<td>88</td>
<td>12</td>
</tr>
<tr>
<td>Annual average PM₁₀ concentration [mcg/m³]</td>
<td>200</td>
<td>11</td>
</tr>
<tr>
<td>Traffic related fatalities per 1 million citizens</td>
<td>193</td>
<td>4</td>
</tr>
<tr>
<td>Dynamics of share PT in modal split [%]</td>
<td>-53%</td>
<td>+186%</td>
</tr>
<tr>
<td>Dynamics zero-emission modes in modal split [%]</td>
<td>-61%</td>
<td>+148%</td>
</tr>
<tr>
<td>Mean travel time to work [minutes]</td>
<td>62.1</td>
<td>18.4</td>
</tr>
</tbody>
</table>

Source: Arthur D. Little FUM 2.0
The first project to get under way was the BRT on the main radial route linking a northern district with the traditional central business district to the south of Lagos Island. Implementation was to be undertaken within a narrow time frame to demonstrate immediate improvement to travelers. BRT was to feature noticeable innovation for users: large-sized, comfortable buses with reliable journey times, bus shelters, fixed routes and fares.

The most critical risks did not lie on the engineering front, but in politics and society. Nigeria is characterized by the high possibility of political change, resistance of existing operators and skepticism of citizens due to a history of poor delivery of transport improvement.

Therefore, LAMATA engaged in stakeholder consultation to generate ownership:

BRT was developed in partnership (PPP) with existing operator unions. They were invited to form co-operative companies able to maintain and operate BRT in line with LAMATA service specifications. This amounted to no less than a revolution in standards that involved rigorous vehicle maintenance, extensive driver training, station management, etc.

Citizens were invited to enter into a dialogue with LAMATA. Through newspapers, radio, TV, and road shows, some six million people in the catchment corridor were informed of how the scheme would solve their transport problems.

As a result, BRT became a people's project, forcing wide political support. Construction was undertaken in a context of anticipated change for the better and the BRT became operational in just 15 months.

With 200,000 daily users, BRT was an immediate success. Travel time on the 22 km corridor was reduced from between 90 and 120 minutes to 50. Travel became more affordable and consistent compared to earlier "arbitrary" fares. In order to continue to foster support and improve services, a BRT Parliament was introduced as well as customer relationship management.

Next steps

This BRT line is still far from solving Lagos's mobility problems but it did demonstrate LAMATA's ability to deliver projects. The next steps are:

- Ongoing (electronic) ticketing integration and distance-based fares
- Two further Bus Rapid Transit routes – which are already under construction
- Rail scheme: Lagos State Government is building the 27 km Blue metro line. A private consortium will provide rolling stock, signaling, and power supply, fare collection and information systems, recouping its 400 m USD investment from passenger fares through a 25-year BOT concession. The line is scheduled to open for commercial service in the coming months and is expected to attract 300,000 passengers a day. LAMATA is committed to deliver tracks and provide bus interchange facilities at key stations.
Case Study 2: Lima
Rank 44 of 84 worldwide
Rank 6 of 9 in Latin America

Background and urban mobility related challenges
Lima is the capital of Peru. Situated along the Pacific Ocean, the Lima metropolitan area is a sprawling conurbation with a population of about 8.4 million inhabitants. It is the fifth largest city in Latin America.

The 1990s were marked by the deregulation of urban transport and the liquidation of the national urban transport company. This has led to the development of a dynamic, but largely fragmented and chaotic, public transport landscape.

About 30,000 buses and minibuses operate on more than 600 routes throughout the city. They compete with each other and with about 200,000 to 300,000 taxis. Buses and minibuses are privately owned by hundreds of small operators, and only one third of the taxis are licensed. The system is marked by poor environmental and safety performance as well as a lack of integration. Commuters spend on average two to three hours a day in transportation.

Significant efforts were made in Lima in recent years, through the development of a BRT system, called El Metropolitano, and the opening of the first metro line, called Tren Electrico. These developments were accompanied by a review of public transport regulation, but further priority areas for wider reform of the organization of urban mobility have been identified.

Performance on Urban Mobility Index
Like Rio, Lima was not part of the 2011 Urban Mobility Index, but was added to the 2013 version as a C40 member. The city scores well with regards to the financial attractiveness of public transport and its share of the modal split, the climate impact of transport, agglomeration density, and the density of vehicles registered (only 139 vehicles per 1,000 citizens). Improvement potential lies in the areas of safety, frequency of public transport/metro services, air quality, cycling infrastructure and innovative mobility services.

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</table>

Source: Arthur D. Little FUM 2.0
Upgrade of the public transport system

Lima’s BRT system was inaugurated in 2010 after four years of construction. Articulated buses circulate on special bus lanes that are segregated from the rest of the traffic.

The line is 26 km long and links the principal points of Lima Metropolitan area, from the north of the city to Chorrillos in the south. The headway varies between five and 10 minutes. The system carries about 350,000 persons per day.

The line is equipped with modern platform style bus stops, where travel cards may be purchased and recharged.

Lima’s first metro line opened in 2012, after several decades of construction. The 22 km long route runs above ground (mostly elevated, partly at grade) and counts 16 stations. It links Villa El Salvador to downtown Lima and the headway is around 15 minutes. There are plans to expand the metro into a five line network.

The development of the BRT system, regulatory measures (see below), and some other projects, including notably sidewalks and bikeways, were supported by a loan of the World Bank. The funding of the infrastructure for the metro was partly supported through an economic stimulus package established by the national government.

Regulatory reforms: present and future

Following the launch of the BRT system in 2010 a set of new rules and regulations were implemented. Financial incentives were provided in order to take the oldest, most polluting, and least safe buses and mini-buses off the road – with an ambition to halve their number by 2021 – and to improve the efficiency of vehicles that would remain in operation.

Other measures included a ban of private buses within 400 meters of the BRT system, which met strong opposition from bus companies.

The formalization of taxi services was also part of the reform program and taxi drivers were required to register with the government within a given period of time. The purpose was to modernize and improve the quality of the fleet based on age, weight and roadworthiness criteria. Registered drivers would receive benefits from the local government, such as healthcare and free training. Registered taxis would be identified by a dedicated label.

However, it appears that further reform would be required to reap the full benefits of the efforts made so far. In that respect, a roadmap for “Sustainable Mobility and Transportation in Lima and Callao by 2025” was developed in August 2013 by a group of local and international universities and organizations. The document sets out a long-term vision and key policies that would significantly improve mobility conditions in Lima.

The document supports the development of a unified technical authority for urban and mobility planning in Lima and Callao, which would ensure continuity in case of changes in the political or economic landscape. Another key policy put forward is the prioritization of polycentric urban development, in order to avoid unnecessary journeys. It also calls for continuing investment in public transport as well as non-motorized mobility.
Case Study 3: Tehran
Rank 81 of 84 worldwide
Rank 2 of 3 in Middle East

Background

Tehran has a population of about 8 million and the greater metropolitan region has about 14 million inhabitants. These totals are expected to soar to 9 and 19 million respectively by 2030. As most economic activities are centered in Tehran itself, the influx of commuters brings the daytime population to more than 13 million people. Over the past decade, the worsening traffic congestion and subsequent poor air quality has turned into a major challenge for authorities.

Performance on Urban Mobility Index

Tehran ranked 65th out of 66 in the 2011 version of the Urban Mobility Index. In the 2013 version the city ranks 81st of 84. Two remarkable features of the Iranian capital are the high share of PT (both formal and informal) in the modal split and smart card penetration (0.81 cards/capita). On the down side, Tehran has the most unsafe mobility system worldwide with 307 fatalities per million citizens (versus a global average of 56 fatalities per million). The frequency of metro services in the city is low and the air quality is poor. The density of vehicles registered is high (541 vehicles/1,000 citizens versus a global average of 380 vehicles/1,000) and innovative mobility services are not developed.

The Master Plan

A Master Plan Tehran 2025 was developed between 2003 and 2008. Its scope is ambitious, comprehensive and visionary and covers, among other issues, land-use and demand management.

The Municipality's strategy focuses on making public transport (rail and Bus Rapid Transit) the backbone of its network, complemented by enhanced bus services and taxis as well as the promotion of cycling and walking. The objective is for public transport and paratransit to make up 75% of the modal share by 2030.
The Master Plan highlights in particular the need to create a poly-centric city in place of the mono-centric configuration that exists at present, and to concentrate these urban developments around six transit corridors served by rail. The infrastructure needed is estimated at 430 km of railways, supported by BRT and interconnected at 80+ interchange stations, to achieve optimum connectivity.

Institutional organization and the role of private sector encouragement

Public transport is mainly organized by the Traffic and Public Transport Office, reporting directly to the Mayor. Rail is provided by TURSC, a municipality-owned company, which is funded 50-50 by the Tehran municipality and the central government. The operation of bus services and the maintenance of fleets, however, is increasingly outsourced to the private sector. Private companies are responsible for 30% of lines. These companies provided new, cleaner fleets (CNG) as part of their contract to operate. In 2010 an integrated electronic fare collection system was introduced on metro and bus services. As a result, journeys in private buses have increased by 40% in just a few years.

Developing Tehran’s rail system

The metro opened in 1999 and has enjoyed considerable success. Today there are 150 km of metro lines serving 88 stations and the system carries nearly 3 million passengers daily (i.e. 16% of the total number of trips). Despite this success, the metro system is not operating at full capacity due to a lack of trains, and this has led to severe overcrowding and uncomfortable conditions. 85 km of new lines are under construction, but due to economic sanctions and Iran’s international isolation, the planned development pace could not be achieved.

The Bus Rapid Transit system

By the end of the 90s, the city bus service had deteriorated. Buses struggled in dense mixed traffic and the bus service was viewed to be of poor quality. The first BRT line was introduced in 2007 and, in the first year of operation, the number of passengers grew from 214,000 to 380,000 daily. At present, eight lines (121 km) of BRT are in operation – carrying two million passengers daily – and a further two will start service by next year. BRT lines with only 4% of the total route transport account for 45% of the total bus passengers.

Promotion of cycling

The promotion of cycling for short-distance trips has been a major focus in the last four years. More than 200 km of dedicated lanes have already been built and the ambitious objective for cycling is to achieve a 5% modal share by 2030.

Transport Demand Measures

Fuel price policy: In Iran, fuel has traditionally been highly subsidized. Since 2007, gradual (unpopular) measures were introduced to curb the use of diesel and gasoline and to reduce the subsidies paid on these fuels.

Congestion charging scheme: A restricted traffic zone (19 km², later extended to 31 km²) has been put in place in the central business district since 1981. An even/odd number plate enforcement system is in place in a slightly larger zone, and trucks are restricted across an even larger area. As manual enforcement was inefficient and frequently breached, a full automatic Congestion Charging System was recently implemented using Automatic Number Plate Recognition (ANPR) with mobile phone payment. As a result, unauthorized entries could be reduced by 90%.

Car-free and pedestrian zones: One of the major projects in promoting pedestrian zones was implemented in the ‘Bazaar’ area. Since 2008, it has resulted in a drastic reduction of air pollution and traffic congestion in the area, which is well served by the metro.

Conclusions

Tehran has developed a comprehensive and ambitious plan. Success is already noticeable, but severe economic restrictions are slowing down the process.
Case Study 4: Istanbul
Rank 27 of 84 worldwide
Rank 3 of 7 in (South-)Eastern Europe

Background

Istanbul is not only the largest city in Turkey; it is its economic, cultural, and historical heart. With a population of 13.8 million, Istanbul is also one of the largest urban agglomerations in Europe and has the unique distinction of spanning two continents, with two thirds of the population living on the European side of the Bosphorus Strait and the remainder inhabiting the Asian side. Urban transportation is one of the key problems faced by the city today and this challenge is growing as its population increases and becomes more prosperous, leading to an even higher ownership rate of private cars. In the last four years alone, Istanbul’s population has increased by 9%. As a result, urban transportation is a hot topic on the agenda of decision-makers and several projects have been initiated to expand the public transport system.

Performance on Urban Mobility Index

The city’s mobility system is affordable and has a well-balanced modal split with 37% of trips being made with PT and 49% with zero-emission modes. There are only 224 vehicles per 1,000 citizens in Istanbul, which results in only 772 kg CO₂/capita (compared to a global average of 1,506 kg/capita), and a very good traffic-safety record (20 fatalities per million citizens in Istanbul versus a global average of 56 fatalities per million). Factors, that are holding back the city’s mobility system include an under-developed bike lanes network (only 27 km/ths km²), marginal car and bike sharing systems (7 shared cars and 9 shared bikes per million citizens – still a progress compared to 2011 Urban Mobility Index, where both car and bike sharing systems were absent), as well as air quality.

Rail Vision 2023

Istanbul Metropolitan Municipality has recently unveiled its future vision for railway transport. The ultimate aim of this plan is to create a metro network with a length of 641 km by the year 2023 (the centennial of the Republic of Turkey). The scale of Istanbul’s ambition is such that it could exemplify UITP’s vision for doubling the market share of public transport worldwide.
As recently as 2004, the city had an urban rail network length of just 45 km. By 2013, this had grown to 141 km. This development featured what must count as one of the most important urban transport investments anywhere in the world, the Marmaray tube tunnel under the Bosphorus, which connected Europe and Asia by rail for the first time. It began carrying paying passengers in October 2013.

The city of Istanbul is committed to meeting the ever-increasing demand for mobility as well as the needs of a rapidly growing population by creating a metro network that will constitute the backbone of the transport network. As things stand, urban mobility in Istanbul is dominated by road transport. In 2012, it accounted for 83% of journeys, while rail’s share was only 13%. The projects under way as part of Istanbul’s future vision will, without doubt, constitute a ‘game changer’, increasing the modal share of railway transport to 31% and decreasing that of road transport to 66% in the year 2014. With the projects currently under construction and in the design phase, as well as the increasing network effect and enhanced connectivity, the ultimate vision for 2023 is to have a metro network responsible for 72.5% of all trips, leaving the road transport network with a modal share of 26.5%.

**Bus Rapid Transit and bus transformation**

In response to the rapid population increase, the city of Istanbul has also developed mass transit solutions to satisfy heavy passenger demand in the short term. The 52 km Bus Rapid Transit System (locally known as Metrobus) carries more than 700,000 passengers a day. BRT was implemented on the city’s main highway, where two lanes were taken away from private cars and dedicated to public transport. With 1x1 lanes, the BRT system offers a capacity more than 30,000 pphpd1 during peak hours when it operates double articulated high-capacity buses with headways of 20 seconds.

Another important characteristic of Istanbul’s BRT system is its speed of construction. The 18.2 km-long first phase was completed in just seven months in 2007, setting a new record for a project of this sort.

The city is also working to enhance bus transportation, which mainly aims to increase the commercial speed of the buses and their service quality. Dedicated bus-lanes have been introduced and the bus fleet has been renewed over the last one and a half years with the introduction of 1,700 new buses.

**Other developments**

An increase in public transport supply is not the only solution for the city of Istanbul, however. Other significant initiatives include:

- Collaboration between local and central government was deepened to upgrade the existing suburban railways and construction of the metro network.
- Management of car parks has been formalized. A municipal company named İSPARK was established and took over the management of most car parks operated by informal operators.
- Introduction of a smartcard system with fare integration. Istanbul is also working on the introduction of a distance-based and zone-based fare system. Smart Bus Stops, with dynamic passenger information system, also came into service.
- Service Quality Improvement is a topical issue on the agenda, with the introduction of EN 13816 European Service Quality Standard and EFQM.

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1. Passengers per hour per direction
Case Study 5: Stuttgart
Rank 12 of 84 worldwide
Rank 10 of 19 in Western Europe

Background and urban mobility-related challenges

Stuttgart is the capital of the state of Baden-Wuerttemberg, which is located in the south-west of Germany. The city itself is home to more than 600,000 inhabitants but about 2.1 million more people live in the surrounding region. Stuttgart is also one of the most attractive and innovative economic locations in Western Europe and the home base of global groups such as Daimler, Porsche and Bosch.

In the face of growing urbanization and the need to improve sustainability, Stuttgart faces increasing challenges. It needs to raise the average travel speed and decrease pollution levels. At the same time, technological innovations such as e-mobility and increasing changes in the behavior of customers offer new possibilities to address these challenges. The combination of different means of transport and innovative technological solutions opens up new approaches to build a sustainable city with an equally ecologically sound urban mobility system.

Performance on Urban Mobility Index

In the last two years Stuttgart has improved its urban mobility performance, according to the Arthur D. Little Urban Mobility Index. Stuttgart is showing particularly impressive results in the area of car sharing: from 419 shared cars per million citizens in 2011 to 1,312 cars per million citizens in 2013, a rate that makes Stuttgart the leading car sharing city in the world. As of 2013, three car sharing providers were operating in the city: car2go (400 eCars), Stadtmobil (320 cars), and Flinkster (76 cars).

Urban mobility strategy and master plan

This success is a result of an implementation of Stuttgart’s “Transport Development Plan 2030”, which was adopted in October 2010. As an addendum to this document the City Administration also issued an action plan “Sustainable Mobility in Stuttgart” in June 2013. Both documents focus on:

1. Environmental issues: congestion relief, reduction of noise, particulate matter, nitrogen oxides and GHG emissions
2. Promotion of vehicles with alternative engines, especially electromobility
3. Promotion of sustainable modes of transport: public transport, walking, cycling
4. Implementation of innovative mobility solutions: car sharing, bike sharing, ride sharing
5. Integrated mobility offerings
6. City logistics, etc.

Stuttgart’s mobility strategy is integrated with the city’s Land Use plan, Clean Air plan, Noise Reduction plan, Local Transport plan, Climate Protection Concept and general Urban Development plan.

“Stuttgart Services” and intermodal mobility offerings

In April 2012, the state of Baden-Wuerttemberg and its capital were selected by the German government to be one of four “Showcases for Electromobility.” About 40 projects worth a total of over 110 million euros were initiated in order to make the vision of electromobility into a reality. The goal is to have over 2,000 EVs and 1,000 charging points in the region by 2015. One of these projects – Stuttgart Services – aims at the integration of electric vehicles with other sustainable modes of transport and the promotion of intermodal mobility. The backbone of integrated mobility offerings in the city is public transport.

Two main outcomes of the Stuttgart Services project are:
1. Mobility card “Stuttgart Services”
2. Integrated mobility platform and app

The integrated mobility card gives the customer the ability to use different services and means of transport in a fuss-free way. It removes the need to carry different cards for different services, a clear value proposition for customers.

The second main component, the mobility platform, provides real-time intermodal information, serves as an information/planning tool and as a booking and reservation system. To the same extent as with the card, a unique customer benefit is created through integration.

By creating intermodal mobility solutions, an ambitious vision is becoming a reality in Stuttgart. The attractiveness of eco-friendly mobility services has been increased. Public transport, car sharing and bike sharing are being pushed and a sustainable, integrated mobility eco-system is being built. This serves to increase the quality of life of the citizens and promotes the attractiveness of the entire region.
Case Study 6: London
Rank 9 of 84 worldwide
Rank 7 of 19 in Western Europe

Background
London is one of the largest cities in the European Union with more than 8.4 million inhabitants. It also has the oldest metro in the world and one of the most extended. The number of inhabitants is increasing each year putting a significant strain on the city’s transport network, which until recently has suffered from years of under investment. Over the next 20 years, the city’s population is expected to increase by almost one million people and employment by more than 600,000, both factors which will increase demand for transport. The main challenges facing the city are to meet this rising demand while maintaining investment in the existing transport network.

Performance on Urban Mobility Index
London's mobility system is in the above average performing group in both versions of the Urban Mobility Index (2011 and 2013). Since 2011 the number of shared cars slightly increased (from 232 to 253 per million citizens), and the number of shared bikes increased from 695 to 1,012 per million. Transport-related fatalities decreased from 39 to 27 per million citizens. Other indicators changed insignificantly. The main strengths of London’s mobility system are its Oyster card (on a par with Hong Kong’s Octopus card sharing the highest penetration rate worldwide), a growing share of public transport in the modal split (34% in the last measurement compared to 31% in the last but one measurement), and the frequency of its public transport services. At the same time, the city has significant improvement potential with regard to cycle lane network density (only 254 km/ths km² in London versus an average of 2,121 km/ths km² in Western Europe) and travel times to work (44 minutes in London versus an average of 31 minutes in Western Europe).

Enhancing the network
Journeys on public transport are constantly increasing, reflecting population and job growth. To improve the reliability and efficiency of London’s transport system, continued investment in the network is vital. The London 2012 Olympic and Paralympic...
Games were a catalyst for major capital investment including a new suburban railway, London Overground, new signaling on the Jubilee line and extensions to the Docklands Light Railway. One of the biggest challenges was to increase frequency and network capacity to accommodate the Games. This was achieved and led to a long-term legacy benefit for Londoners. Moreover, a strong emphasis on Travel Demand Management not only led to a smoothing of the peaks on mainstream public transport and less congestion at busy transport hubs, it also led to increased walking and cycling.

Olympic and Paralympic Games legacy include:

- Improved reliability
- Raised capacity
- Long term vision for London's road network
- Improvement walking and cycling
- Better travel demand management and signage

Transport for London has also been pioneering contactless payment card technology for ticketing alongside an ambitious digital strategy which has embraced the principle of open data. The aim is to make public transport as simple and as easy to use as possible.

**Funding public transport**

The Central London Congestion Charge introduced in 2003 to reduce congestion in the city center continues to deliver improved traffic flows and contributes to a general improvement in mobility. The net proceeds of the scheme are being reinvested in the city’s transport system. In 2008 London also introduced a city-wide Low Emission Zone to improve air quality.

Crossrail, a new high frequency East-West railway, will be fully opened in 2019. This ambitious project (42 km of new tunneling over its 118 km length) will add 10% capacity to London's rail network and will carry around 200 million people annually. Crossrail has been recognized by the business community as critical for London’s future. The funding model involves contributions from Transport for London (TfL), the government and private businesses, reflecting the wide economic benefits the scheme will deliver. This innovative funding model could be an example for other cities.

Finally, TfL is a good example of a strong and integrated regional authority which controls all aspects of mobility in a city: not only mainstream modes such as metro, tram and buses but also taxi regulation and licensing, the promotion of walking and cycling and responsibility for the city’s principle roads to name a few.
Case Study 7: Stockholm
Rank 2 of 84 worldwide
Rank 1 of 19 in Western Europe

Background
Stockholm is built on different islands, interconnected by bridges. This geographical and urban context presents a number of challenges to the transport authorities charged with organizing access to the city center and controlling traffic. At the same time, it provides opportunities for controlling access to the central business district, as bridges are easier to police than an urban zone with multiple points of entry and exit.

The city is also well known for its green projects (energy, building, transport) and quality of life. When it comes to public transport, everything is done with an eye to making it clean, safe and reliable, with real-time information and fare reimbursement in the case of delays. These are some of the reasons why Stockholm ranks second after Hong Kong in the Urban Mobility Index.

Performance on Urban Mobility Index
In the 2011 Urban Mobility Index, Stockholm ranked 4 after Hong Kong, Amsterdam and London. In the 2013 version Stockholm is a best performing European city. Stockholm’s modal split became more sustainable, with environmentally-friendly modes taking a 67% share. The number of shared cars per million citizens increased from 138 in 2011 to 400 in 2013. Transport related fatalities decreased from 21 per million in 2011 to 9 per million in 2013. It was the same story when it came to transport-related CO₂ emissions: down from 1,430 kg per capita in 2011 to 1,348 kg per capita in 2013. Also remarkable is Stockholm’s cycle path network density – the third most dense in the world – with 4,041 km of lanes per 1,000 sq km, as well as the city’s high air quality.
Stockholm as a green city

In 2010, Stockholm was awarded the title of the first European Green Capital. Thanks to voluntary policies instituted since the 90s, greenhouse gas and fine particulate matter have been reduced. The city has also been reducing its fossil fuel dependency by encouraging a reduction in the use of such fuels and by replacing its private and public fleet with green vehicles. Specific objectives are detailed in the Stockholm Environment Program for 2012-2015:

- Environmental certification has been set up for municipal vehicles; in order to meet new standards on air quality an electric city car fleet is being incentivized
- For green cars, the objective has been set is to reach 85% of alternative fuel usage
- Commitment of transport authority to ensure that at least 55% of transport services are operated using green vehicles
- Improvement of cycling network

Sweden has been a pioneer in the use of green vehicles since the 80s. It has also made great efforts to purchase electric vehicles and set up infrastructure for them. In October 2010, a public-private joint procurement was launched with a view to stimulating electric vehicle demand in Sweden. The bus transport fleet in Stockholm is made up of 229 methane buses (which run on a mix of biogas and natural gas), 768 ethanol buses (ED95), and 224 RME buses. The objective is to fully phase out fossil fuel vehicles by 2050.

These objectives are ambitious and the city is already on the right track.

Demand management and the introduction of initiatives to encourage a modal shift towards PT, walking and cycling

Stockholm was one of the first cities to implement a 30 km/h speed limit in residential areas. This initiative has helped public transport by giving it a comparative advantage. Stockholm also introduced a permanent congestion charge in 2007 after a test period in 2006. This scheme, combined with other public transport-friendly measures, led to a reduction in congestion and traffic (-20%) and a modal shift towards greener modes of transport: between 2004 and 2010, 12% of Stockholm inhabitants shifted from private motorized vehicles to public transport and cycling (9% and 3%).

In line with demand management activities, the following initiatives were implemented:

- Reorganization of the bus network with high-speed lines and feeder lines
- Real time information on traffic and bus arrival times
- Improvement of quality and capacity of all modes of transport
- Improvement of the cycle path network, introduction of a bike sharing scheme, journey planner, etc.

In Stockholm, it is the public transport authority that faces the challenge of finding appropriate measures to address demand management and plays the leading role in implementing them. The quality of the network it created and the incentives it offered citizens to shift to public transport made Stockholm a worthy runner-up to Hong Kong in the survey.
Case Study 8: Hong Kong

Rank 1 of 84 worldwide
Rank 1 of 28 in Asia Pacific

Background

In terms of population density, Hong Kong is one of the most crowded cities in the world, with more than seven million people living in an area covering 1,100 km². As a result of this demography and due to geographical factors, the city is dominated by high-rise buildings in order to maximize urban capacity.

The public transport network is also one of the most efficient in the world, with public transport and walking making up 92% of the modal split. Hong Kong’s transport system is a multi-modal network based on rail transport supported by bus, minibus, tram, ferries, and taxis. The network is well integrated and the Octopus smart card allows customers to use all modes of transport and to pay for parking, shops and leisure facilities.

Performance on Urban Mobility Index

Hong Kong is the study winner of both the 2011 and 2013 Urban Mobility Index versions (i.e. when considering both 11 and 19 urban mobility indicators). The city performs top with regard to financial attractiveness of PT, share of PT in modal split, smart card penetration, number of vehicles per capita, traffic safety, climate impact of transport and public sector initiatives. In addition to this, it has an above average performance with regard to share of zero-emission modes in modal split, road density, agglomeration density and PT frequency. Improvement potentials lie in areas of cycle path network density, car and bike sharing as well as air quality, especially with regard to NO₂.

Rail as a backbone of the network and city

Given its topography and the volume of users, Hong Kong’s network needs to have high capacity and negotiate geographical barriers such as water or mountains. The response of the transport authority to these two demands was a rail-based network that accommodated both spatial and ridership issues.

The rail network has developed impressively since the 80s. The objective was to reach a symbiosis between rail public transport supply and construction. Since the construction of the...
rail network and the development of the competencies of the Mass Transit Railway Corporation Limited (MTR), the company has come to rely on secondary revenue provided by station and property-related businesses.

**Focus on rail and property model of financing**

MTR bases its business model on real estate and density value. Before building a new line, MTR acquires land rights at a pre-railway valuation before preparing an overall scheme, including building and railway design, in cooperation with a property developer. The property developer then finances the development and MTR oversees the construction. When the property is sold, MTR takes a share of the profit and may retain estate management rights.

Today, 86,000 residential units are managed by MTR, together with 76,000 sq m of commercial and office spaces. MTR also has investment properties in 13 shopping malls.

MTR has turned Hong Kong’s high population density into an opportunity rather than a threat. Its policy of combining public transport development and urban development/renewal has led to an almost optimal situation in terms of finance, ecology and ridership. While there may be no perfect urban mobility system, Hong Kong has achieved great success in balancing the conflicting demands of urban planning, transport infrastructure and specific constraints. The result is a low rate of car ownership – 73 per 1,000 citizens – and a dominant role for public transport. This implementation is supplemented with IT facilities such as the Octopus card.

**The Octopus card**

The Octopus card, launched in 1997, was the second contactless smart card system to be introduced in the world. It not only allows users to travel on public transport but also to pay and register for a range of other services. The fact that card-holders can make payments for shops, fast-food outlets, parking facilities, phone use, together with using it for key card access to residential and offices buildings, and even as a library card for students, means that Octopus card penetration is extremely high. It has become part of the Hong Kong resident’s daily life and is widely used. According to the Octopus system operator, there are around 22 million cards in circulation.

Hong Kong is a striking example of a city entering into a virtuous system (increasing density, building, and improving the network). But Hong Kong’s mobility has been shaped by one dominant operator and further improvement of the mobility system will require more cooperation with other stakeholders in the ecosystem and the introduction of innovative mobility services.
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Urban mobility and congestion problems in India

Are all cities in India congested or just some of them? Are Delhi and Mumbai less or more congested than, say, Patna and Varanasi?

By Anushka Khare  01/10/2018

New Delhi: Traffic congestion has increased dramatically in India. Congestion and the associated slow urban mobility can have a huge adverse impact on both the quality of life and the economy. Are all cities in India congested or just some of them? Are Delhi and Mumbai less or more congested than, say, Patna and Varanasi? Are mobility and congestion different within cities across the centre and periphery, and at different times of the day? How congested are Indian cities compared to cities in the US? What does the future hold?

Our understanding of the underlying reasons for congestion is still evolving. A popular view is that urbanization leads to ever larger cities and increased rates of motorization. These two features eventually lead to complete gridlock and congestion. However, economic growth also brings about better travel infrastructure, which facilitates uncongested mobility and increases the pace of urban mobility. Indian cities have experienced both these trends. These changes are taking place at a much faster pace in India than in the UK and the US. Transportation investments constitute the largest component of lending of many global development institutions. A deeper understanding of the interactions between urbanization, urban mobility and congestion will help improve investments in transport and city competitiveness.

Data on urban transportation in India is scarce. In the UK and the US, knowledge on urban mobility and congestion stems from surveys of household travel behavior. However, such surveys are prohibitively expensive to carry out in India. We used other methods to...
examine urban mobility and congestion. We used a popular web mapping and transportation service to generate information for more than 22 million trips across 154 large Indian cities (Mobility and congestion in urban India by Aman Protoy Akbar, Victor Couture, Gilles Duranton, Ejaz Ghani and Adam Storeygard, 2018, World Bank).

Hard data shows that mobility is slow in most Indian cities. It is slow even outside the peak hours of traffic and in both large and small cities. India’s mean travel speed across cities is just 24.4 km per hour, much slower than the mean travel speed of 38.5 km per hour in metropolitan cities in the US. There are also big differences in mobility across cities in India. A factor of nearly two separates the fastest and slowest cities. These differences are driven by the differences in uncongested mobility, and not by differences in how congested they are.

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Anushka Khare
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Beyond Borders: Gender and Urban Mobility in India

‘Beyond Borders’ is our new series of articles where we explore how the world is changing from an inclusive perspective. Whether we’re looking into new technologies or sustainable practices, ‘Beyond Borders’ showcases innovations and cultural shifts happening across the world.
With this series, we aim to challenge perspectives on how we go about tackling global challenges and invite cultural nuance and diversity into the conversation.

First up: a 4-part story on redefining urban mobility on a local scale in South Africa, India, the US and Brazil.

Welcome to Part 2, where we talk to the World Resources Institute's Jyot Chadha about the challenges and opportunities in India's gendered urban mobility landscape.

Part 2: The Trio of Gender, Transport and Safety in India
“As a woman, knowing when I can get transport and what I'll do to get to my final destination allows me to be more in control.”

Jyot Chadha leads the New Sustainable Mobility practice at the World Resources Institute's Ross Center for Sustainable Cities. Her team works on a high level to increase urban mobility, most often in emerging and developing countries. For Chadha, India is a focus area—where, despite recent initiatives by the government to innovate urban mobility, the dynamics of transportation remain significantly gendered. “The highest instance of harassment against women on public transport happen when they’re actually waiting for transport at a stop,” explains Chadha. “There are larger cultural shifts that need to happen for sure—but how can we recognise this and then think about minimising the time people have to spend waiting for the bus?”

According to Chadha, public transportation in India is, overall, unreliable. She says that congestion significantly delays bus schedules—and if your bus is delayed, you don’t really have a way of being updated. “We have huge issues in terms of people waiting for 15-30 minutes without knowing when their bus is actually going to come,” she explains. For all commuters, those delays are annoying—but for women, they can prove detrimental. Indeed, a recent research report identified that about 80 percent of Indian women have been harassed at a bus stop. And it’s not all lost on Indian women that in between 2007 and 2016, crimes against women have skyrocketed by 83 percent—the most high-profile and violent of which happened on public transport. As a result, Indian women’s concerns about urban transport overwhelmingly have to do with safety—so much so that a study of over 4,000 women at Delhi University found that women would be up for paying almost 300 dollars more than men for safer travel that decreased the chance of harassment.

Today, one in five Indians don’t have that extra 300 dollars—and even if they did, the implementation of safer travel is an immense process.
announced the Green Urban Mobility Scheme: in between 2018 and 2023, around 70,000 crore will be invested into sustainable transport. (That’s over 9 billion euro.) But despite this, critics say that urban transport investments remain largely “gender blind” and don’t consider safety a crucial enough aspect of sustainable transportation.

So, how are women in India navigating a potentially dangerous transportation ecosystem? In 2017, a report released by India’s Institute for Transportation & Development Policy and Supporting Safer Cities identified unsafe transportation as a key barrier to Indian women’s integration in the workplace. To paraphrase, many women are simply avoiding public transport—which also means they’re taking lower-paying jobs to stay closer to home. This is significant not only for women’s quality of life on its own, but for India’s economy. In urban India, women’s labour force participation is only at 15.5 per cent—and actually dropped by 19.2 million people between 2005 and 2012. That loss is costing India a huge chunk of money: if more women were to work...

...tune of a whopping 770 billion increase to India’s GDP by 2025.
But there is progress. Over the past eight years or so, India has rolled out initiatives like an all-woman police station in Gurgaon, anti-leering training for taxi drivers, and reserved seats for women on buses. And in 2018, Pune began to send out Tejaswini buses—women’s-only buses operated by female drivers and conductors during peak hours. Outside of transport, there’s even a compulsory ‘gender sensitisation’ programme that’s been implemented in all of India’s schools. Initiatives like these reflect a cultural motivation—to make women feel safer through transportation itself, but also by challenging the existing gender dynamics between men and women. “Poor gender dynamics are an entrenched problem in India—it’s not only a problem of provision of transport,” adds Chadha. “Why is that the case, and how do we start to tackle that?”

These are all pretty recent initiatives, however. It may take years to make public transportation in India safer for women on a massive scale. But Chadha stresses that public transport is far from the only option available: she sees the urban mobility landscape in India as “very shared and active” and full of diverse options. Many people walk and cycle, and many others take form of shared mobility—which includes everything from trains to metros to shared rickshaws and taxis. With all these options, surely some must be present a safer alternative for women than the bus, right?

The problem is that this diversity doesn’t translate to ease of accessibility for all demographics. “In all of these areas, there are a number of obstacles in terms of having a safe, efficient, comfortable and equitable journey,” says Chadha. Take the auto-rickshaw, for example. Although it’s been one of the most common for-hire vehicles in Indian cities for decades, its drivers have a serious reputation of ripping people off—whether that’s through refusing rides are jacking up rates. “People have different needs. The same person has different desires at different times of the day depending on situations they’re in—or even the weather,” says Chadha. “Looking at an ecosystem as a
and seamless? Cities need to recognise that human beings are not taking the bus and then the train for the fun of it, but to get to their destination.”

Chadha also explains that part of the issue that’s making it so difficult to implement a well-oiled transportation system in India has to do with the country’s scale of the ‘last mile’—the final bit of transport you need to go through to get to your destination. “A lot of the time, what’s called ‘last mile’ in a city like London or New York will be a kilometre or less. In India, it can be up to 10 kilometres,” she explains. “That requires an additional connection point. In the past, that fuelled this big ecosystem of rickshaws and taxis, but what we’re seeing today is that this space of looking at last mile options has completely opened up. The big change is that now there are enterprises trying to provide these services, not just micro-entrepreneurs.”

Indeed, the landscape of transportation options in India has been

the past decade or so, India has grown to become the second-largest
mobile market on the planet; in response, on-demand and app-based taxi services have flourished. There's Indian ride-hailing company Ola Share, for example, which operates in over 100 Indian cities; Uber has vehicles in 20. There's tech-integrated buses and motorbikes – like rBus, Shuttl or ZipGo – where you book seats in air-conditioned buses via an app. There's app-based motorbikes, like Rapido in Bangalore and Delhi, where you can book your bike outside of a train station to take you to your next destination. And there's even start-ups which are directly addressing the last mile issue: take Gurugram's SmartE, which – in partnership with Delhi Metro Rail Corporation – has deployed about 1000 electric three wheelers outside of more than 10 metro stations. (As of April 2018, about 60,000 people a month have been using these services.)

Clearly, there's an appetite for smart, shared transportation innovation in India. So, why is 'the last mile' still an issue—and why isn't transport becoming safer for women? According to Chadha, it most often has to do with a discrepancy between public policy and transportation entrepreneurship. For example, in between 2016 and 2017, dozens of bike taxi startups popped up but ultimately failed due to 'operational and regulatory hurdles'. And Chadha says that right now, mobility innovations may operate on a city-by-city basis – primarily as pilot projects – but haven't managed to fit into a legal framework that would enable a rollout across the country. "The challenge is that our policymakers think of transport providers and solutions in the context of how things used to be," says Chadha. "They're trying to retrofit new models into that old structure. It's like trying to fit a round peg into a square hole."

And besides: tech-based ride-sharing initiatives like Uber require you to have a smartphone—something that's rapidly on the rise in India, but still out of reach for many in the country. What this means is that although the transportation options are out there, fragmented and unreliable public transportation is still the primary option for many.
But maybe the fix doesn’t have to come entirely from the government and policy makers. Could other forms of smart transportation innovation help close the barrier between safety and transportation for women? “I don’t think that the digitisation of transport can solve the issue of safety for women on its own,” says Chadha. “But I think it holds promise in starting to try to address some of the pain points. SafetiPin is a good example of how that unfolds.” Founded in 2013, the app crowdsources perceptions of safety across different points in a given city. Based on those insights, SafetiPin generates maps of areas where people feel unsafe for a variety of reasons—like if the area is poorly lit, or if there’s a significant gender imbalance in play. “This kind of initiative helps the government say, ‘how can we intervene’?”, explains Chadha. “If the gender balance is poor in an area, maybe we can add more food vendors there so that families will visit and therefore even out the gender balance. Understanding what the changes we can bring about are on this granular, deeper or more meaningful way are very important. They can be offered by some of these new technologies.”
and accessible transportation for all in the face of a rapidly increasing urban landscape. “The number of people moving to cities is gigantic. We have never seen this scale, ever,” says Chadha. By 2050, India will likely be home to 1.5 billion people, making it the most populated country in the world. Over the last 30 years, its urban population has doubled. “For the first time, we are asking ourselves: how do we move people in a way that is efficient without ignoring the negative externalities of transport?”

In Chadha’s mind, one thing is for sure, though. To increase urban mobility responsibly in a densifying environment while eradicating serious issues like women’s vulnerability on transport, India shouldn’t look exclusively look at new apps or tech solutions. Instead, it should revisit the infrastructures and transportation cultures that are already there. “The future of India is not moving towards more developed countries’ system of private cars but to remain active and shared. And sure, our mobility may not all be app-based – and most of it isn’t – but it’s always been shared auto-rickshaws, shared taxis, minivans, shared buses,” she says. “Now, the challenge is making sure that what’s active and shared is accessible—to be used with dignity, ease and efficiency for everyone.”

Beyond Borders: Redefining Urban Mobility in South Africa
Newsletter

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Opinion: Urban Mobility Challenges in India

In big cities like Mumbai, Delhi, and Kolkata, a person spends, on an average, about 3 hours per day commuting to and from his place of work and residence.

By Raghavan Sethuraman  -  22/01/2019

Even a child will tell you that the biggest challenge facing the nation as a whole is its population. However, the flip side is the advantage of trained human capital that can be harnessed for progress. This is the segment of the population the nation depends on for its growth and march towards superpower status. And these are the people who work in bustling metropolises and tier 2 and 3 cities with visions for themselves, the community and the nation.

Longevity in India is on the rise, with an increase in the population of senior citizens who have made cities their permanent home. They want a quality of life and dream of living in an urban utopia for the rest of their lives.

The urban population in India is made up of different groups each with its own agenda, vision, ambition, and needs. The common thread running through all this is the central issue of rapid transportation in urban areas. This problem has assumed gargantuan proportions and is the central factor in town planning across cities in the country.

**Public transport in big cities is inadequate and overburdened**

In big cities like Mumbai, Delhi, and Kolkata, a person spends, on an average, about 3 hours per day commuting to and from his place of work and residence. This is the time that could be put to better use as leisure time or work hours. Safety is also an issue because of overcrowding, footboard travel and the like.
Parking space is becoming extremely difficult to find

This is a real nightmare in big cities and sometimes, one has to wait for long periods of time before a slot becomes free. This is time wasted.

Environmental activism is a factor to reckon with in any development plan

The problem of urban transport needs massive investment and will on the part of the concerned authorities. However, environmental factors are not to be ignored and decisions should take into consideration all sections of the population.

India compares very unfavorably with European cities with respect to average speeds in cities

The average speed of urban travel in India is around 20 kmph compared to around at least 30 kmph in London. This difference can be attributed to traffic indiscipline and the condition of roads, among other factors.

Massive investments in rapid transportation is the only solution

Considering all factors, it is obvious that improvement in rapid transportation in cities is the only solution to the urban mobility challenges in India. Measures like imposing utilization tax and tolls will not solve the problem as people can pay their way through.

To give them credit, successive governments have taken the issue seriously and have allotted funds for development of urban infrastructure, including urban transportation. The only solution is to pursue targets with renewed vigour as the problems like population are felt accompli.
Raghavan Sethuraman

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Reshaping Urban Mobility

UITP Senior Adviser Yves Amsler reflects on the role of urban rail in a changing market, and considers how automation and connectivity look set to disrupt traditional models of public transport provision.

Transport is changing. And urban transport, both rail and road, is changing faster and more profoundly than we have ever seen before. Global trends such as urbanisation, technical innovation and the imperatives of tackling climate change are combining to transform the services offered to city dwellers, the way in which transport networks are organised and operated, and the kinds of vehicles that are needed.

Past experience has shown how the emergence of new technologies has shaped the evolution of railways over time, improving the productivity, attractiveness and sustainability of the rail mode. Today, factors such as electrification, automation and the connectivity of people and systems are leading to new concepts of shared mobility, such as Mobility as a Service.

If urban rail modes from metros and suburban railways to trams and light rail are to remain attractive, their role must be clarified. Rail should be the backbone of urban transport networks around which all other modes are articulated. But it will be imperative for rail to offer commercial speeds and capacity that are clearly superior to road alternatives, along with very high levels of reliability, both to justify this priority and to minimise passenger exchange and transfer times.

Electrification as the norm

Electric traction has been a reality in urban rail for a very long time, but now it is set to become the norm. The ability for electric buses to operate without fixed infrastructure has seen off prospects for new trolleybus networks and helped to push the development of catenary-free trams.

However, the electrification of other modes still presents opportunities for rail. Recharging facilities in the city will become increasingly important, as private vehicles, from bicycles to cars, will need access to energy when parked away from their usual base. Railway substations could thus become the anchor points of urban ‘electromobility’, particularly if they can be integrated into multimodal interchanges where the feeder modes connect with rail-based trunk routes.

Radical changes to the structure of operating costs will make energy consumption a much more important parameter in the economic comparison between modes, as well as influencing vehicle design. In order to improve off-peak frequencies while saving energy, it will be necessary to adjust train lengths by automatic coupling and uncoupling, for example.

Automation reshaping services

Automation looks set to trigger the most profound upheavals in the provision of public transport. Eliminating drivers will reduce operating costs considerably, as staffing is by far the most expensive element today. That will inevitably pose challenges for operators, authorities and unions, and we can be sure that the transition will not be straightforward.

In terms of surface transport, automation will enable ultra-precise guidance of vehicles, which will minimise the physical width of bus lanes and reduce the relative advantage of trams and light rail. It may also facilitate the operation of road vehicles longer than the current permitted maximum of 24.5 m. Conversely, smaller and more flexible autonomous vehicles may enable the economical provision of public transport at off-peak times. Once again, the relative advantage of rail over bus will decrease.

Public transport providers will have to adapt the way in which they organise their operations. Conventional regular services will increasingly be limited to the densest city areas and peak times, while flexible ‘on-demand’ modes will become more common in the outskirts of cities and at quieter times.

The maintenance regime will also change, thanks to continuous monitoring and early detection of equipment failures. Vehicles are already being inspected automatically when they enter or leave a depot.

Personal connectivity

The near universalisation of personal connectivity is opening up new perspectives. Connected urban dwellers are already modifying their consumption of transport, favouring the emerging new providers of on-demand services, both private and shared.

Internet-enabled individual-use (but perhaps no longer ‘private’) vehicles will become more comfortable and easy to use for all types of short and long journeys. Meanwhile, MaaS will facilitate the shared use of vehicles, building on the concepts of carpooling, car- or bike-sharing.

The current reference is Uber, which was initially created to provide individual passenger transport and has now diversified into other services such as home delivery as well as shared services such as Uberpool. Today, private MaaS providers are often seen as benefiting from unfair competition with public transport. But lower operating costs thanks to automation should ensure a more secure role for public transport as part of a global approach to urban mobility.

Taking a leaf from the Uber playbook, automated public transport could be used for freight, from the delivery in passenger vehicles of packages ordered online to the deployment of dedicated vehicles such as a ‘cargo-tram’ or ‘cargo-bus’.

The regulation of MaaS and its coordination with transport providers under public service obligations remain to be clarified. The concept raises many
The safe operation of driverless Metro Trains has mostly been achieved using Communication based Train Control, CBTC.

Secureing priority use for automated metros over individual modes, as all are now regarded as Intelligent Transport Systems.

Today, trams, light rail and buses are largely managed without resorting to metro-type automation, but when all road vehicles are fully automated they will need similar priority over general traffic. However, nothing has been proposed to safeguard the needs of public transport operators, and it seems that in the future there will have to be more sharing of frequencies.

At the same time, the connectivity needs of passengers will increase exponentially in the coming years. Passenger data exchanges will compete for transmission capacity with system-specific data flows, verbal communications between operating staff as well as things like CCTV security feeds. This must all be done without degrading quality or safety.

And operators will have to consider the impact on vehicle design and energy consumption of providing all the onboard facilities demanded by passengers.
Pilot Tram Route foreshadows five-Line Network

Construction of the first line of a comprehensive tram network in the expanding port city of Douala is expected to start in the next few months.

CHRISTIAN DOCHY
Director
Iristone Engineering & Civil Work

Plans to construct a pilot tram line in Cameroon’s principal port city of Douala are awaiting the final go-ahead. Initial works are expected to start during the coming months, now that validation of detailed studies has been completed. As with all major infrastructure projects, the first step will be to move the various public utilities that are located along the line of route.

Negotiations for an operating contract are expected to start shortly. The decision to move to the operational stage of the project follows detailed planning work triggered by the signature on July 29, 2016, of a memorandum of understanding between the government of the Republic of Cameroon, represented by the Minister of Housing & Development, and the Belgian-Turkish group Iristone-Ilci. This provided for the establishment of a network that would eventually consist of five lines totalling 85 km to 100 km, depending on the final choice of route. Possible destinations include the airport and a new administrative zone.

If all goes ahead as planned, the first section of the pilot line could be up and running in 2021-22. Around 1,000 jobs would be created.

The Belgian-Turkish consortium has been working with the local business community to ensure that Cameroon companies are involved in many aspects of the scheme. They will have a role to play in geotechnical work, earthworks, drainage, paving, concrete production and other elements of the project.

Route

This first line will have a length of about 18.5 km, and construction will enable the contractors to gain experience ahead of work to build the other four lines. The line will be built to metre gauge, as in the long term there is a possibility of developing a tram-train network with through running over sections of the national rail network operated by Camrail.

The route starts near the intersection of the N3 and N5 motorways at Bekoko, in the Bonaberi suburb west of Douala, and runs on a northwest-to-southeast alignment to terminate in the city near the intersection of Boulevard de la Réunification with Avenue Japonaise, known as Carrefour Agip. A large park-and-ride terminal will be established at Bekoko.

From the N3 to the junction with Rue de l’École Publique, the alignment will be double-track through the left side of the road looking towards Douala. On this section ballasted track consisting of Type 49 E1 flat bottomed rails will be laid on concrete sleepers. Level crossings will make use of Strail components, with Type 54 G2 grooved rails through the crossings.

Roughly at the midway point of the line in the Bonassama district, west of the Wouri River, the alignment will change to two single tracks. Trams bound for Douala will run south of the N3 and those travelling out from the city will use a track north of the N3 along Rue de l’École Publique.

The two tracks converge again in Bonassama on the west bank of the River Wouri before crossing the waterway on an old road bridge, which was superseded by a new structure that opened last year. The new bridge has six lanes and space for two main line rail tracks for Camrail services, only one of which has been laid so far. A tram stop with park-and-ride facilities will be built just west of the old Wouri bridge.

A considerable amount of work will be required on the old bridge to ensure it is fit to carry trams. Built in the 1950s, it is structurally sound, but the infrastructure will need cleaning and underlying vegetation will need to be removed from some of the piers. Repairs will need to be made to piers 1 and 4, both of which have suffered damage. Similarly, the paintwork and protective coating and the various joints will need to be treated or replaced.

Bus feeders

South of the N3, on the banks of the Wouri River, there is a very active industrial zone. This will be served by buses that will connect with the tram service, allowing employees and other workers living elsewhere in the Douala conurbation to have good access to the industrial zone.

Once on the east side of the River Wouri, the double-track alignment will continue along Boulevard de la Réunification to Carrefour Agip. Here the city terminus will be established and interchange provided with bus rapid transit services. Over this section of the route plans envisage the use of Type 54 G2 grooved rails laid on concrete sleepers.

The alignment passes close to the busy Deido roundabout, and provision will be made here for the alignment to cross one of the other planned tram lines. Stops along the route in the central area will include one to serve Camrail’s Bessegoué station and another convenient for the city’s stadium, the Stade Omnisport de Bépanda.

Stops will be located about 500 m to 600 m apart, except along the northern section close to the N3 between the point where the line crosses the Camrail route to Kumba and the Bekoko terminus. Here the distance between stops will be increased to around 800 m.

Stops will generally have a platform on each side of the double track, but there will be island platforms along Boulevard de la Réunification in order to avoid occupying too much of the road. All stops will allow easy access for people with reduced mobility or those with pushchairs or prams.

Each major junction will be equipped with traffic lights and signals giving priority to trams. Similarly, pedestrian crossings with traffic lights will be installed at the stops. The principles of the traffic control system have been defined and agreed with Siemens, which would be responsible for design and manufacture of the equipment.

Railway systems

The main contractor has approached Voestalpine and Vossloh Cogifer as suppliers of track and related equipment.
Martin Rose, who is employed by Camrail, is expected to obtain the contract for tracklaying. Point motors for the main route and the depot areas are to be supplied by Hanning & Kahl. Furrer+Frey has been solicited as the supplier of the 750 V DC catenary.

The consortium is planning to acquire 42 vehicles, each around 44 m long. The fleet will be kept secure in a maintenance and depot area that includes a main hall and a dedicated maintenance building. The site and its facilities will be large enough to cater for storage and maintenance of rolling stock for two other lines, thereby making the most of investment in expensive equipment such as an underfloor wheel lathe and vehicle lifting plant. Equipment for the workshop would be provided through the Belgian firm Buhllmann who will work with VAB to supply signalling in the depot area. A two-aspect signalling system with speed supervision if needed will be installed along the pilot route.

One of the most difficult problems to solve is ensuring a reliable supply of electricity for traction and other services. In recent months Cameroon has experienced a number of power supply problems, and the solution devised by the Belgian-Turkish consortium in collaboration with Siemens is to build a 65 MW gas turbine power plant in the industrial area of Bonabéri located south of the N3. This would provide enough power for normal operations with some reserve available for use at peak hours; any surplus could be fed into the national grid serving the city of Douala.

High-voltage cables (15 kV AC) will connect the power plant to the national grid and to the various substations that will supply the trams with traction power at 750 V DC. There will be 11 portable substations supplied by ABB, including two close to each end of the line. The depot and maintenance area will have its own substation that will be independent from the running line. The substations will all be prefabricated and delivered in containers so that they can be easily installed in a limited space.
Openings and Approvals hit Indian Headlines

The pace of Indian metro development picked up at the start of 2019, with openings and approvals coming thick and fast.

Progress with Indian metro projects can sometimes feel slow, especially compared with countries like China. This was not the case, however, in the first few months of 2019. As well as metro openings, several project approvals made the news.

Nagpur inaugurated its first metro line on March 8. The 11.8 km first phase runs between Sitabuldi in the north and Khapri in the south via the airport, serving 11 stations. The 7.1 km northern section is elevated and the rest of the route is at-grade. Sitabuldi will be the interchange with the future 18.6 km east-west metro line, which would serve 19 stations between Prajapati Nagar and Bansi Nagar.

CRRC Dalian has supplied a fleet of 23 three-car trainsets to operate on both lines under an Rs8.51bn order placed in March 2017 that also includes 10 years of maintenance and staff training.

The stainless steel bodied 25 kV 50 Hz trainsets have a maximum speed of 80 km/h and a crush load capacity of 974 passengers. Siemens has supplied CBTC signalling.

Prime Minister Narendra Modi laid the foundation stone for the metro in August 2014, and test running started in October 2017 using two Hyundai Rotem trainsets on loan from the Hyderabad metro.

The north-south route is due to be extended at both ends in December. A northern extension from Sitabuldi to Automotive Square would add 6.7 km and seven stations, while a 1.2 km southern extension would take the line to Metro City and add two stations.

Plans for the second phase were formally adopted by the Maharashtra state government on January 8, and the Detailed Project Report submitted to the national government for endorsement.

Expected to take four years to build, Phase 2 would add a further 48.3 km of elevated route and 35 stations to the initial two lines. The state has also approved a Rs112bn funding package for the second phase.

Phase 2 would see five new sections added. The existing north-south line would be extended north by 13 km from Automotive Square to Kanhan, adding 12 stations, and south for 18.5 km from Milan to the Bhatibori industrial estate with 10 stations. The east-west line would be extended east by 3.5 km from Prajapati Nagar to Transport Nagar in the Mahulgaon district, adding three stations. In the west, the line would continue for 6.7 km from Lokmanya Nagar to Hingya, with seven stations, while a 4.5 km branch would diverge northwards from Vasudev Nagar to Lata Walli, serving three stations.

The first 6.5 km section of the Ahmedabad metro was inaugurated on March 4. The network is being developed by the Gujarat Metro Rail Corp, a special purpose vehicle established in 2014 by the national and state governments.
to develop a metro network for the neighbouring cities of Ahmedabad and Ghandinagar. Construction of the first phase began in 2015 and is expected to be completed by 2023. The Rs107bn cost is being supported by an Rs60bn soft loan from Japan International Co-operation Agency.

The first phase includes two routes in Ahmedabad which intersect at Old High Court. The 21.2 km east-west Line 1 with 17 stations will run from Vastral Gam to Thaltej Gam, including 6.5 km underground through the city centre. The 18.9 km north-south Line 2 with 15 stations linking the Motera cricket stadium to APMC in Gyanpur will be elevated throughout.

The first section to open was the elevated eastern part of Line 1, between Vastral Gam and Apparel Park, serving six stations. Hyundai Rotem is supplying a fleet of three-car trains which will be based at two depots: Apparel Park on Line 1 and Gyanpur on Line 2.

The second phase of the metro was formally approved by the national government on February 19. This will see the network expanded to Ghandinagar at an estimated cost of Rs53.8bn. Line 2 is to be extended north by 22.8 km from Motera Stadium to the Mahatma Mandir conference centre, while a 5.4 km branch will serve the Ghandinagar National Law University and the Gujarat International Fin-Tech City on the east bank of the Sabarmati River.

**Capital region**

The 29.7 km Aqua Line metro serving the Noida and Greater Noida districts to the east of Delhi was formally inaugurated on January 25.

Authorised by the state government in October 2014 at an estimated cost of Rs50.6bn, the line has been developed by the Noida Metro Rail Corp special purpose vehicle. The state and national governments each contributed 20% of the cost, with the remainder raised from external sources. Running from Sector 71 to Depot, the Aqua Line serves 15 stations in Noida and six in Greater Noida. Interchange with the Delhi Metro Blue Line is provided at Sector 71, which is around 300 m walk from Sector 52 station on Line 3.

The line is operated by a fleet of 19 four-car trainsets supplied by CRRC. These can carry around 1,000 passengers, and have wheelchair spaces in both driving vehicles. A consortium of Ansaldo STS and ZTE has supplied the signalling, train control and telecoms, offering ATO over CBTC using the technology adopted for Wenzhou Line S1 (p15).

On December 4 the Greater Noida Industrial Development Authority formally approved the 15 km second phase of the project, which will see the line extended east from Sector 71 and then south to Knowledge Park V in Greater Noida. Serving nine more stations, the extension is expected to cost Rs26bn to build.

Prime Minister Narendra Modi officially inaugurated two metro extensions in Delhi on March 8, ahead of their entry into passenger service the following day.

Line 1, also known as the Red Line, has been extended by 9.6 km east from Dilsad Garden to Shaheed Sthal/New Bus Adda, serving eight new stations. Line 1 thus becomes the first line of the Delhi metro network to serve the city of Ghaziabad in the neighbouring state of Uttar Pradesh.

Line 3 has been extended by 6.7 km on an elevated alignment between Noida City Centre and Noida Electronic City. This adds a further six stations to the southeastern branch of the Blue Line.

Opening of the two extensions takes the total length of the Delhi metro network to 373 km, serving 271 stations.

Of this, 59.5 km is located in Uttar Pradesh, with lines 1, 3 and 4 serving Ghaziabad, Vaishali and Noida.

The openings followed that of the next phase of the driverless Line 7, also known as the Pink Line, on December 31. The 9.7 km section between Lajpat Nagar and Mayur Vihar Pocket 1 with three underground and two elevated stations was the fourth section of Line 7 to open, and came two months after the Shiv Vihar–Trilokpuri Sanjay Lake section was inaugurated. Line 7 will eventually form a 58.4 km U-shaped route from Mukundpur to Shiv Vihar.

**Hyderabad and Mumbai**

The western section of Hyderabad metro Line 3 entered service on March 20. The route from Anmeerpet to Hitech City extends the initial section of Line 3, which was inaugurated on November 28 2017 between Anmeerpet and Nagole.

The Hitech City extension forms part of Phase 1. When complete, the metro will form a 72 km network including Line 3 and two north–south lines. Line 1 opened in two phases in November 2017 and September 2018, but Line 2 is yet to open.

The second phase of the Mumbai monorail opened on March 3. The 11.3 km Phase 2 runs from Wadala to Sant Gadge Maharaj Chowk, and is an extension of the 8.3 km Phase 1 from Chembur to Wadala which opened in 2014.

Services operate from 06.00 to 22.00, with a journey time of 30 min for the entire 19.5 km route with 17 stations.

Construction of the monorail has been undertaken by a joint venture of Larsen & Toubro and Scimi Engineering, which supplied the air-conditioned four-car straddle trainsets with a capacity of 560 passengers and a maximum speed of 80 km/h. In December Mumbai Metropolitan Region Development Authority terminated the joint
venture’s PPP concession to develop and operate the route and took operations in-house.

**Uttar Pradesh Metro Rail Corp**

Completion of the 23 km Phase 1-A of the Lucknow Metro was marked on March 8, when Modi ceremonially flagged off an inaugural train using remote video-conferencing. Passenger services were scheduled to start the following day.

The initial 8.5 km between Transport Nagar and Charbagh with eight stations opened in September 2017. The line has now been extended 2.6 km south to Charan Singh International Airport and 12.6 km north to Munshipula, completing the priority phase of the project, which has 19 stations on a 19.4 km elevated alignment and three on an 3.4 km underground section. Tunnelling was undertaken by Tata Projects.

In 2015 Lucknow Metro Rail Corp awarded Alstom a €150m contract to provide 20 four-car Metropolis trains and CBTC signalling. The 25 kV AC trains were designed in Bangalore and manufactured at the Sri City plant. Alstom’s factories in Bangalore and Saint-Ouen in France supplied the Urbanis 400 CBTC, with the line switching over in January from manual driving with ATP to GoA2 attended ATO.

The line is intended to be the first of a network which is being planned with the aim of increasing public transport use from 10% to 27% of the city’s population of 3 million people, reducing traffic, cutting journey times and helping to lower emissions.

The European Investment Bank provided a €450m long-term loan to support the project. Project promoter Lucknow Metro Rail Corp is now to be restructured as the Uttar Pradesh Metro Rail Corp, which will be responsible for developing metro projects in other cities in the state including Agra and Kanpur. Both of these were recently approved by the national cabinet.

As well serving one of the largest cities in Uttar Pradesh, the two-line Agra Metro will serve tourist destinations including the Taj Mahal and Agra Fort. Completion is planned in five years at an estimated cost of Rs83.8bn.

Line 1 would run for 14 km from Sikandra to Taj East Gate, with six elevated and seven underground stations serving destinations including the Taj Mahal, Agra Fort, Raja Ki Mandi station and the medical college. Line 2 would run 15.4 km from Agra Cantt to Kalindi Vihar, with 14 elevated stations serving Agra Cantt, Collectorate, Sanjay Place and several densely populated residential areas.

The project will be financed by the national and state governments and through soft loans from bilateral and multilateral international funding agencies. The state government has allocated Rs1.75bn for the 2019-20 financial year.

Two lines have been authorised for Kanpur, with construction expected to take five years. One would run for 23.8 km from the Indian Institute of Technology Kanpur to Naubasta, with 14 elevated and eight underground stations. This line would run through the city centre, serving IIT Kanpur, CSJM University and GSYM Medical College as well as Jharkarabi bus station and Kanpur Central railway station.

The second line would run 8.6 km from Agriculture University to Barra-8, with four elevated and four underground stations. This would improve connectivity in densely populated residential areas including Kakadeo and Govind Nagar.

The estimated cost of the project is Rs110.8bn, which is to be financed by the national and state governments on an equal equity basis and through soft loans from international funding agencies. The state government has already allocated Rs1.75bn for the project in the 2019-20 financial year.

In both Agra and Kanpur, non-fare revenue would come from rental and advertising as well as value capture from transit-oriented development and the transfer of development rights.
METRO NEWSLETTERS

on

“URBAN MOBILITY AS A SERVICE”

PUBLIC MULTIMODAL URBAN, SUBURBAN AND
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WITH METRO-BUS, LIGHT-RAIL, TRAM-TRAIN,
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MAGLEV AND HOVERCRAFT TRANSIT/PEOPLE
MOVER, WATER-METRO, AUTONOMOUS
PEOPLE-MOVER

TRANSPORTATION AND ECONOMIC
DEVELOPMENT IN MODERN URBAN/MEGAPOLIS
ENVIRONMENT

METRO Newsletter by Dr. F.A. Wingler
METRO 69, May 2019

Bombardier INNOVIA APM Centre Rail guided and Rubber tired
Autonomous People Mover on Roll-Guideway, Shanghai
Diesel-electric Hybrid AC Bus and proposed Ropeway; Bandra Kurla Complex gets a Gold Coin; India

**Bandra Kurla Complex**, known to most people as BKC, the new financial hub of Mumbai, and also the site of the Make in India Centre recently, has got a bonus Gold Coin in terms of transport.

Tata Starbus has bagged an order for its new Diesel-Electric Hybrid AC Bus from the MMRDA. These buses will be operated by BEST as part of their fleet, thus complementing their existing AC fleet.

Tata Motors bags order for 25 Tata Starbus Diesel Electric Hybrid Bus from the MMRDA. Image copyright Tata Motors.

As per a notification on MMRDA’s website, these buses will be owned by MMRDA, maintained by Tata Motors for a period of five years and operated by BEST. Further, they will operate in dedicated bus lanes within BKC, connecting the District to Bandra Railway Station, Kurla Railway Station and Sion Railway Station.
These buses are set to be a game changer. The reasons being:

- They are Hybrid buses, that too, Electric Hybrid. The hype that the bus can generate is enough to get people flowing in and once that is in motion, can be sustained easily. **The hype generated when BMTC got its BYD Electric Bus was what made it so successful.**
- Tata has always delivered on the design front, right from their first Starbus Model that was introduced in 2004, **which is now used on the Fort Pheri route.** Unlike Volvo’s new Hybrid bus, which looks like a regular Volvo, this looks different, and good design is the first step to getting more crowd.

**Now coming to Kurla and Sion Stations:**

Sion station is set to get a massive makeover. The road bridge connecting Dharavi /LBS Marg to Rani Laxmi Chowk that houses the entrance to the station is set to be demolished to make way for the Fifth and Sixth railway lines connecting Ghatkopar to CST. This means that the station entrance will be shifted, and is good news in the long run.

Kurla Station [West] is the proposed site for MMRDA for the Station Area Transit Improvement Scheme [SATIS], which will see an elevated platform for buses and autos, similar to the structure at Thane Station West.

The new buses will mostly be housed at BEST’s newest depot, the Kala Killa Depot [KK] which was earlier an empty plot adjacent to the Dharavi Depot where buses of the Kurla Depot were parked during its reconstruction. The depot became operational on 31st January 2016.

Another major project for BKC is a **ROPEWAY.** After CIDCO proposed a ropeway between Vashi and Kopar Khairane and Vashi and Ghatkopar, the MMRDA has now proposed a new ropeway connecting Kurla and BKC. The ropeway has been considered on this route given the congestion and taking land availability as well.

Another update on this stretch is from the Mumbai Metro Rail Corporation Limited [MMRCL].

Amidst all controversy and outrage from Environmentalists and the National Green Tribunal [NGT], the latter of which has failed to do its duty and rakes up controversy needlessly, the MMRCL has silently been doing a good job in acquiring land for the underground Metro which will connect Colaba, Cuffee Parade, BKC Mumbai International Airport and SEEPZ.

**PART II: ACTIVITIES FOR URBAN MOBILITY AS A SERVICE**

**INTERNATIONAL**
Integrated Multimodal Urban, Suburban and Interurban Public Transport

ALCATEL-LUCENT ENTERPRISE • FAST FORWARD: INTEGRATED AND MULTIMODAL TRANSPORTATION FOR THE 21ST CENTURY24; International

Trends in the transportation industry are set to disrupt the way we travel forever, while new technology moves us toward a multimodal transportation system, that will create a fully connected experience for passengers. The technology to create seamless or connected multimodal transportation exists, but the majority of services are still being delivered to the end customer in a disconnected, piecemeal way. For example, a journey from A to B might involve switching from a bus to a train and then a ferry, with tickets purchased for each separate stage from the different operators providing the transportation. In order to improve services and keep up with the huge growth in numbers of people travelling throughout the world, we need to look at new ways to streamline services for travellers and simplify the provision of services for operators.

TRANSPORTATION 4.0 from ALCATEL explained all things point to a future, that lies in multimodal transportation, where different forms of transportation are integrated into a single passenger interaction to arrange complete door-to-door travel. Imagine buying one ticket to get you on a metro, bus, people mover, train, to the airport and straight to the hotel – where your luggage will be waiting for you. The aim is to make travel experiences more efficient, safer, greener, with less hassle, while optimizing journey times, and minimizing costs for travellers. We are just now starting to see how this future might develop, and with it, the potential to completely transform travel as we know it.
A GLIMPSE INTO THE FUTURE

**Multimodal Transportation** will completely transform the way we travel. The technology is already here, enabled by open APIs that offer a single mobile application providing “**Mobility as a Service**” rather than having to purchase tickets across different modes of transportation. Indoor location-based applications are being deployed that collect intelligence on user behaviours giving way to a new level of precise contextual awareness to enable personalized services. And finally, modern multimedia communication, that mix bots with people can match the richness of passenger needs and maintain the much needed personal touch. But the groundwork of network and systems that connect it all together must be installed now if we are to take full advantage of **Seamless Travel**. This means having a secure and reliable network that keeps passengers and operators connected no matter what mode of transportation they choose.

**Welcome to the Future of Urban Mobility; Siemens Mobility; Germany**

As the trend toward urbanization accelerates worldwide, cities need solutions for some of their most pressing demands: The need to transport growing numbers of people in an efficient, reliable, safe and sustainable way. Therefore intelligent and comprehensive urban mobility concepts and seamless integrated and intermodal solutions are becoming increasingly important.

Siemens Mobility has the extensive expertise and experience to deliver digital innovations that increasingly cross-link the “complete mobility system”. Under the slogan “Shaping connected mobility,” we will showcase those pioneering solutions at this year’s UITP Summit – solutions that guarantee availability, make trains and infrastructures intelligent, increase value sustainably over the entire lifecycle, and improve passenger comfort and travel experience.

Welcome to StockholmUIT Summit and welcome to the Future of Urban Mobility.

**MOBILITY AS A SERVICE (MaaS)/INTEGRATED TRANSPORT (IT):**
Discussion paper offering the perspective of Polis member cities and regions on Mobility as a Service (MaaS).

4 September 2017

Editor: Suzanne Hoadley on behalf of the Polis Traffic Efficiency & Mobility Working Group

Polis, Rue du Trone 98, 1050 Brussels, Belgium www.polisnetwork.eu
WHY PREPARE A DISCUSSION PAPER ON MAAS?

“Mobility-as-a-Service”, MaaS, has been marketed as a new transport concept, that may change or disrupt current models of transport provision, particularly in urban areas. The concept of MaaS claims to offer a personal mobility package based on lifestyle needs and delivered through an Integrated Transport, IT, model.

Discussion of MaaS, driven partly by business and technology priorities, is beginning to have an impact on policy thinking, including at EU level. It is important that city and regional authorities, who play a key role in regulating and/or providing transport services, contribute to this debate. Polis members believe that a key factor in sustainable urban mobility is effective integration of planning and services.

To the extent that new mobility services are developed by the private sector, Polis members would like to ensure that these are developed collaboratively with local and transport authorities and support city and regional transport priorities and policies.

The purpose of this paper therefore is to:

I. gain clarity on what is MaaS, promote awareness among local and regional authorities and determine the best role for them in the MaaS environment,

II. discuss the views of local and regional government on MaaS to ensure the debate is not entirely business- or technology-driven,

III. promote integration of new and traditional mobility services with city and regional transport policies, notably the principles of multi-modality and active travel and the key objective of modal shift,

IV. encourage more communication and greater cooperation between new mobility service providers and local and regional authorities

The paper is specifically targeted at:

I. City and regional authorities, to support them in reflecting on how they could approach the introduction of MaaS in their own area

II. New mobility service/MaaS provider, to make them aware of the views of transport authorities and the need for partnership working to ensure MaaS delivers benefit for all rather than the few

III. National and European author
ities, to inform their policies and funding programmes related to Maas.

Polis members would like to ensure that new mobility services are developed collaboratively, and support city and regional transport priorities and policies.
1. BACKGROUND

The role of local government in managing transport is multi-faceted. This role differs across the EU but involves some or all of: policy formulation (local transport policy/strategy); setting transport rules and regulations (to meet the local or national transport policy, such as access restrictions, parking zones, public transport or more liveable cities); transport service delivery through in-house or contracted services (public transport, public bike schemes, travel information), as well as operational aspects (traffic management).

Advances in technology and changes in customer expectations mean that this role must continue to evolve. For example, travel information services can now be provided by satellite navigation companies and through Smartphone apps, a trend that is likely to grow in view of greater availability of open data and new EC rules1. Another example is the new shared mobility service area, particularly car-sharing, in which the private sector is playing an active role, including vehicle manufacturers.

Transport authorities generally support working in partnership with the private sector to develop better outcomes for customers, especially for journeys (low demand) and population groups (elderly and disabled) that cannot be easily accommodated by traditional public transport. There may therefore be opportunities for authorities to work with the private transport market to deliver new transport solutions for users that fill a service gap and support the city’s wider sustainable transport policy goals (e.g. ridesharing that complements the existing public transport network).

2. POLIS AND MAAS

Polis has observed that attention given to MaaS at European level and national level in some Member States is not necessarily replicated at local/regional level. While a few Polis members are engaging in projects involving new mobility services, others are not actively considering new approaches. Nonetheless, where there is awareness of the development of new mobility services, there is acknowledgement that these could play a role in reducing car use/ownership and improving access to the full range of available transport services. Except for a few city authorities, there is a perception that the involvement of local and regional government in MaaS activities has been limited. The same could be said about the public transport sector. MaaS has largely been driven forward by digital and ITS industries and the personal transport sectors of car-sharing and taxis. The role of the wider public transport sector appears to have been minimised, which is a major issue for city and regional authorities as mass transit is the backbone of mobility. This
lack of involvement and understanding of key stakeholders may go somewhere towards explaining why MaaS commercial integrators have indicated a key challenge of MaaS will be developing commercial agreements with public transport operators.

Transport authorities support working with the private sector, especially to offer better journeys that cannot be easily accommodated by traditional public transport.

There has been limited involvement of local and regional government and the public transport sector in MaaS developments to date.

1 Commission delegated regulation (EU) 2015/962 and proposed delegated regulation C(2017) 3574, 31/5/17
3. TOWARDS A COMMON MaaS VISION

It has become clear that there is no one definition of **MaaS**. It has become a general term to describe many different things. Some define it in terms of the few MaaS apps in operation today, in other words as an online platform for accessing (planning, booking and paying for) a tailored package of public and private transport services. Others use it to denote a wider vision for shared mobility. Whereas others still use it more liberally to describe a transport service (such as car-sharing, ride-hailing or cycle hire), an integrated traveller information service (eg, a trip planner) or an integrated transport payment scheme (such as a Smartcard). Since many of these services exist already in many cities, in some cases for many decades, it begs the question what is MaaS and why is it so different to what we have already? Polis members have attempted to shed some light on this.

One model of MaaS seeks to offer the:

- Integration of commercial transport services (taxis, car-sharing schemes and car hire companies) into a mobility offer – currently most integrated traveller information services and payment systems are restricted to public sector-supported services, such as public transport.

- Personalisation of the mobility offer to meet the travellers’ needs.

- Private sector delivery of functions traditionally sitting with local transport authorities and/or contracted bodies, particularly information and payment related to public transport services

This third-party model of MaaS requires:

- Transport services: without trains, buses, trams, taxis, car-sharing clubs, etc, MaaS cannot happen. These services are operating without MaaS but MaaS could potentially influence their shape and form in the future

- Open access to data about the transport services: this could include service routes, passenger counts, distance travelled, schedules, real-time information and (likely to be more sensitive) fare data

- Commercial agreements, potentially entrusting the selling of transport services to a third party. Existing transport operators may be cautious about this.

- Users: demonstrating to potential users
that a MaaS offer provides something new and advantageous compared with existing service provision.

However, this approach seems to assume that there is little current integration of services and that the best way to address this is through the creation of a market of third-party (private sector) integration platforms. This may be the case in certain circumstances but is unlikely to be a workable model where considerable integration already exists. In any case, the overriding public policy priority is to reduce the environmental impact of transport, increase safety, while keeping people moving and supporting economic growth. The creation of new markets or promotion of certain technologies is only to be supported if they contribute to these priorities.
goals. To this end, a balanced governance model with public sector leadership should be sought to ensure an equitable and sustainable transport system.

An alternative model will see some cities and regions using the MaaS concept to develop a systems approach to transport planning and service delivery. By leveraging local authority partnerships with transport operators and defining the parameters and objectives of a MaaS system, some transport authorities and local/regional government organisations are aiming to create a single, integrated MaaS offer featuring a range of transport choices including traditional public transport and new mobility services. This approach relies on a clear vision and strategy and could enable cities and regions to develop and improve their travel demand management, dynamic network management and route optimisation of traditional public transport services, along with offering greater flexibility and travelling options to the public. This style of MaaS could see transport authorities and local government organisations delivering an integrated offer themselves or monitoring a MaaS system with some degree of strategic control, ensuring it is accessible, sustainable and meets wider city and regional goals.

4. OPPORTUNITIES OF MAAS

4.1 Promote sustainable Travel

By improving integration of transport systems and services, advocates claim that MaaS could lead to a reduction in car use and/or car ownership. By providing easier access to personal transport services (including car hire companies, car-sharing clubs and taxis) and by facilitating more informed decisions about which mode(s) of travel to use in a certain set of circumstances, it is possible that the need to use or own a car would be reduced.

If access to mobility is easier and use and ownership of a car is less attractive, customers may be more inclined to use public transport and potentially to walk more or use a bicycle (at least to reach a public transport stop), ie, they would use a wider range of transport modes (multimodal) and different modes for a trip (intermodal). Whether, in reality, a customer will actually give up his car will depend on a number of factors, including the price, convenience and comfort of alternative mobility services and whether they are prepared to
change behaviour by, for example, greater use of car hire, car-share clubs and taxis or other shared mobility services.

4.2 Improve efficiency of existing Transport Services and public Resources

For many Polis members, MaaS holds potential to make better use of existing transport services and resources. While traditional public transport services, such as buses, trams and even taxis, are well utilised (even over-subscribed) in city centres during peak times, the same cannot be said for the suburbs and rural areas and for services provided in the early morning or late evening/night-time periods. In these situations of low

If access to mobility is easier, customers will use a wider range of transport modes.
and dispersed demand, the service can be under-utilised and therefore proportionately more costly.

Offering customers access to other types of existing services, such as personal or shared taxis or other forms of demand-responsive transport, could offer a more efficient use of resources. For example, one Scandinavian Polis member is aiming to make the city’s taxi service more efficient, by promoting shared taxis and reducing the high proportion of time the taxis are not actually carrying customers. Another member is using MaaS to foster greater cooperation among the main public transport operators. These offer examples of how public authorities are implementing a MaaS approach, as a solution to a well-defined problem without putting a burden on public budgets.

4.3 Take Advantage of the personalised Approach to develop an inclusive Transport System

The personalised approach of MaaS may offer inspiration for developing sustainable transport solutions for all citizens, especially those who find it difficult to use traditional public transport, such as the elderly and the disabled by easing access to door-to-door transport provision. Mobility provision is not only a fundamental right but also meets social and economic goals – it is widely acknowledged that keeping people active increases their physical and mental well-being. The level of transport service for people with reduced mobility can vary enormously from one area to another: dedicated solutions put in place tend to be organised and subsidised by public authorities or supported by volunteers as “traditional” services (public or private) tend to be too costly. Personalised services for vulnerable categories of society could fill the gap and improve access to mobility.

4.4 Enhance Access to Transport Services

While many cities and regions have some form of integrated travel information and payment schemes or they are working towards this, these rarely include the full range of mobility services available in a city. Many other towns and regions have very poor or no such platforms. MaaS has the potential to make service provision more accessible. Furthermore, some Polis members agreed that the private sector may be able to deliver a more attractive platform for providing information on or access to transport services, just as some Smartphone app developers today are delivering better travel information.
services than public authorities, often using public sector data.

Given the different circumstances in different cities and regions, it seems unlikely that a single MaaS model would be universally applicable. Cities and regions engaging with the MaaS concept need to have a clear strategic vision of how they intend to develop. This vision can be used to guide MaaS systems and improve collaborative partnerships with transport operators and private MaaS organisations, to ensure a MaaS system fits with policies and wider goals.

Personalised services for vulnerable groups of society could improve access to mobility.

The diversity of Europe’s cities and regions make it unlikely that a single MaaS model would be universally applicable.
4.5 Offer Choice to Users

With the possibility to include any type of transport provider (public or private), MaaS has the potential to provide easier access to a wider range of services, thus offering the user greater choice and potentially the most affordable trip for the purpose. If designed in the right way, this type of service also has the potential to reduce environmental impacts and provide customised mobility options and better accessibility to people with disabilities or reduced mobility. Cities and regions utilising the MaaS concept will need to engage with operators and communities to ensure new mobility services are accessible and inclusive. They will want to avoid a situation where a MaaS offer only addresses the most profitable part of the market leading to a two-tiered approach to mobility, with some areas having considerably better transport provision than others.

5. THE RISKS OF A PURELY COMMERCIAL APPROACH TO MaaS

5.1 Dis-incentivise sustainable Trips

The previous chapter highlighted the opportunity for MaaS to promote more sustainable travel, notably by reducing private car use and ownership. There is risk that the opposite may happen, that there is a shift from public transport to individual modes (taxis, car-sharing, etc) and from active modes (walking, cycling) to motorised modes (mass transit or individual modes). The success in some markets of new services, including apps for private-hire vehicles and ride-sharing, clearly has the potential to disrupt existing urban mobility services and could also encourage a shift towards car use away from more sustainable modes.

The predominance of individual modes and the poor visibility given to public transport in current MaaS discussions and developments is a cause for concern. Ultimately, user modal choice will depend on how the MaaS system is designed and how services are priced and promoted. For instance, in one current MaaS structure if a subscriber does not use all the trips, notably the taxi or car-sharing trips, that are part of a monthly package, these are carried over to the next month. Without this option, the user may be inclined to make unnecessary motorised trips to avoid losing them.
5.2 Higher Costs for the User or the Transport Provider and unequal Services

In case of commercial Megaservices, the operator will need to receive payment for the services delivered. Who will ultimately bear the cost for these services remains to be defined: will it be the customer or will it be the transport provider, such as the bus or tram operator? Both cases are of concern to transport authorities, who ensure that public transport fares remain low (often through subsidy) to keep them affordable and to make public transport an attractive travel option. Or can MaaS take advantage of other revenue streams, such as advertising, which is already commonplace in the digital sector? Additionally, it may happen that MaaS further increases inequality, for instance, where new MaaS services offer...
premium levels of service to those who pay more (such as priority seats and boarding, or faster and safer connections).

5.3 Create a Disconnect between the User, the Transport Provider and the Transport Authority

Transport authorities have invested substantial time and public money in recent years to improve the quality of public transport services and to encourage citizens to use public transport. Part of this effort has involved creating a relationship between the user and the public transport operator, for instance creating a single branding for several transport modes, as is the case in a number of cities. It may be that established public transport operators would be reluctant to participate in a system which required an intermediary between the transport provider and the transport user if they believed that their relationship with the customer and their brand image would be weakened. The digitalisation of transport services may create an additional disconnect for those who are less tech-savvy, leading to the widening of the so-called digital gap.

6. KEY ISSUES

6.1 Defining the best Role for the Transport Authority in the MaaS Environment

Should it be an enabler, a leader or let the market develop unimpeded? These are the questions that transport authorities are asking themselves. To date, commercial MaaS developments have tended to happen with little public authority involvement. However, there is a growing recognition that if MaaS is to take off, there has to be stronger collaboration between the public and private sector. While some commercial MaaS operators hold the view that MaaS should not be led by the public sector, some transport authorities are taking the lead in setting this up within their city or region, recognising that by being the provider or overall controller of a MaaS system, the benefits can be utilised in a greater number of areas, including data analytics and schedule optimisation, and the system will have a greater chance of supporting wider goals and objectives.

Whatever the nature of the MaaS service introduced in a city or region, there is a need for the public sector to oversee these developments, notably to monitor the performance.
of this service with respect to quality, affordability, access and inclusiveness.

6.2 Finding the right public-private Sector Balance for Transport Service: Planning/Booking/Payment

This is a fundamental issue for transport authorities as it touches on core functions that they typically use for strategic purposes, such as integrated payment systems (e.g., Smartcards) or trip planning to make travelling on public transport more seamless and therefore easier. A shift of some functions from the public to private sector is already happening through open data policies for instance, which is seeing all sorts of static and dynamic transport data made available to app developers, including the Should the transport authority be an enabler, a leader or let the MaaS market develop unimpeded?
release of APIs for journey planning and even public transport fares in some rare instances. Allowing third parties to sell tickets represents a paradigm shift for transport authorities and the public transport sector generally and will no doubt require extensive discussions between the parties concerned to ensure key issues such as affordability, access and service levels are guaranteed to the user.

This issue of defining an optimal balance has generated significant debate among elected members of local and regional authorities and highlights that a unique approach to MaaS will need to be taken by any city or region engaging with the concept and considering implementing a MaaS system.

6.3 Understanding the Impact of MaaS on Travel Behaviour

Enthusiasts claim that MaaS can succeed where other initiatives have failed, namely, to persuade people to give up their car. This is a very ambitious goal and one that does not just rely on the presence of a MaaS platform in a city or region, but more importantly on the availability of alternative transport modes (public transport, taxi, etc) and their effective combination. Conversely, as explained in the previous section, there is a fear that MaaS could in fact induce less sustainable travel. Evidence of the impact of MaaS on travel behaviour is therefore needed.

6.4 Creating a Win-Win: Combining the personalised Approach of MaaS with delivering System Benefits

The fact that MaaS is meant to be more personalised offers an opportunity to build a transport system that responds to individual needs, including those with limited transport access, as described in section 5. However, these personalised services must equally respond to wider societal and transport policy goals. Innovations in technology and services have not always given sufficient consideration to overall system impacts, which has slowed down their deployment. One example is the area of cooperative ITS (C-ITS), which is slow to be deployed in cities and regions because the benefits for a city and regional transport authority have not been adequately explored.

6.5 Determining the best market environment for MaaS

In the circumstances where third
party, private sector MaaS platforms are being developed, the value and importance of having an open and multi-player MaaS market cannot be overestimated. Some public transport operators have already voiced concern that in a situation where there is only one MaaS operator, this player could dictate the terms under which the transport provider sells tickets to the operator, e.g., the price and volume. However, a multi-player MaaS environment could potentially become chaotic and confusing for the user, especially for people who are not able to use modern technology (smartphone apps, online banking, etc) today, such as the elderly. Whatever approach is taken, there is a need for the transport authority to have control/oversight of the system. From the European legislative perspective, good market conditions need

Innovations in technology and services have not always given sufficient consideration to overall system impacts.

Whatever MaaS approach is adopted, there is a need for public sector oversight.
to be created and passenger rights safeguarded, particularly regarding issues such as roaming costs and levels of service.

6.6 Understanding the Business Model and who will pay

Some clarity is needed on the business model for MaaS. Insights on this aspect are few and far between, mainly because MaaS is still very much in a piloting phase, i.e., there are very few commercial systems in operation today. This area will require further discussion and review between cities and regional authorities and MaaS related businesses. It is still not clear whether there would be a workable business case for third-party MaaS offers, particularly if the service depended on effective integration of a wide-range of existing public transport and other mobility services.

6.7 Exploring the potential long-term Impact of MaaS on Transport Service Procurement

This is more of a potential long-term effect of MaaS but certainly something that should be monitored as the market develops. In some areas of Europe, there are already movements afoot to move away from the traditional approach of tendering transport service supply (eg, bus routes) towards a more innovative approach based on tendering transport service demand.
7. CONCLUSIONS

I. Cities, regions and local transport providers are in many cases already providing integrated mobility offers, though the scale and coverage of these differs widely across the EU. Policy makers at EU and national level should take this into account.

II. Polis members should actively consider how new mobility services might affect traditional public transport provision in their areas.

III. Where new mobility services do develop, the policy environment (at EU, national or local level) should ensure these contribute to sustainable mobility goals, for example by being complementary to public transport provision and the encouragement of active modes (walking and cycling), ie, truly intermodal trips.

IV. Whether it makes sense to encourage development of third-party private MaaS platforms will depend on local circumstances and, in particular, on the level of integration of existing services.

V. Further research is necessary to gain greater insight into the potential impact of new mobility services, especially in terms of travel behaviour change, and an understanding of those situations in which such services can deliver greatest and quickest benefit.

VI. City and regional authorities need to be involved in the development of policy around MaaS at EU and national level, through new models of governance and with public sector leadership, to avoid environmental, economic and social dysfunctions.

VII. MaaS should not be regarded as a distinct player from policy; it can only achieve its goals if integrated with other measures such as low emission zones, pedestrianised areas, on-street parking policies, personal/work place mobility management, etc.
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This paper was prepared by the Polis Traffic Efficiency & Mobility Working Group, which brings together Polis members to share experiences and views on a wide range of areas related to ITS and traffic management.


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Mobility Planning Software for smarter Cities; UK

27 May 2019
UK: ‘Mobility is changing fast but transport decision-making is slow and expensive, based on poor data’, believes Robin North, co-founder and CEO of planning software company Immense Simulations.

The company has just raised US$4.6m to support the development of its ‘simulation as a service’ transport modelling platform in a Series A financing round co-led by European investor Amadeus Capital Partners and Japanese technology venture capital firm Global Brain Corp. Further investment came from 31 Ventures, part of the Mitsui Fudosan Group.

Immense was founded in 2016 as a spin-out from the UK government’s Catapult programme. It provides detailed simulations of mobility in cities, to support local authorities and service providers when planning the deployment of new technology and business models including autonomous, connected, shared and electrified transport.

‘Cities need to accommodate growth, improve resilience and serve an ageing population while improving accessibility, air quality and energy consumption’, said North. ‘Operators are facing increasingly low margins and both market and technology disruption, and consumers are expecting an ever more seamless service. This is a large-scale system problem that requires digital transformation to integrate siloed assets and empower effective decision-making.’

Amelia Armour, Principal at Amadeus Capital Partners, said ‘we’ve reached an inflexion point for transport technology, with machine learning and simulation software providing radical new opportunities for planners and providers’.

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‘World’s largest Fleet of Hydrogen Fuel Cell Trains’ ordered; Germany

21 May 2019
GERMANY: Following a European tender, the Fahma rolling stock subsidiary of Rhein-Main Transport Authority RMV has awarded Alstom a contract to supply and support a fleet of 27 fuel cell multiple-units.

‘RMV will have the world's largest fleet of fuel cell trains in passenger service’, said RMV Managing Director Prof Knut Ringat when the order was announced on May 21, adding that it was the largest order that Fahma had placed. ‘After electrically powered trains, electric buses and hydrogen buses, we are now offering our passengers a further opportunity to travel without emissions. This milestone makes me proud and is a giant step towards mobility without pollutants.’

The order is worth around € 500 m, including 25 years of maintenance and the supply of hydrogen which Alstom will undertake in co-operation with Infraserv GmbH & Co Höchst KG.

The refuelling point will be located at the Höchst industrial park. ‘With its existing hydrogen infrastructure, Industriepark Höchst is an ideal filling station location for fuel cell vehicles’, said Dr Joachim Kreysing, Managing Director of Infraserv Höchst. ‘The operation of the hydrogen filling station for trains as a supplement to the tanking facilities for buses and trucks fits in perfectly with our concept’.

The Coradia iLint units are scheduled to be delivered in time for the December 2022 timetable change, replacing diesel vehicles on routes RB11 Frankfurt-Höchst – Bad Soden, RB12 Frankfurt – Königstein, RB15 Frankfurt – Bad Homburg – Brandoberndorf and RB16 Friedrichsdorf – Friedberg. Each unit will have 160 seats, real-time passenger information, free wi-fi and spaces for bicycles, wheelchairs and prams.

Hessen’s Minister of Economics, Energy, Transport & Housing, Tarek Al-Wazir, said fuel cells offered ‘a quickly feasible alternative to expensive electrification’ in the Land, where transport is responsible for a third of greenhouse gas emissions. ‘Steam instead of diesel soot is therefore an exciting approach’, he said. ‘We will continue to actively support the project and make every effort to ensure that the necessary adaptations to the rail infrastructure around the hydrogen filling station in Höchst make rapid progress.’
The Federal Government is covering 40% of the additional cost of the hydrogen units compared to DMUs, and providing support for the hydrogen filling station. ‘The purchase of 27 vehicles is a lighthouse project for fuel cell mobility’, said Enak Ferlemann, Parliamentary State Secretary of Transport & Digital Infrastructure. ‘We hope that many other projects in Germany will follow this example.’

Two Alstom Coradia iLint multiple-units have been in regular service on the Elbe-Weser network in Niedersachsen since September 2018, and a fleet of 14 is expected to be in service between Cuxhaven, Bremerhaven, Bremervörde and Buxtehude from 2021.

Related news

- 20 May 2019 - Shift2Rail study backs fuel cell train development
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- 07 Feb 2019 - IMechE recommends electrification instead of hydrogen trains
- 24 Jan 2019 - Hydrogen train goes on tour
- 10 Dec 2018 - SNCF to run fuel cell train in 2022
- 22 Nov 2018 - Hydrogen train operation planned
- 17 Sep 2018 - Hydrogen multiple-units enter service
- 15 May 2018 - Alstom and Eversholt plan fuel cell EMUs
- 18 Apr 2018 - Hydrogen locomotive on the Liliputbahn
- 20 Mar 2018 - Shift2Rail launches fuel cell research
- 24 Sep 2014 - Fuel cells to power regional trainsets
- 17 Aug 2012 - Hydrogen locomotive demonstrated at Hydrail conference
- 18 Apr 2012 - Fuel cell locomotive trial
- 04 Mar 2010 - Fuel cell testing begins
- 06 Mar 2009 - BNSF explores the fuel cell
- 01 Jan 2008 - Demonstrating the power of hydrogen
- 01 Aug 2005 - Hydrogen offers no alternative to main line electrification

Fahma orders 27 Hydrogen Fuel Cell Trains from Alstom; Germany

21 May 2019 | Railway-News

The Rhein-Main Verkehrsverbund (RMV) Subsidiary Fahma GmbH, which operates the Taunusbahn, has chosen a winner of its Europe-wide tender for 27 fuel cell trains: Alstom. The French rolling stock manufacturer will deliver the Coradia iLint units in time for the timetable change in December 2022. Alstom says this order will give Fahma GmbH the world’s largest fleet of fuel cell trains.
The contract also includes an order for the supply of hydrogen and for the maintenance and provision of reserve capacities for 25 years. Alstom will supply the hydrogen in cooperation with Infraserv GmbH & Co. Höchst KG. The filling station is situated in the Höchst industrial park.

The full value of the contract is 500 million euros (557 million USD), of which Alstom’s share is 360 million euros (401 million USD).

Parliamentary State Secretary of the German Ministry of Transport and Infrastructure, Enak Ferlemann, said:

“The purchase of 27 vehicles is a lighthouse project for fuel cell mobility, about which I’m very pleased. The federal government supports this investment in climate-friendly mobility by assuming 40 percent of the additional vehicle costs incurred in comparison to diesel vehicles, as well as by providing proportional support for the hydrogen filling station. The project can serve as a model for the German transport ministry. We hope that many other projects in Germany will follow this example.”

The 27 hydrogen fuel cell trains will replace the existing fleet of diesel trains on the RB11, RB12, RB15 and RB16 lines.

Tarek Al-Wazir, the Minister of Transport for the German state of Hesse, said:

“On Hesse’s tracks you can still find many diesel vehicles today as overhead lines are missing. Fuel cell traction is therefore a quickly feasible alternative to expensive electrification. In Hessen, transport is responsible for one third of greenhouse gas emissions. Steam instead of diesel soot is therefore an exciting approach. We will continue to actively support the project and make every effort to ensure that the necessary adaptations to the rail infrastructure around the hydrogen filling station in Höchst make rapid progress.”
Hydrogen Refuelling

The hydrogen fuel cells will be refuelled at the Industriepark Höchst in Frankfurt, an “innovative chemical and pharmaceutical site in Europe’s heartland”. It is well situated for access to international transport routes and is home to more than 90 companies, such as Bayer, Sanofi and Celanese.

Dr Joachim Kreysing, Managing Director of Infraserv Höchst, which operates the industrial park, said:

“With its existing hydrogen infrastructure, Industriepark Höchst is an ideal filling station location for fuel-cell vehicles. The operation of the hydrogen filling station for trains as a supplement to the tanking facilities for buses and trucks fits in perfectly with our concept, with which we as an innovative company are further developing our energy supply concepts and are relying on environmentally friendly energy carriers.”

Alstom’s Coradia iLint

The Coradia iLint, which is already in operation elsewhere in Germany, is the first passenger train in the world that uses electrical power from hydrogen fuel cells. The Landesnahverkehrsgesellschaft Niedersachsen began operating Alstom’s hydrogen trains in September 2018 and will operate a total of 14 of them from 2021. This makes RMV the second German operator to adopt the technology. They are locally emission free, with the only by-products being steam and liquid water. Another emissions area where these trains have a positive scoresheet is noise. They produce decibel levels on par with suburban trains.

Dr Jörg Nikutta, Managing Director, Alstom Germany and Austria, said:

“We are very pleased that Alstom’s zero-emission Coradia iLint regional trains will be operated in Hesse in the near future, allowing climate friendly transportation of passengers in the Taunus region. This new success, coupled with Coradia iLint’s previous success, demonstrates how trendsetting and sustainable transportation is already a reality.”
Coradia iLint for RMV

Each of the 27 trains will come with passenger information systems with real-time information monitors. They will have 160 seats per vehicle as well as space for bicycles, wheelchair and prams. Passengers will also benefit from complimentary wifi. Once these 27 trains are in service, capacity on the Taunus subnetwork will rise by up to 40 percent. This is particularly positive for commuters who travel during rush hour.

Prof. Knut Ringat, Managing Director, RMV, said:

“This award sets two records: With the commissioning of the new vehicles in 2022, RMV will have the world’s largest fleet of fuel cell trains in passenger transport and it is the largest order in the history of our subsidiary fahma. After electrically powered trains, electric buses and hydrogen buses, we are now offering our passengers a further opportunity to travel without emissions. This milestone makes me proud and is a giant step towards a mobility without pollutants.”

Ulrich Krebs, District Administrator, Hochtaunuskreis and Deputy Chairman of RMV’s Supervisory Board, said:

“In addition to electrifying the S5 to Usingen, the fuel cell trains offer various advantages for routes that have not yet been electrified. Commuters benefit from more space in the trains and a significantly quieter journey because the engine noise of the vehicles is quieter due to the electric drive. This is also an advantage for the people living near the lines.”

CRRC-Bombardier JV Sign Contract for LRT 19 APMs for Singapore; Singapore

22 May 2019 | Railway-News

In March 2018 Bombardier Transportation signed a contract with Singapore’s Land Transport Authority to upgrade the Bukit-Panjang Light Rapid Transit system.

CRRC Puzhen Bombardier Transportation Systems Co., Ltd (PBTS), a joint venture established by CRRC Nanjing Puzhen Ltd and Bombardier Transportation, has now signed a contract with Bombardier Transportation for the Bukit-Panjang Light Rapid Transit project, which is a subcontract of the original contract signed in March 2018.

PBTS’s Scope of this Contract is as follows:

CRRC Puzhen Bombardier Transportation Systems Co., Ltd (PBTS), has signed a contract to deliver 19 INNOVIA APM 300R cars to the Bukit-Panjang Light Rapid Transit Guideway in Singapore. The JV will also deal with train commissioning and quality assurance. Manufacturing will take place at the PBTS site in Wuhu, in China’s Anhui province (southeast).
The current Rolling stock: Bombardier INNOVIA APM 100 Singapore, a Predecessor of the APM 300 © Bombardier – a Rubber tired Roll-Monorail-Guideway People Mover

PBTS will deliver the automated Rubber tired Roll-Guideway People Movers from September 2020 to October 2022, as set out in the contract. The Monorail guided LRT System in Singapore currently uses INNOVIA APM 100 rolling stock, which this new order will replace. The first INNOVIA APM 300R is expected to enter service in December 2022.

Bukit Panjang LRT Line

The light rapid transit guideway in Singapore is 7.6 km long. The elevated system opened in 1999. It is electrified via 600V AC third rail power. The system owner is the Land Transport Authority, but the operator is SMRT Light Rail. Two of the stations on the system connect to Singapore’s metro network.
INNOVIA APM 300R

There have been three generations of INNOVIA APMs, the APM 100, the APM 200, and now the APM 300. Each car will have four doors. The units will operate based on Bombardier’s CITYFLO 650 system, a CBTC signalling system.

Also read:

- China: Shenzhen Airport Orders Automated People Mover from Bombardier
- Shanghai’s New Driverless APM System Starts Passenger Service
- Bombardier-CRRC Secure First Monorail Contract in China
- Bombardier to Supply 396 MOVIA Metro Carriages to Singapore

Bombardier wins Contract to upgrade Singapore’s Bukit Panjang Light Rail Transit, LRT, Line; Singapore

March 7, 2018 Berlin Transportation, Press Release

1 of 2: BOMBARDIER INNOVIA APM 100 for Singapore's Bukit Panjang Light Rail Transit Line Upgrade

The Contract includes new vehicles, retrofit for existing vehicles and signalling system upgrade.

New asset replacement contract demonstrates Singapore Land Transport Authority’s confidence in 20-year partnership with Bombardier Transportation.

Rail Technology Leader Bombardier Transportation today announced that it has recently signed an asset replacement contract with Singapore’s Land Transport Authority (LTA). The contract’s scope covers the supply of 19 new BOMBARDIER INNOVIA APM 300 automated people mover cars, the retrofitting of 13 existing BOMBARDIER INNOVIA APM 100 cars, as well as delivering a signalling system upgrade for 14 stops on
the Bukit Panjang Light Rail Transit (LRT) Line. The contract is valued at approximately 344 million SGD ($262 million US, 211 million euro).

Commenting on the contract award, Jayaram Naidu, Vice President of Southeast Asia, Bombardier Transportation, said, “As a world-leading rail supplier, Bombardier adds value for its customers and this latest contract shows the trust LTA has in us and further deepens our long-term presence in this important market. Bombardier started delivering INNOVIA APM 100s for Bukit Panjang Line in 1999 and we are ready to continue meeting Singapore’s mobility needs with our high-performance rail vehicles, signalling systems and integrated fleet support.”

Since 2012, Bombardier has delivered 276 driverless BOMBARDIER MOVIA Metro cars for Singapore’s Downtown Line in addition to 13 driverless INNOVIA APM 100 cars for the Bukit Panjang LRT. Singapore’s Mass Rapid Transit (MRT) and LRT networks have a combined ridership of over three million passengers daily and LTA is seeking to strengthen the country’s rail infrastructure with the target to expand the rail network to 360km by 2030.

Bombardier has over 40 years of experience in designing, building, operating and maintaining automated transit systems for airports and cities globally providing exceptional route flexibility, while maintaining an unprecedented track record for reliability and dependability. In addition, our advanced CITYFLO 650 solution, chosen for over 40 lines across the world, covers the full range of automatic train control technology, as well as supporting our driverless automated people mover and monorail systems. The system can be expanded within short delivery times, and with minimum disruption to suit the operator’s growing requirements.

**About Bombardier Transportation**

Bombardier Transportation is a global leader in rail technology and offers the broadest portfolio in the industry. It covers the full spectrum of rail solutions, ranging from trains to sub-systems and signalling. The company also provides complete transport systems, e-mobility technology and maintenance services. As an innovation driver, Bombardier Transportation continuously breaks new ground in sustainable mobility. It provides integrated solutions that create substantial benefits for operators, passengers and the environment. Headquartered in Berlin, Germany, Bombardier Transportation employs around 39,850 people and its products and services operate in over 60 countries.

**About Bombardier**

With over 69,500 employees across four business segments, Bombardier is a global leader in the transportation industry, creating innovative and game-changing planes and trains. Our products and services provide world-class transportation experiences that set new standards in passenger comfort, energy efficiency, reliability and safety.

Headquartered in Montreal, Canada, Bombardier has production and engineering sites in 28 countries across the segments of Transportation, Business Aircraft, Commercial Aircraft and Aerostructures and Engineering Services. Bombardier shares are traded on the Toronto Stock Exchange (BBD). In the fiscal year ended December 31, 2017, Bombardier posted revenues of $16.2 billion US. News and information are available at bombardier.com or follow us on Twitter @Bombardier.
Light Rail Safety Standards Board appointed; UK

24 May 2019

**UK: The Light Rail Safety Standards Board** has been established to facilitate more effective co-operation across the tram sector.

Allocated £1.5m of government funding, it will build on work undertaken by the safety steering group that was established by the UK Tram industry group following a derailment at Sandilands in Croydon which killed seven passengers.

The creation of a safety board was one of 15 recommendations made by the Rail Accident Investigation Branch when it published its report into the November 2016 derailment.

‘Since the publication of a detailed report into the accident a great deal of work has already been undertaken to address the issues it raised’, said LRSSB Chief Executive Peter Cushing on May 23. ‘LRSSB is now well placed to take these efforts to the next level. Light rail is already one of the safest forms of public transport and we intend to help the industry improve its standards even further.’

The non-executive board comprises West Midlands Metro Director Phil Hewitt, who is LRSSB Interim Chairman; Bob Morris, Chief Operating Officer for Transport for Greater Manchester; Carl Williams, Director of Operations at Midland Metro Ltd; Jonathan Fox, Director, Rail & Sponsored Services at Transport for London – who led TfL’s response to the Croydon derailment; and David Nicholls, HSQE Director at KeolisAmey Metrolink.
‘The broad experience and expertise offered by the new board members will help ensure a joined-up approach to light rail safety that will deliver significant benefits for operators and the travelling public alike’, said Hewitt. ‘Our clear aim is to draw on the experiences of light rail operators in the UK and, indeed, across the world to ensure we can continue to raise the bar in terms of best practice.’

Related News

- 15 Jan 2019 - UK tram operators study automatic braking systems
- 07 Dec 2017 - 15 recommendations in Croydon Tramlink derailment report
- 02 Jun 2017 - Tramlink automated tram speed monitoring systems sought
- 16 Nov 2016 - Excessive speed caused Croydon tram derailment

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Sydney opens Australia’s first Metro Line; Australia

May 28, 2019
Written by Mark Carter

THE $A 8.3bn ($US 5.7bn) first stage of the Sydney Metro Northwest metro line between Tallawong and Chatswood opened on May 26, with around 140,000 people experiencing free travel for the day on the new service.
Epping Station on the new Sydney Metro Northwest Line; Photo: Paul Hogan

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May 28, 2019 |

Not only is this Australia’s first metro line it is also the first automated passenger operation in Australia to use driverless trains. In addition, the 13 stations on the line are the first in Australia to be equipped with platform screen doors.

Much of the newly-constructed 23km rail line between Tallawong and Epping is underground with 15.5km in twin tunnels between Bella Vista and Epping, and 4.4km on a continuous viaduct between Kellyville and Rouse Hill. At Epping the new line has been extended to include the former Sydney Trains 13km Epping – Chatswood rail line which has been converted for driverless metro operation.

The Northwest Rapid Transit Consortium (NRT), comprising MTR, John Holland, Leighton Contractors, UGL Rail Services and Plenary Group, previously won the $A 3.7bn public-private partnership (PPP) contract to supply trains and systems, which includes a 15-year operation and management contract. The fleet comprises 22 six-car Alstom Metropolis EMUs which are fitted with Alstom’s Urbalis 400 CBTC system. The line is electrified at 1.5kV DC overhead.
Macquarie University Station on the Epping – Chatsworth Section, which has been upgraded for Metro Operation. Photo: Paul Hogan

Chatswood will be the major interchange between Sydney Metro Northwest metro line and the Sydney Trains commuter rail network for access to the city centre until stage two, the Metro Sydney City & Southwest line, opens in 2024. Construction of the $A 12.5bn 30km line is well underway. Two more metro lines are planned to serve the second Sydney airport at Badgery’s Creek and the western suburbs out to Parramatta.

A full report on the Sydney metro will appear in the June issue of IRJ.

For more information on metro projects around the world, subscribe to IRJ Pro.

Categories: News
Tags: AlstomAustraliaMTRSydneySydney MetroSydney Trains

Scomi Rail ordered to wind up; Malaysia

10 May 2019
MALAYSIA: The High Court ordered the winding-up of monorail manufacturer Scomi Rail on May 6.

The order follows Scomi Rail defaulting on debts to Maybank and Voyage Logistics International (Malaysia). The property of the Scomi Engineering subsidiary, which had a net book value of just under 507m ringgit on March 31 2018, is being managed by Adam Primus Abdullah of accountancy firm Adamprimus, who Maybank appointed as receiver of Scomi Rail on May 9.

Scomi Group does not intend to contest the order, and does expect the winding-up of its subsidiary to have any significant financial or operational impact for the current financial year.

Related News

- 28 May 2019 - Bombardier Transportation selected for Cairo monorail contract
- 19 Dec 2018 - Mumbai monorail operating contract terminated

Bombardier chosen as Contractor for Cairo Monorail Projects; Egypt

May 28, 2019
Written by Kevin Smith

EGYPT’s Ministry of Transport has selected a consortium of Bombardier and Egyptian companies Orascom Construction and Arab Contractors as preferred bidder for two monorail projects in Cairo.
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A 54 km line will connect New Administrative City with East Cairo while the second 42 km line will connect 6th October City with Giza. Together the two monorail projects could be worth up to €3bn.

**Bombardier** will be responsible for the design and build contract and says its share of the deal is worth €1.2bn. The company also has a 15+15-year operations and maintenance contract with a potential value of around €1.1bn. The supplier says the monorail trains will be designed and built in Derby, Britain.

Negotiations over the schedule for delivering the Cairo project will now take place ahead of the award of the contract.

If negotiations with the chosen consortium fail, the ministry will turn to a Chinese consortium to deliver the project.

Categories: AfricaMetrosNews
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METRO NEWSLETTERS

on

“URBAN MOBILITY AS A SERVICE”

PUBLIC MULTIMODAL URBAN, SUBURBAN AND INTERURBAN PASSENGER TRANSIT SYSTEMS WITH METRO-BUS, LIGHT-RAIL, TRAM-TRAIN, METRO-RAIL, METRO-TRAIN, REGIONAL RAPID TRANSIT, COMMUTER-RAIL, ROPE-WAY/TRAIN, MAGLEV AND HOVERCRAFT TRANSIT/PEOPLE MOVER, WATER-METRO, AUTONOMOUS PEOPLE-MOVER

TRANSPORTATION AND ECONOMIC DEVELOPMENTS IN MODERN URBAN/MEGAPOLIS ENVIRONMENT

METRO Newsletter by Dr. F.A. Wingler
METRO 70, June 2019

Next Generation Train
PART I: ACTIVITIES AND INITIATIVES FOR URBAN MOBILITY AS A SERVICE IN INDIA

Opinion: System Assurance & RAMS (Reliability, Availability, Maintainability and Safety); India

It is truly interdisciplinary in nature since failures are not limited to any particular types of engineering systems, processes and services

By Dr. Ajeet Kumar Pandey; L & T Technical Service

29/11/2018

In the present scenario of global competition RAMS (Reliability, Availability, Maintainability and Safety) Engineering plays a vital role in design, maintenance,
safety/security and management of engineering systems. Reliability is considered one of the most important performance assessment index for most of the industrial products, processes and services. It focuses on systematic study and analysis of failures and developing methods for eliminating them or at least minimizing their occurrence with minimum damage to system and environment. It is truly interdisciplinary in nature since failures are not limited to any particular types of engineering systems, processes and services. It is in effect a specialization sought by all engineering practitioners and researchers.

In Railways, the RAMS Engineering and Management can be applied to all Railway Systems and plays an important role at different stages of product life cycle starting from conceptual design, manufacturing, operation, maintenance, replacements to disposal. It systematically designs, studies failure process, finds out the root causes, suggests improvements and quantifies the product performance over a period of its mission time in contrast to the conventional engineering practices, which mainly focus on design of systems for certain specific functional requirements.

Reliability, Availability, Maintainability and Safety (RAMS) have developed as a new Engineering discipline in the recent past. This has evolved and grown in mostly Aviation and Defence Laboratories because the performance in those fields had to be totally dependable and utmost safe. Metro-Railways in urban areas need similar high standard of reliability and safety. European Commission has issued EN 50126-1999, updated in the year 2017 for specifying and demonstrating RAMS targets achievement for Railway applications.

Compliance to international Standards is demanded today for every railway systems; for signalling it is compulsory. There are many globally accepted standards around the world such as IEC, EN, AREMA, along with some country specific standards. We are currently in the process of converting (harmonizing) European railways standards into international standards, and one of those is the RAMS standard.

Exclusive Interview with Shri Kumar Keshav, Managing Director, Lucknow Metro Rail Corporation - Fastest ever Metro Project Execution, that has ever happened in India; India

May 31, 2019 Interviews
Managing Director, Lucknow Metro Rail Corporation

Shri Kumar Keshav, an IRSE (Indian Railway Service of Engineers) officer and a gold-medallist engineer from IIT-Kanpur (M.Tech) and IIT-Roorkee (B.E.), took over as Managing Director of the company on 18th August, 2014. As Director (Projects & Planning) at Delhi Metro Rail Corporation (DMRC), he is credited with successfully completing and commissioning various projects in Delhi Metro.

As regards the Lucknow Metro Project, it is a dream which is being realised by him. Lucknow Metro is a dream project of the people of Uttar Pradesh, which is being executed by Metro engineers under the leadership of Shri Kumar Keshav. Work for this project is going-on day and night without any break with the Managing Director leaving no stone unturned to see that the 8.5 km priority Metro corridor is commissioned for trial runs on 1st December, 2016 in just two years and two month period which is a record in itself, thereby achieving the distinction of being the fastest ever Metro project execution, that has ever happened in the Country as stated by ‘Metro Man’ Dr. E. Sreedharan.

Rail Analysis: Please tell us about the Future Corridors and your upcoming stretch of Lucknow Metro Rail Corporation?

Shri Kumar Keshav : The LMRC has made operational the 22.878-km-long stretch of NorthSouth corridor (Phase 1A) at Lucknow from CCS Airport to Munsipulia much ahead of the initial deadline of April 2019. Now we are focusing on Kanpur Metro and Agra Metro which are approved by the Central Government. We have submitted the revised DPR of Lucknow Metro (East-West corridor) to the government of Uttar Pradesh and it is yet to be approved. The 11.098 km long East-West Corridor at Lucknow which will connect from Charbagh to Vasant Kunj. The corridor will have 12 stations – Charbagh, Gautam Buddha Marg, Aminabad, Pandeya Ganj, Lucknow City Railway Station, Medical Chauraha, Nawabganj, Thakurganj, Balaganj, Sarfarazganj, Musa bagh and Vasant Kunj.
Rail Analysis: What is the Role of LMRC in Meerut Metro, Agra Metro and other Metro Projects in the State?

Shri Kumar Keshav: LMRC is now a role model for other Metros that shall be coming up in the city of Kanpur, Agra, Varanasi, Allahabad, Gorakhpur and Meerut in near future. Lucknow Metro has now ushered a revolution in bringing Mass Rapid Transit System in important cities of Uttar Pradesh. The Govt. of U.P. had nominated LMRC as a agency for implementation of various metro projects in Uttar Pradesh and Kanpur and Agra Metro Projects is already approved by the Central Government and other Metro Project are in process.

Transit-oriented Development (TOD) in Lucknow Metro

Rail Analysis: Please tell us more about Transit-oriented Development (TOD) in Lucknow Metro?
Shri Kumar Keshav: Transit-oriented development helps in creating a sustainable and inclusive system by providing easy access to resources and opportunities. An integrated rail system having seamless integration with other mass public transports is a key to this. Further, support by feeder buses and easy walking or cycling connections are also desired. The North-South corridor (Phase 1A) has been connected to the airport, railway station and bus station while the East-West corridor will extend the connectivity to the other parts of the Lucknow City.

Rail Analysis: How much Budget was allocated to LMRC and how do you Plan to spend it?

Shri Kumar Keshav: According to the Detailed Project Report (DPR), the completion cost of the 23 km long Lucknow Metro’s Phase 1A (North – South Corridor) was expected at Rs 6,880 crore. This cost was funded by equity contributions from the Central Govt. and the State Govt. in equal proportions with an external loan of Rs. 3,502 crore from the European Investment Bank (EIB).

Till now, LMRC has received Rs 6,851.80 crore from the Government for completing the Phase 1A (North – South Corridor). These fund was used judiciously for completing the project in the city.

We have been able to complete the project in a record time ahead of schedule and well within sanctioned cost.

Rail Analysis: Please inform us about your Initiatives for Last Mile Connectivity?

Shri Kumar Keshav: Last mile connectivity is one of the top priorities and in this direction we have been working with state authorities. We are in process to sign MoU with Urban Mass Transit Company (UMTC) and UBER Company to meet the demand from Metro commuters for feeder services across the city. LMRC has also planned to hire E-rickshaws as feeder services because of their benefits to the environment. We have also
been providing parking facilities at most of the stations in order to provide people with park and ride facility.

LMRC ties up with HDFC Bank to provide Passengers with GoSmart Card

Rail Analysis: Any other Initiative of LMRC, that you would like to share with us?

Shri Kumar Keshav: We have recently tied up with HDFC Bank to provide our passengers with GoSmart Card. The HDFC Bank facility has enabled customers of all banks to purchase metro tokens and prepaid cards easily by making it cashless. With the tie-up, the LMRC has made it convenient for commuters to purchase token, reload prepaid GoSmart cards using any debit card, credit card, or net banking facility, on the website of Lucknow Metro. Passengers using the GoSmart cards are getting facilities like free WiFi, hassle-free travel as well as freedom from standing in queues with online recharge facility.

Lucknow Metro joined hands with Lucknow Municipal Corporation for providing the payment facility to the GoSmart card users through which passengers can use their “GoSmart Card” to make payments for the property tax at ticket counters (TOMs). Same kind of MoU had also signed between LMRC and BSNL for facilitation of customer services where the GoSmart card of Lucknow Metro shall be used for the payment of BSNL post-paid mobile bills along with the purchase of pre-paid products at the Ticket Office Machine (TOM) counters at all the Metro stations.

Rail Analysis: Lastly, Congratulations for winning the Award at Rail Analysis Innovation and Excellence Summit 2019. What are your Views and Feedback about the same?
Shri Kumar Keshav: It’s an honour not only to the whole team of LMRC, our General Consultants, Contractors, Vendors and the construction work-force in implementing this world-class infrastructure project in a record time, it is pride for the people of Lucknow. The LMRC is a new metro system in India and it has achieved national as well as international recognition in a very short span of time. Awards like these foster a sense of pride and responsibility besides encouraging the company to go for new challenges and initiatives.

Winning the Award at Rail Analysis Innovation and Excellence Summit 2019

Pune Metro aiming to be inaugurated in December 2019; India

June 3, 2019 Rail News

Pune Metro is moving quickly on its 11km stretch to meet December as its Target for Inauguration.

More Information
• The 11 km stretch includes 6 km from PCMC to Bopodi and 5 km from Vanaz to Garware College.
• Presently, the stretch from PCMC to Bopodi is 45 per cent complete & the foundation of 317 of the 456 pillars is complete.
• The work on Anandngar and Garware college stations is being undertaken on priority.
• Soon after civil work is completed, the Pune Metro will begin laying the rails.

About Pune Metro:

• Pune Metro is a metro rail based rapid transit system under construction to serve Pune Central.
• The length of the system is 31.25 km.
• The number of stations it has: 30 stations.
• Pune metro rail is one of the most ambitious project undertaken to transform Pune city transport.
• Pune metro rail project is executed with the state of the art project management tools such as Primavera, 5D BIM (Building Information Modelling).

Feasibility Report for Nashik Metro is ready - Mass Transit Urban Trams - Hybrid Battery Operation; India

June 3, 2019 Rail News

Metro Projects are rising at a very fast rate. Maha Metro, which is incharge of Pune, Nagpur and Thane Metro, has now prepared the feasibility report for the Nashik Metro.
It has been submitted the report to state govt., CIDCO and Nashik Municipal Corporation for response and the DPR will be prepared accordingly.

More Information

- The project is estimated to cost over Rs 1,800 crore.
- This city project will utilize mass transit urban trams – each carrying up to 80 passengers at a time which will draw power from overhead electric cables.
- The feasibility report was prepared after an extensive three-month survey of the city.
- There will be two corridors:
  - Corridor 1: Length of 18.45 km with 17 stations. It will stretch from Shrimik Nagar to Nashik Road railway station.
  - Corridor 2: Length of 9.45 km with 10 stations. It will be from Gangapur to Mumbai Naka.
- These high-speed trams will also be able to leave the elevated corridors and run on normal city roads for about 25 km under battery power. Once the batteries drain, the trams will return to the elevated corridors to run on electricity.
- Apparently, two major financial institutions from Germany and France have also shown interest in funding the project.

Mumbai Metro Update: Metro-2A & 7 expected to open next Year; India

May 28, 2019 Rail News

Things are moving fast in the City of Mumbai with multiple Metro Lines under Construction.

Lines 2A & 7 are expected to open next year now, more Details:

1) Recently, Chief Minister Devendra Fadnavis on Monday chaired a review meeting of all mega infrastructure projects in the state.

2) It is expected that the Metro-2A and Metro-7 lines will be operational by early 2020.
Metro Line-2A Details:

Construction on the first section of the line, called Metro 2A (between Dahisar and D.N. Road), began in November 2016, and is expected to be completed in 2019.

- Metro Line 2A from Dahisar to D N Nagar is 18.589 km. long elevated corridor with 17 stations.
- It shall provide interconnectivity among the existing Western Express Highway, Western Railway, Metro Line 1 (Ghatkopar to Versova), the ongoing Metro Lines 2B (D N * Nagar to Mandale) & 7 (Andheri (E) to Dahisar (E)) and the proposed Metro Line 6 (Swami Samarth Nagar to Vikhroli).
- It shall facilitate smooth and efficient interchange with the suburban rail system and MRT system at Dahisar and D N Nagar.
- It shall provide connectivity between the Western, Central Mumbai and the Northern suburban Mumbai.
- It shall provide rail based access to the commercial and geographical landmarks in Mumbai.
- It shall reduce the current travel time by anything between 50% and 75% depending on road conditions.

Metro Line-7 Details:

Metro Line 7 from Andheri (E) to Dahisar (E) is 16.475 km. long elevated corridor with 13 stations.

- It shall provide interconnectivity among the existing Western Express Highway, Western Railway, Metro Line 1 (Ghatkopar to Versova), the ongoing Metro Line 2A (Dahisar to D N Nagar) and the proposed Metro Line 6 (Swami Samarth Nagar to Vikhroli).
- It shall facilitate smooth and efficient interchange with the suburban rail system and MRT system at Andheri, JVL R and Dahisar.
- It shall provide connectivity between the Central Mumbai and the Northern suburban Mumbai.
- It shall provide rail based access to the Mumbai International Airport (CSIA), SEEPZ, National Park and other commercial and geographical landmarks.
- Dedicated Depot is planned at Dahisar in an extent of 15 Ha.
- It shall reduce the current travel time by anything between 50% and 75% depending on road conditions.

3) The Assembly elections are scheduled to be held in September-October this year in Mumbai.

4) The CM also directed officials to complete construction of the additional six Metro Lines in Mumbai and Mumbai Metropolitan Region (MMR) by 2022.

5) By 2022, they plan to have a Metro Network of 119 km by completion of Metro Lines which shall be:

- DN Nagar-Mankhurd (Metro-2B)
- Colaba-Bandra-Seaeez (Metro -3)
- Wadala-Ghatkopar-Thane-Kasarvadavali (Metro-4)
- Wadala-GPO (Metro-4B)
- Thane-Bhiwandi-Kalyan (Metro-6)
- Lokhandwala-Vikhroli (Metro-5)
Gurugram (Gurgaon) Metro: Metro line to be extended upto Udyog Vihar; India

May 28, 2019 Rail News

The recent meeting of Gurugram Metropolitan Development Authority in Chandigarh on Monday approved the DPR for metro rail connectivity will stretch from Yellow Line of Delhi Metro and continue further into Gurgugram to Udyog Vihar.

More Details:

1) This corridor will go till the old city and industrial estates across the expressway.

2) The length of the corridor will be 31.11 km with around 25 stations and six interchange stations.

3) The project is expected to cost around Rs 6,000 crore.

4) The new Metro corridor is expected to be commissioned by 2024.

5) The extension will have the following stations:

- Sector 45
- Cyber Park
- Sector 46
- Sector 47
- Sector 48
- Technology Park
- Udyog Vihar Phase 6
- Sector 10
- Sector 37
- Basai
- Sector 9
- Sector 7
- Sector 4
- Sector 5
- Ashok Vihar
This plan will now be sent to the Union government for approval.

**L&T earns World Record by installing 2599 Metro Pillars; India**

*May 27, 2019 Rail News*

Recently, a significant Achievement was done by L&T in Hyderabad Metro, where the Work is now moving at a fast Pace.

**Key Updates:**

1) L&T Metro Rail (Hyderabad) Limited recently achieved a world record by becoming the first company to construct 2,599 metro pillars.

2) This was on the 66-km stretch on which the LTMRHL has erected the 2599th pillar near the Mahatma Gandhi Bus Station (MGBS), exactly 2,599 days after work started on the project in April 2012.

3) With this, the entire project barring a 6-km stretch in Hyderabad’s Old City area, has been completed.

4) Mr Reddy said “Permissions from Defence (took 4 years); Railways (4 years); NH (3 yrs) & innumerable other government organisations; winning over 370 cases in High Court etc. Handling 20 religious structures with patient negotiations in an adroit manner in a communally sensitive Indian city & handling heritage & other sensitive issues – no MIT,
Stanford or Harvard can teach you. One needs to be a dexterous leader & not a bureaucrat/manager to do so,” he said.

5) The MD also said that the process involved translocation of over 2,100 trees and removal of 3,000 trees.

6) He further added that this also includes the compensatory plantation of 6 lakh saplings; besides making the roads wider, widening of culverts and nalas, for smooth flow of traffic during metro construction.

7) The team is set to complete the – Corridor Three (Nagole to Raidurg), about 1.5 km from Raidurg or about 29 km, in all respects by July to put in place normal metro rail operations with better frequency.

8) At present, metro rail services are being run from Nagole to Ameerpet normally and from there to HiTec City, the operations are run on twin tracks since the line up to Raidurg is still under construction and the ‘reversal’ at the HiTec City is under works.

9) Further, Passengers are also getting a new station on the blue line of the Metro tracks in the city. The blue line runs between Nagole and Hitec city at present and in the future, it will be extended till Rayadurgam.

Delhi Metro’s busy Station – Rajiv Chowk Station gets Platform Doors; India

May 30, 2019 Rail News
The Delhi Metro Rail Corporation (DMRC) has finally installed platform screen doors at one of its busiest stations: The Rajiv Chowk station in Connaught Place, that would help in crowd management at interchange stations.

More Information

- The new addition has been made on the Yellow line.
- The platform screen doors are presently operational at Kashmere Gate.
- In 2018, these doors were installed at several metro stations including Chandni Chowk, Chawri Bazar, New Delhi and Central Secretariat.
- The new routes, including the Pink and Magenta lines, have platform screen doors, as does the Airport express line.
- Over the last few years, it has become a social issue to install the PSD on all the stations.
- This is done in order to prevent incidents of commuters falling on tracks.

Utility Investigation Work for Construction of proposed Phase IV Corridor for the Section between Indira Gandhi Domestic Airport Terminal-1 to Saket; India

May 31, 2019 Rail News
Project: **Delhi Metro Phase IV**

Tender Title: Utility Investigation Work for Construction of Proposed Phase IV Corridor For the Section between Indira Gandhi Domestic Airport Terminal-1 to Saket (Tender is Valid till 11th June 2019)

About: DMRC Invites open tender through e-tendering system (i.e. Technical and Financial bid) from eligible applicants for Utility Investigation Work for Construction of Proposed Phase IV Corridor For the Section between Indira Gandhi Domestic Airport Terminal-1 to Saket.

More Details:

The tenders for this contract will be considered only from those tenderers (proprietorship firms, partnerships firms, companies, corporations, consortia or joint ventures) who meet requisite eligibility criteria.

A tenderer shall submit only one bid in the same tendering process, either individually as a tenderer or as a partner of a JV. A tenderer who submits or participates in, more than one bid will cause all of the proposals in which the tenderer has participated to be disqualified.

The brief scope of the work and site information is provided in ITT clause A 1.1 (volume-1)

**Detailed Geotechnical Investigation Work for Underground Section in between Rajiv Chowk to Kherki Daula Toll; India**
Animation of Regional Rapid Transit

**Project**: Regional Rapid Transit System

**Tender Title**: Detailed Geotechnical Investigation work for Underground section in between Rajiv Chowk to Kherki Daula toll (Tender is Valid till 2nd July 2019)

**About**: National Capital Region Transport Corporation Ltd. (NCRTC), a joint venture Company of Government of India and participating States invites open e-bids (Electronic Bid) For Detailed Geotechnical Investigation work for Underground section in between Chainage 32.80 km (Rajiv Chowk) to Chainage 40.8 km (Kherki Daula toll) and in between Chainage 45.5 km to Chainage 49.3 km (in Manesar area) of SKK (Sarai Kale Khan) – SNB (Shahjahanpur-Neemrana-Behror) Regional Rapid Transit System (RRTS) Corridor.

**More Details:**

Bidders are advised to note the eligibility and minimum qualifying criteria specified in the Section 1 “Instruction to Bidders” and Section 3 “Evaluation and Qualification Criteria” stipulated in the bid document.

E-Bids must be accompanied with a bid security in original of requisite amount and validity as stipulated in clause.

A pre-bid meeting will be held at the address mentioned in clause 1.2 (k) of IFB (Bid Schedule) at such date and time as mentioned in clause 1.2 (g) of IFB (Bid Schedule).

NCRTC reserves the right to accept or reject any or all bids any time without assigning any reasons. No bidder shall have any cause of action or claim against the NCRTC for rejection of bids.

Bidders are advised to keep in touch with e-bidding portal for any updates.
Detailed Geotechnical Investigation Work for elevated Section from Dharuhera to Sarai Kale Khan; India

May 28, 2019 Rail News

Project: **Regional Rapid Transit System**

**Tender Title:** Detailed Geotechnical Investigation work for elevated section from Dharuhera to Sarai Kale Khan (Tender is Valid till 2nd July 2019)

**About:** National Capital Region Transport Corporation Ltd. (NCRTC), a joint venture Company of Government of India and participating States invites open e-bids (Electronic Bid) for Detailed Geotechnical Investigation work for elevated section from Chainage 71.00 km (Dharuhera) to Chainage 106.4 (SNB) of SKK (Sarai Kale Khan) – SNB (Shahjahanpur-Neemrana-Behror) Regional Rapid Transit System (RRTS) Corridor.

Bidders are advised to note the eligibility and minimum qualifying criteria specified in the Section 1 “Instruction to Bidders” and Section 3 “Evaluation and Qualification Criteria” stipulated in the bid document.

E-Bids must be accompanied with a bid security in original of requisite amount and validity as stipulated in clause.

NCRTC reserves the right to accept or reject any or all bids any time without assigning any reasons. No bidder shall have any cause of action or claim against the NCRTC for rejection of bids.

Bidders are advised to keep in touch with e-bidding portal for any updates.
PART II: ACTIVITIES FOR URBAN MOBILITY AS A SERVICE; INTERNATIONAL

6th RAILWAY FORUM Berlin 2019 on Digital & Automated: The Future Agenda of the Mobility Industry; Germany

January 21, 2019

6th RAILWAY FORUM Berlin 2019: The future of the Railway Industry is discussed in Berlin

Together with renowned partners from the rail industry and politics, the largest rail conference in Europe in 2019 will take place on the 1st and 2nd of October under the competence partnership of Deutscher Bahn AG.

Digital & Automated: The Future Agenda of the Mobility Industry

The rail industry is changing: a) the digitization progresses and anchors itself deeply in all areas of the system. b) It is followed by the vision of data-driven automation in the rail sector for greater efficiency and customer satisfaction. c) New technologies for vehicles, infrastructure and factories complement the technological revolution. d) In addition to technological development, the increasing European and global competition among producers and operators is causing adjustment in companies. These and further challenges force the rail industry to act and accelerate exchange.

The developments will be discussed at the 6th RAILWAY FORUM Berlin on 01. and 02. October 2019 in Berlin. Patrons and substantive impulses are Uwe Günther, CPO, Deutsche Bahn AG and Rolf Härdi, CTO, Deutsche Bahn AG. At the RAILWAY FORUM Berlin, more than 1,000 decision-makers and specialists from the rail industry meet to
discuss future developments and challenges. The circle of participants consists of railway operators, manufacturers, suppliers in all tier-levels, political decision makers and thought leaders from Germany, Europe and beyond.

– see conference video here –

Selected program highlights include contributions from Dr. Richard Lutz, CEO, Deutsche Bahn AG, Dr. Jörg Nikutta, Managing Director Germany & Austria, Alstom, Dr. Ben Möbius, Managing Director, German Railway Industry Association (VDB), Michael Ziesemer, President, Zentralverband Elektrotechnik- und Elektronikindustrie (ZVEI) and Uwe Günther, Chief Procurement Officer, Deutsche Bahn AG.

– to the conference program –

In addition to the conference, more than 110 exhibitors are expected in the accompanying exhibition. These present innovative solutions for the railway industry of the future. The exhibition area is divided into the areas of a) Vehicle Technology, b) Maintenance &

**Strong Metro Car Growth Forecast for Europe; International**

Jun 3, 2019
Written by David Briginshaw

An annual growth rate of 15% for metro cars is forecast for Europe up to 2023, according to a report on the world metro market published by SCI Verkehr.

Metro car demand is forecast to increase by 3% per annum in Europe up to 2023.

The global market for metro vehicles is expected to continue to grow at the rate of about 3% per annum, despite an already high market volume. Growth in metro car orders is
being fuelled mainly by the need to replace trains nearing the end of their life together with the steady expansion of existing metro networks and the construction of new ones.

According to SCI Verkehr, there were 185 metro systems in operation worldwide last year compared with 159 in 2016, 107 in 2000 and 84 in 1990.

The metro car after-sales market is expected to continue to expand by almost 6% annually due to the continually increasing size of metro train fleets.

**China**

China continues to be the largest market for metro trains with 46% of the global market volume, even though the Chinese metro market is stagnating. Almost 50% of metro cars globally were procured in the last 10 years, particularly in China.

Between 2014 and 2018, CRRC dominated the world market for new metro vehicles and now holds a share of 60%. This compares with the next largest suppliers, Bombardier and Alstom, which each have a 7% market share globally. Although most of CRRC’s metro car production is for Chinese operators, SCI Verkehr says it now has a leading position in Asia, and has won contracts in India, Turkey, and the United States.
Irish Rail seeks up to 600 electric and Battery-electric Vehicles; Ireland

May 29, 2019
Written by Kevin Smith

IRISH Rail (IE) has published a notice in the Official Journal of the European Union and eTenders seeking expressions of interest for a contract to supply up to 600 electric and battery-electric vehicles over 10 years for use as multiple units on commuter services.
The new trains will expand and replace the Dublin Area Rapid Transit (Dart) fleet of 76 trains, which will be nearly 45-years-old at the end of the current National Development plan in 2027. The contract will also provide a framework for further orders if demand warrants and will include a technical service and spare part supply agreement of up to 15 years.

The procurement is supported by Ireland’s National Transport Agency (NTA). IE says the tender is expected to attract the interest of virtually every major train manufacturer such is the scale of the order, which it describes as the largest and greenest fleet order in Irish public transport history.

The trains will be compatible with the 1600mm-gauge Dart network and 1.6kV dc overhead electrification which is set to expanded on the lines to Maynooth, M3 Parkway, Hazelhatch and Drogheda under the Dart Expansion plan, which is part of Project Ireland 2040. The trains will operate in complete and half configuration, with a full length of 160-168m.

IE says the majority of the order will consist of electric rolling stock. However, it says a provision for battery-electric trains will meet surging demand should electrification be pushed back beyond 2024. As well as boosting the Dart fleet capacity, the order will free up Dart DMUs for use on long-distance services.

“The procurement of this fleet is the first step in the delivery of Dart Expansion, a programme that will attract some €2bn in NTA funding in the coming decades,” says Ms Anne Graham, NTA CEO. “The recent Oireachtas Climate Action Committee report recommended that the public transport elements of Project Ireland 2040 be prioritised.

“The Committee called for the speedy delivery of public transport investment to encourage more people to choose sustainable modes and leave the car behind. Today’s announcement represents a significant step in that direction.”

In addition, IE and NTA are progressing with shorter term options to boost fleet capacity and meet record demand on IE’s network – the network carried 47.9 million passengers in 2018.

IE is currently negotiating with suppliers to agree an order for 41 extra inter-city coaches, which will supplement the existing fleet of 234 vehicles from late 2021. NTA is also currently tendering for the possible purchase or lease of used trains, which will require modification for operation on Ireland’s network.

Categories: Commuter RailFinancialFleetNewsRolling stock
Tags: IrelandIrish Rail IEtenders

Alstom delivers first MP16 Rubber tired Metro Train for Lyon; France

29 May 2019 | Railway-News

Alstom has delivered the first MP16 train that will run on Line B of the Lyon Metro. Following its arrival at the La Poudrette depot on 25 April. This train has been put through over five months of testing in Valenciennes. During that time it completed 5,000km. Now,
this first train will commence dynamic testing on the Lyon network at the end of May. These tests will initially take place at night.

New Rubber tired Metro for Lyon Line B © Alstom/Mobylette June

The full order for the Lyon metro, based on a 2016 contract, is for 30 trains. It also comprises Alstom’s automatic train operation solution, which will allow an increase in capacity on the line.

Jean-Baptiste Eyméoud, President, Alstom France, said:

“Alstom is proud to present this first next-generation metro train, which addresses the pressing mobility issues faced by SYTRAL, our customer and long-standing partner. This project will be a showcase for French railway industry expertise.”

MP16 Trains for Lyon Metro Line B

Each of the 30 trains will be 36m long. And each one will have a capacity in excess of 300. These new-generation trains offer an enhanced passenger experience over the earlier MP75 trains. They feature large bay windows, LED lighting and comfortable seats as well as passenger information displays and air-conditioning.

The trains’ wide doors and aisles improve accessibility for passengers with reduced mobility. The design also makes it easier for passengers to move about within the train during their journey.

Environmental considerations have also flowed into the train design. 96 percent of the materials are recyclable. Furthermore, they have a fully electric braking system along with other features, such as LED lighting, that mean the energy consumption of these trains is 25 percent less than that of their predecessors.
Alstom’s CBTC Urbalis 400 Solution

The new rubber-tired MP16 metro trains for Lyon also feature the company’s latest technology that will improve availability and operational flexibility. The Urbalis 400 solution means these trains can operate automatically, without the need for drivers.

New Siemens Mobility Metros for Bangkok Skytrain System; Thailand, Germany

11 Apr 2019 | Josephine Cordero Sapién

Thailand – In August 2018 Siemens Mobility and consortium partner Bozankaya (Turkey) delivered metro trains to Bangkok. The first seven of these metros have now started running on the Bangkok Skytrain (BST), including the Sukhumvit Line extension.

This latest extension to the system opened in December 2018. This 25km extension connects Samut Prakan to the south of the city with Bangkok. The elevated section of the line, meanwhile, begins in Bearing and runs for 13km. The Bangkok Mass Transit System Public Company (BTSC) will now deploy them into full service on the Sukhumvit (Green) Line between Mo Chit Station to Samut Prakan Station.

© www.siemens.com/press
The Siemens-Bozankaya Consortium Contract & Breakdown

Overall, the Siemens-Bozankaya consortium will supply 22 four-car trains. The consortium won the contract in May 2016. Siemens Mobility's contribution comprises the bogies, drive and brake systems and auxiliary services. Siemens Mobility is also responsible for project management, engineering, design and the metros’ commissioning.

The manufacturing facility for these metro trains will be the Bozankaya plant in Turkey's capital, Ankara. The consortium intends to deliver all 22 metro trains by the end of the year. Siemens Mobility meanwhile will service and maintain the trains for 16 years.

As part of the 2016 contract, Siemens Mobility also has other responsibilities. It will, for example, supply the traction power for the Green Line’s extension.

Sabrina Soussan, CEO of Siemens Mobility, said:

“The Skytrain is a very special success story for us: It’s the first public rail transport system in the Thai capital and Siemens Mobility delivered the elevated system as a turnkey project. We've provided full service for the system since its commissioning nearly 20 years ago and will continue to do so until 2029, ensuring that over 99 percent of the existing trains are available daily. With the addition of our new trains, capacity on the Green Line will increase to over one million passengers a day. At the same time, they offer users optimal passenger comfort and convenience.”

Siemens Metro Order Background for the Bangkok Skytrain

Siemens Mobility provided the first metro trains for the skytrain system when it opened in 1999. These metros were three-car trains. In 2010 then the BTSC ordered new cars to extend the existing three-car fleet into four-car trains. This current order for 22 new trains is Siemens Mobility’s third rolling stock order with BTSC.
600 kmph Maglev Prototype unveiled; China
24 May 2019

**CHINA:** Two prototype vehicles intended to support research into a 600 kmph maglev system were unveiled by CRRC Qingdao Sifang on May 23.

The 53 m long locally-developed prototype comprises a driving car and an intermediate vehicle. It has been built as part of a five-year maglev development programme announced by the Ministry of Science & Technology in 2016. Led by CRRC Qingdao Sifang, the project has a total budget of 3.2bn Yuan, of which the government committed 433m Yuan and the remainder is to be raised by CRRC Group.

The programme includes the construction of a 5 km test track in the Qingdao area by 2021, facilitating research into vehicle design, guideway, communications and power supply technologies. Work on the test centre is already underway, and the first facilities are expected to be ready by the end of this year.

According to CRRC Qingdao Sifang's Deputy Chief Engineer Ding Sansan, who is heading up the maglev research and development team, the prototype has already achieved ‘static levitation’. It will be used ‘to optimise the key technologies and core system components for the high speed maglev system, and form the technological basis for the forthcoming engineering prototype’, she explained.
The five-car engineering prototype trainset is scheduled to roll off the production line in 2020. It will then be put through a comprehensive testing programme, with the integration and verification stages due to be completed in 2021.

**China has already developed a low-speed maglev line, which is operating in commercial service as a feeder to the Beijing metro network.** As part of the government-initiated programme, CRRC Zhuzhou Electric Corp is leading research into a 'medium speed' variant suitable for 200 kmph applications.

**Bentley Systems announces the Availability of OpenBuildings Station Designer; International**

*May 21, 2019 Press Release*

*Bentley Systems*, Incorporated, the leading global provider of comprehensive software and digital twins services for advancing the design, construction, and operations of infrastructure, today announced the general availability of **OpenBuildings Station Designer**, a new multidisciplinary application for the design, analysis, visualization, and simulation of new or operating rail, metro or other transit stations. Advancing beyond generic BIM applications, **OpenBuildings Station Designer** was developed specifically for rail and transit station modeling, with asset-specific content and workflows. **OpenBuildings Station Designer** streamlines and automates design collaboration design between architectural, mechanical, electrical, and structural disciplines sharing modeling, clash resolution, and documentation capabilities.
OpenBuildings Station Designer streamlines multidisciplinary Design between Architects and mechanical, electrical, and structural Engineers with a shared Set of Modeling, Clash Resolution and Documentation Capabilities.

OpenBuildings Station Designer incorporates LEGION, the industry-leading simulation software, acquired by Bentley late in 2018, for fully modeling pedestrian traffic to optimize footfall, wayfinding, crowd management, safety, and security. With the integrated capability to model and simulate pedestrian scenarios, OpenBuildings Station Designer helps designers to improve the functional use of space, passenger throughput, and the pedestrian experience.

By virtue of Bentley’s open modeling environment, OpenBuildings Station Designer enables iterative digital workflows spanning OpenRail and OpenRoads to assure comprehensive and coordinated engineering modeling of transportation assets and modes. Within Bentley’s OpenRail Connected Data Environment (CDE), the Components Center cloud service contributes to station project quality and integrity through pre-populated digital components which include signaling equipment, escalators, turnstiles, public address systems, signage, kiosks, and more.
OpenBuildings Station Designer incorporates LEGION Model Builder, Bentley's leading Application for fully Modeling Pedestrian Traffic

OpenBuildings Station Designer breaks down barriers among stakeholders and increases the value and fitness-for-purpose of design deliverables through its:

- included LEGION pedestrian simulation;
- integration with OpenRail for rail design;
- integration with OpenRoads for roads design;
- clash resolution;
- multi-discipline documentation;
- ready-to-use catalogs for functional spaces and equipment; and
- enlivened visualizations.

Santanu Das, SVP for Bentley's design integration business unit, said, “OpenBuildings Station Designer reflects our goal of advancing BIM through digital twins, by including within its multi-discipline design scope the integral simulation of pedestrian traffic outcomes. With such insight, the designer can anticipate pedestrian bottlenecks and modify the layout to improve the station efficiency and safety, ultimately improving the passenger experience. Accordingly, we expect OpenBuildings Station Designer to also benefit existing rail and transit stations for renovations and upgrades, increasing their capacity and throughput.”
OpenBuildings Station Designer helps Designers improve the Quality of Station and Facility Design and optimize the functional use of Space and the Pedestrian eXperience

Mike Nicholson, associate for Steer Group, said, “For over a decade Steer has successfully been delivering a wide range of pedestrian modeling studies around the world utilizing LEGION. We are now looking forward to using the full BIM capabilities of OpenBuildings Station Designer.”

More about OpenBuildings Station Designer

About Bentley’s Open Modeling Environment

Sharing digital components through Components Center and connecting automated and iterative digital workflows across disciplines for design integration are the foundation of Bentley’s open modeling environment. Bentley’s open modeling applications are also “open” to analytics and simulation from among Bentley’s portfolio of analysis tools including RAM, STAAD, PLAXIS, LEGION, LEAP, SITEOPS, and AutoPIPE.

Comprising MicroStation-based engineering and BIM applications specialized for asset types and solutions, the open modeling environment advances collaboration, enabling clash resolution and production of multidiscipline deliverables from any application. Bentley’s growing list of open modeling applications include OpenBuildings, OpenPlant, OpenRoads, OpenRail, OpenBridge, OpenSite, OpenFlows, and OpenUtilities.
OpenBuildings Station Designer was developed specifically for Rail and Transit Station Design, with Asset-specific Content and Workflows.

About Bentley Systems

Bentley Systems is the leading global provider of software solutions to engineers, architects, geospatial professionals, constructors, and owner-operators for the design, construction, and operations of infrastructure. Bentley's MicroStation-based engineering and BIM applications, and its digital twin cloud services, advance the project delivery (ProjectWise) and the asset performance (AssetWise) of transportation and other public works, utilities, industrial and resources plants, and commercial and institutional facilities.

Bentley Systems employs more than 3,500 colleagues, generates annual revenues of over $700 million in 170 countries, and has invested more than $1 billion in research, development, and acquisitions since 2014. From inception in 1984, the company has remained majority-owned by its five founding Bentley brothers. Bentley shares transact by invitation on the NASDAQ Private Market. [www.bentley.com](http://www.bentley.com)
RAMS, Reliability, Availability, Maintainability and Safety; International

RAMS in Rail - Functional Safety Edition; Conference 27-29 August 2019 | Hotel Palace Berlin, Germany

2019 Conference Focus:

- Hear smart strategies from leading companies to implement cost-optimized functional safety
- Find out how data can be extracted from and injected into safety-critical systems while warranting data isolation
- Get an in-depth understanding on cyber security newest threats and how to ensure secure safety-critical systems that do not compromise safety
- Ensure EN 50126, EN 50128 and EN 50129 compliance by developing comprehensive standards complexity management
- Discover how the human factor and safety personal views impact on safety management teams when it comes to time-critical decision making
- Discuss with experts on collaborative approaches to E/E hazard identification to save costs and time as early as possible during development cycles

Opinion: System Assurance & RAMS

*It is truly interdisciplinary in nature since failures are not limited to any particular types of engineering systems, processes and services*

By
Dr. Ajeet Kumar Pandey; L & T Technical Service
- 29/11/2018
In the present scenario of global competition RAMS (Reliability, Availability, Maintainability and Safety) Engineering plays a vital role in design, maintenance, safety/security and management of engineering systems. Reliability is considered one of the most important performance assessment index for most of the industrial products, processes and services. It focuses on systematic study and analysis of failures and developing methods for eliminating them or at least minimizing their occurrence with minimum damage to system and environment. It is truly interdisciplinary in nature since failures are not limited to any particular types of engineering systems, processes and services. It is in effect a specialization sought by all engineering practitioners and researchers.

In Railways, the RAMS Engineering and Management can be applied to all Railway Systems and plays an important role at different stages of product life cycle starting from conceptual design, manufacturing, operation, maintenance, replacements to disposal. It systematically designs, studies failure process, finds out the root causes, suggests improvements and quantifies the product performance over a period of its mission time in contrast to the conventional engineering practices, which mainly focus on design of systems for certain specific functional requirements.

Reliability, Availability, Maintainability and Safety (RAMS) have developed as a new Engineering discipline in the recent past. This has evolved and grown in mostly Aviation and Defence Laboratories because the performance in those fields had to be totally dependable and utmost safe. Metro-Railways in urban areas need similar high standard of reliability and safety. European Commission has issued EN 50126-1999, updated in the year 2017 for specifying and demonstrating RAMS targets achievement for Railway applications.

Compliance to international Standards is demanded today for every railway systems; for signaling it is compulsory. There are many globally accepted standards around the world.
such as IEC, EN, AREMA, along with some country specific standards. We are currently in the process of converting (harmonizing) European railways standards into international standards, and one of those is the RAMS standard.
“URBAN MOBILITY AS A SERVICE”

PUBLIC MULTIMODAL URBAN, SUBURBAN AND INTERURBAN PASSENGER TRANSIT SYSTEMS WITH METRO-BUS, LIGHT-RAIL, TRAM-TRAIN, METRO-RAIL, METRO-TRAIN, REGIONAL RAPID TRANSIT, COMMUTER-RAIL, ROPE-WAY/TRAIN, MAGLEV AND HOVERCRAFT TRANSIT/PEOPLE MOVER, WATER-METRO, AUTONOMOUS PEOPLE-MOVER

TRANSPORTATION AND ECONOMIC DEVELOPMENTS IN MODERN URBAN/MEGAPOLIS ENVIRONMENT

METRO Newsletter by Dr. F.A. Wingler
METRO 71, June 2019

Delhi-Meerut Regional Rapid Transport System, RRTS, Station Design; India (Image: Ayesa)
PART I: ACTIVITIES AND INITIATIVES FOR URBAN MOBILITY AS A SERVICE IN INDIA

Delhi Metro Rail Corporation orders 40 additional Bombardier Movia Metro Cars; India

Jun 5, 2019
Written by

**DELHI Metro Rail Corporation (DMRC)** has awarded Bombardier a contract to supply an additional 40 Movia Metro Cars, increasing DMRC’s fleet of Movia Cars from 776 to 816.

Bombardier MOVIA Metro Car arriving onboard of Antonov Air Carrier
The high-capacity vehicles will be equipped with the Mitrac propulsion and control system and Flexx Metro 3000 bogies, which were designed specifically to suit Delhi’s infrastructure.

The vehicles will be configured into eight-car trains, which will each accommodate up to 2960 passengers, providing capacity increases on three of Delhi’s main metro lines.

Categories: AsiaMetrosNews
Tags: BombardierDelhiDelhi MetroIndia

Mumbai Metro celebrates five Years of Dedicated Service; India

In five years Mumbai Metro one has carried Mumbai city population over 40 times with 540 million plus satisfied commuters.

By Narendra Shah
08/06/2019

Metro Trains at the Metro Depot in D N Nagar

MUMBAI (Metro Rail News): Reliance Infrastructure promoted Mumbai Metro One has successfully completed five years of dedicated service to Mumbaikars. Mumbai Metro One is India’s first PPP metro rail project that has carried over 540 million commuters, which is equivalent to transporting Mumbai’s population over 40 times. Entering the MRTS space largely managed by public sector organizations, Mumbai Metro One has already proven to be a case study in the industry.
Highlights

- In five years Mumbai metro one has carried Mumbai city population over 40 times
  With 540 million plus satisfied commuters
- Unmatched on-time performance and train availability of 99.9% across 6.17 lakh trips
- The proud safety record of zero-accident and no-fatality.

With an unwavering focus on operational efficiency, technological innovation, and
customer centricity, Mumbai Metro One has unmatched on-time performance and train
availability of 99.9 percent spread across a staggering 6.17 lakh trips. It has become a
lifeline in the Versova-Andheri-Ghatkopar corridor with a proud record of zero accident and
no fatality.

Being Mumbai’s first Metro, the operator has been able to imbibe the Metro culture among
the commuters and educate people about working of Metro system. MMOPL has been
aptly reciprocated by Mumbaikars who have showered their love, support, appreciation
and sense of belonging on various platforms.

An MMOPL spokesperson said: “We are extremely happy to reach this milestone of
providing delightful customer experience over the course of the last 5 years of our
journey in the Versova-Andheri-Ghatkopar corridor. We appreciate the
overwhelming affection provided to us by Mumbaikars who helped us become a
lifeline in this belt. The people of Mumbai have reciprocated our gesture by quickly
imbibing the Metro culture in this bustling town. We are confident to receive similar
cooperation from the city of Mumbai in the future. We shall continue to serve the
city of Mumbai with the same zeal and dedication for the remaining concession
period of 24 years.”

Ayesa bags 311 Crore Consultancy Contract for Delhi-Meerut RRTS Corridor; India

This new contract is yet another achievement for Ayesa, following the recent signing of a
contract with NCRTC to design four of the elevated stations for this corridor (Sahibabad, Ghaziabad, Guldhar and Duhai) as well as 2 depots.

By
Narendra Shah
- 04/06/
Regional Rapid Transport System DELHI (Metro Rail News): Ayesa, a Spanish multinational which specializes in engineering, technology, and consultancy (ETC), has bagged a 311 crore contract to provide technical assistance (General Consultancy) for India’s first rapid rail line, which will run between Delhi and Meerut.

The company, which is celebrating its tenth anniversary in India this year, has secured this major contract, in consortium with Italferr, for the management and supervision of the entire rail corridor, except for the civil works supervision. As such, it covers all phases from tender and design through to commissioning and initial operating.

The Regional Rapid Transport System (RRTS) is one of the most ambitious projects in the National Capital State Territory of Delhi. Promoted by the National Capital Region Transport Corporation (NCRTC), it will be a real trailblazer in the country, with a design speed of 180 kilometres per hour. The line will allow 82 km to be covered in just 62 minutes, almost half of the current journey time, and will form a semi-high-speed link joining the cities of Delhi, Ghaziabad and Meerut. The aim is to improve the transport system in New Delhi and the Delhi metropolitan area, one of the world’s largest with a population of around 57 million.
Nagpur Metro tests East-West Line; India

30 May 2019

**INDIA: Nagpur Metro** began test running on the westernmost section of its east-west line on May 30, with a trial run attended by Maharashtra Metro Rail Corp Managing Director Brijesh Dixit.

The 5·5 km section from Subhash Nagar to the terminus at Lokmanya Nagar, where the depot is located, will form the outermost section of the 18·6 km line. Skirting the Ambazari Lake, this section includes intermediate stations at Rachana (Ring Road), Vasudev Nagar and Bansi Nagar.

Construction of the 10·4 km elevated ‘Reach 3’ between Lokmanya Nagar and Jhansi Rani Square near the city centre has been underway since December 2016, following the award of civil works contracts to Afcons and ITD Cementation.

This was the second section of the two-line Nagpur Metro to get underway following Reach 1 between Sitabuldi and Khapri. That forms the southern half of the city’s north-south line, and was opened for revenue service on March 8. Interchange between the two routes will be provided at Sitabuldi.

No date has yet been set for opening of the east-west line, although the remaining sections of the north-south line are expected to be ready by December. CRRC Dalian has supplied a fleet of 23 three-car trainsets to operate on both lines.

Related News

- **11 Mar 2019 - First metro line in Nagpur inaugurated**
Mumbai Metro-3 Corridor runs behind Schedule; India

By Narendra Shah
31/05/2019

The Colaba-Bandra-Seepz Metro-3 Corridor is likely to face a further Delay

MUMBAI (Metro Rail News): The Mumbai Metro Rail Corporation (MMRC), which is executing the Metro 3 corridor seeks permission to cut trees in Aarey for construction of Metro Coach depot. Their applications are pending with the Brihanmumbai Municipal Corporation’s (BMC), tree authority, which has not been functional since October 2018 owing to a Bombay high court (HC) stay.

In October 2018, High court restrained the tree authority from taking any decisions on cutting trees until it has independent experts as nominated members in the authority. The BMC has four experts on the authority and 15 corporators. Although In February 2019 the BMC got 37 applications for the tree authority, 32 got rejected.

“The way the BMC called for advertisements was wrong. Candidates are rejected as the civic body put a condition that the experts must be residents of Mumbai. The court has
clearly stated the committee must have an equal number of corporators, who know the city, and experts.” said Zoru Bhathena, a petitioner in the case and activist.

JV Pardeshi, superintendent of gardens, BMC, said close to 70-80 applications are pending since the stay. When asked if the BMC will issue an advertisement to call for experts again, he said, “It will be as per the high court orders.”

The rolling stock for Metro line 3 is expected to be delivered by November 2020 As the MMRC had awarded contracts for the rolling stock of 248 coaches in September 2018.

Also, It will take two years to construct the car depot where the rolling stock will be brought.

According to the source, if the depot is not ready on time, there is a high possibility that the rolling stock will remain at the manufacturing unit. The completion of the project on time is now subject to the car depot. Rolling stock is tested for close to six months before the commercial operations begin.

With legal hurdles, the MMRC had already revised its deadline for phase-1 (Aarey-Bandra Kurla Complex) of the underground corridor from December 2020 to June 2021.

The project has faced numerous hurdles owing to litigation from environmental groups and citizens against the MMRC’s plan to cut trees to build the car depot within Aarey Milk Colony, Mumbai’s green lung.

In addition, an earlier stay by the Bombay high court, disallowing construction work between 10 pm and 6 am, also slowed down construction.

The MMRC had earlier estimated that a delay of one day would cost Rs 4.5 crore to the exchequer.

**Mumbai Metro Line 2A and 7 to be operational by 2020; India**

By
Narendra Shah
29/05/2019

[https://www.metrorailnews.in](https://www.metrorailnews.in)
 Founder and Managing Editor at Metro Rail News - A Symbroj Media Pvt Ltd. Playing Key role in editorial activities & operation.
The CM also directed Officials to complete Construction of the additional six Metro Lines in Mumbai and Mumbai Metropolitan Region (MMR) by 2022

MUMBAI (Metro Rail News): Maharashtra Chief Minister (CM) Shri Devendra Fadnavis on May 29, 2019, chaired a review of all mega infrastructure projects in the state and extended the deadline to early 2020. The 18.6 KM long Mumbai Metro line 2A corridor will connect Dahisar to D.N. Road with an elevated corridor via Link Road and will have 18 stations.

On the other hand, The 16.5 km Mumbai Metro line 7 corridor will connecting Andheri East to Dahisar East via Western Express Highway and will have 16 stations.

S senior official from the chief minister’s office (CMO) said “The two Metros, totally 35.1 km in length, will be operational by early 2020. The total progress on Metro-2A and Metro-7 is 65% and 68% respectively”.

Mumbai Metro line 2A and 7 are expected to cater to 16 lakh commuters in the city. The Mumbai Metropolitan Region Development Authority (MMRDA) has proposed to introduce 10 new rakes for the monorail. Monorail Line 1 was inaugurated by former Maharashtra Chief Minister Prithviraj Chavan on February 1, 2014.

The CM also directed officials to complete construction of the additional six Metro lines in Mumbai and Mumbai Metropolitan Region (MMR) by 2022. “By 2022, we plan to have a Metro network of 119km by completion of Metro lines DN Nagar-Mankhurd (Metro-2B), Colaba-Bandra-Seepz (Metro -3), Wadala-Ghatkopar-Thane-Kasarvadavali (Metro-4), Wadala-GPO (Metro-4B), Thane-Bhiwandi-Kalyan (Metro-6) and Lokhandwala-Vikhroli (Metro-5),” the official said, adding that by 2022, work on 169km of additional Metro lines across the state will start. Officials said the work on MTHL will be completed by 2022-end.

Delhi Metro Phase 4 Commissioning in 2025; India
The Delhi Metro Phase IV Projected its commissioning in 2025, 10 lakh people per day are expected to carry in six proposed corridors of Delhi Metro’s Phase IV and commuting fares will range between Rs 20 and Rs 100.

New Delhi: The projected year of Delhi metro phase 4 commissioning in 2025, This six proposed corridors of Delhi Metro’s Phase 4 are expected to carry over 10 lakh people per day, while the commuting fares will range between Rs 20 and Rs 100.

These projections, which form part of the financial viability segment of the Phase IV Detailed Project Report (DPR) prepared by the Delhi Metro Rail Corporation (DMRC), are being factored in by the Delhi government before approving the project at the next Cabinet meeting. The length of the six corridors will be 104 km.

The Metro’s estimates assume significance in light of the Delhi finance department’s observations that the proposed corridors would not qualify for a high capacity Metro even
in the year 2031 and the bitter spat between the AAP and the DMRC over the 2017 fare hikes.

Also, DMRC had estimated that around 40 lakh commuters will use its network daily after the completion of Phase III. However, its ridership has slid down to 2015 levels and is hovering around 25 lakh per day after a double-phased fare hike in 2017.

The Metro has prepared the Financial Internal Rate of Return (FIRR) of the project assuming that there will be a 14 per cent hike in fares once every two years, considering the increase in the Consumer Price Index and input costs of operations, the report states. Accordingly, it has been assumed that the fare slabs will be Rs 20 for travel of 0-2 km, Rs 30 for 2-5 km, Rs 50 for 5-12 km, Rs 60 for 12-21 km, Rs 80 for 21-32 km and Rs 100 for travels beyond 32 km (after rounding off to Rs 10).

The segment, titled ‘Financing Options, Fare Structure and Financial Viability’, pegs the daily average ridership at 15.50 lakh by the year 2031 and 22.32 lakh by 2041. It’s part of annexures of the draft Cabinet note of the project.

The proposed Rithala-Narela (21.73 km), Tughlakabad-Aerocity (20.20 km) and Inderlok-Indraprastha (12.58 km) corridors, which were declared unviable by the Delhi Finance Department, will carry 1.29 lakh, 1.66 lakh and 2.07 lakh commuters per day in 2025, the report states.

The corresponding ridership in 2031-32 will be 1.77 lakh, 2.55 lakh and 3.17 lakh per day, it added. The DPR puts the deadline of Phase IV completion as December 31, 2024, and expected date of commissioning as January 1, 2025.

According to DMRC estimates, the other three corridors — Lajpat Nagar to Saket G Block (8 km), Janakpuri West to RK Ashram (28.9 km) and Mukundpur to Maujpur (12.55 km) — will register a daily average ridership of 70,000, 3.29 lakh and 1.14 lakh in 2025.

“The traffic growth rate has been assumed at 6 per cent per annum up to 2030-31, 4 per cent per annum up to 2040-41 and thereafter 3 per cent per annum,” the report states.

The Delhi council of ministers is expected to clear the Rs 45,603-crore project next week. The Delhi government’s share will be around Rs 10,465 crore. On Tuesday, the finance department held a meeting with the DMRC and the transport department at the Delhi Secretariat, in which some progress was made towards finalising the Cabinet note, an official said.

PART II: ACTIVITIES FOR URBAN MOBILITY AS A SERVICE; INTERNATIONAL/GLOBAL

Shaping Mobility for Sustainability and Innovation; International
Prof. Dr. Henning Kagermann, Chairman of the Steering Committee of the National Platform Future of Mobility.

COMMENTARY

Mobility affects the day-to-day life of all of us: it is part of our individual freedom and a basis for prosperity and employment. Society as a whole is therefore facing the challenge of developing mobility to make it fit for the future. Far-reaching structural changes in our mobility system are to be expected. We are currently experiencing a change in motivation, an increasing connection between the energy and transport sectors and, above all, a second wave of digitization with a trend towards networking, autonomous systems, digital technology platforms, new business models and services. This creates a challenge for established companies, especially in the automotive sector and the supply industry, but also a great opportunity to simultaneously improve both the quality of the environment and life. If we want to exploit the potential of innovative technologies and to achieve an innovation boost for our economy, an interdisciplinary discussion between business and academic sectors and their cooperation is needed.

The next generations of vehicles will require different components and infrastructures than they use today – it is therefore decisive for a joint success that car manufacturers and suppliers cooperate closely along the entire value chain. Together, reliable framework conditions can be created and innovations can be secured. With the MES Expo, a new platform has been created where electronics suppliers an obtain information on key issues of mobility across all modes of transport and where they can exchange ideas with each other as well as with vehicle manufacturers, policy makers, industry and science. I very much welcome and am delighted that the National Platform Future of Mobility will accompany MES Expo this year as program partner.

Developing the Mobility Market; International

Martin Schmitz
VDV - Verband Deutscher Verkehrsunternehmen e.V.
ETR | Juni 2019 | NR. 6; www.eurailpress.de/etr
The innovation speed of technology development will have a high impact on the mobility market significantly over the next few years. Here are four major technology drivers: e-mobility, digitalisation, networking and automation.

E-mobility will be particularly provided for reasons of efficiency and for reasons of use alternative fuels or regenerative energy driven. From the UN climate agreement laws derived from Paris Regulations on Climate Protection Act, the CVD require investment in new infrastructure. Due to the current development status, indeed a technology-opener approach is helpful, but needs now focused on infrastructure development to capitalize on necessary investments begin. A promotion of energy and turn around in public transport is necessary.

With the help of new technologies new potentials and business models, the digitalization enables an increase in efficiency as well as an improvement of service levels. These chances have the public transport assumed to be potential disruptive and prevent dislocation. The public transport is a pioneer in networking and cooperation with each other and with third parties through data exchange at passenger information, integration of bike and ride sharing and mutual ticket distribution in the building phase.

With the foundation of the Mobility Forum as part of the VDV Annual Meeting, the standardization activities of VDV and the Networking Initiative "Mobility Inside" become a cooperation and networking in the interests of the customer, which further expanded. Mind games about the potentials of the autonomous driving are currently producing many Fantasies. To implement however many tasks, not only technical but especially also operational, ensure passenger safety, the handling of data (use only personified possible and with security systems equipped vehicles) as well as the interaction between persons, who disturb operation, are still to be clarified. These questions are examined in many public transport-operated projects of autonomous driving and have currently high public interest. The industry offers traffic concepts with a lot of potential. For those in the weighting advanced evaluation criteria, such as the reduction of energy consumption and emissions transport, an extension of the supply and the public transport capacity as well as a reduction of the space requirement of traffic in the urban space, the public transport
offers solution concepts. Now are smart adjustments of the framework needed to economy, social and environmental, to match requirements. The public transport industry is involved in the development in all fields of innovation solutions and stands for further developments of **MOBILITY as a RELIABLE PARTNER.**

## Constantine Light Rail Line Extension opens, Algeria; International

Jun. 4, 2019  
Written by David Burroughs

A 6.9 km extension of the light rail line in Constantine, Algeria, was opened on June 3, adding five new stations to the line.

![Constantine Light Rail Line Extension](image)

**Algiers Metro Company (EMA)** awarded a consortium of Alstom, Isolux Corsan and Algerian construction company Cosider a turnkey contract in July 2015 to build a 10.3km extension to the line, with the first section connecting the existing Zouaghi station to the entrance of the new city of Ali Mendjeli.

Constantine’s single 8.1 km line from Benabdelmalek to Zouaghi was inaugurated in July 2013, and currently transports around 30,000 passengers per day.

As consortium leader, Alstom is providing the integrated system, track, catenary, telecommunication and signalling systems, substations and ticketing equipment.

The Annaba rolling stock assembly plant operated by Cital, a joint venture 41% owned by Ferrovial, 10% by EMA, 6% by Alstom Algeria and 43% by Alstom Transport, is supplying 24 new LRVs for the line, which will operate alongside the 20 LRVs already operating.

Categories: AfricaLight RailNews  
Tags: AlgeriaAlstomConstantine
FRANCE: RATP has awarded three framework contracts to Alstom, Heuliez Bus and Bolloré for the supply of up to 800 12 m long electric buses.

Each of the orders, which are being financed by Île-de-France Mobilités, is worth up to €133m. Deliveries of the firm orders of 150 buses are due between the end of 2020 and the end of 2022. Alstom will supply its Aptis model, while Heuliez will deliver the GX 337 model and Bolloré its Bluebus design.

The tender forms part of RATP’s Bus2025 programme, which aims to have a fleet of entirely zero-emission buses by the end of 2025. Two-thirds of these would be electric and the remaining third would be powered by biogas.

Related news

- 11 Mar 2019 - Strasbourg becomes launch customer for Aptis
- 23 Mar 2018 - Paris electric bus order placed

Previous news story
Data tools for the north of England
Next news story
Shenzhen tests 5G for smart Metro Applications, China; International

03 Jun. 2019

**CHINA:** As part of a ‘smart metro’ development programme, Shenzhen Metro and Huawei are testing the use of 5G for the rapid transfer of large volumes of data between trains on Line 11 and the control room.

The tests aim to transfer the 25 GB of data generated by a train during a typical 1 h journey to the control room in around 150 sec, avoiding the need to manually download data from a train’s hard drive at the end of journey.

The operator envisages that enhanced data communications could support applications including the use of high-definition CCTV to provide automated lost luggage alerts and searches. In an emergency, the fast data transfer could be combined with facial recognition and intelligent behaviour analysis to identify dangerous activities.

Related news

- 20 Sep 2018 - Facial recognition ticket gates to be introduced this year
- 28 Oct 2016 - Shenzhen metro adds two lines
- 29 Jun 2016 - Shenzhen metro reaches airport
- 13 Jul 2015 - Shenzhen metro train rolled out

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Two bids for Hurontario light rail project

Next news story
Urban transport news in brief

Urban Transport News in Brief; International

03 Jun. 2019

**UKVZ** is to supply 15 unidirectional low-floor trams to Magnitogorsk, Russia. Separately, NPO Gorizont is to supply 10 bodyshells for rebuilding old vehicles.
China’s National Development & Reform Commission has approved the third phase of the Zhengzhou Metro network; China. Due to be built by the end of 2024, the 159·6 route-km includes an extension of Line 3, as well as six new lines.

ST Engineering is supplying a control system for Wuxi Metro Line 3, China.

A consortium of Sumitomo Corp, Mitsubishi Heavy Industries Engineering and TES Philippines began work on May 1 to return Manila Metro Line, Philippines, 3 to its design capacity and improve safety. The scope includes repairs to track, catenary, signalling and rolling stock. The ¥35·5bn contract was awarded in January.

ST Engineering is supplying an automatic fare collection system for the future Bangkok, Thailand, Gold Line.

The first of 14 Twist Trams Pesa is supplying to Gorzów Wielkopolski, Poland, were delivered on April 20.

The Québec provincial government has asked project promoter CDPQ to undertake studies for extending Montréal’s, Canada, REM automated metro to the neighbouring district of Laval.

Rail Works is to supply track to the Minneapolis Southwest Light Rail project; USA.
FRANCE: Paris public transport operator RATP Group has signed a partnership with Airbus to explore the feasibility of developing ‘urban air mobility services’ in the Île-de-France region.

‘Beyond mass transport, which remains our core business, it is important for RATP Group to develop its human and technical know-how in order to develop new mobility and new services for the smart city of tomorrow’, said CEO Catherine Guillouard.

In the longer term, the partners intend to establish a ‘broad ecosystem of relevant partners’ to develop this new transport offer in other large cities around the world.

‘Autonomous flights are no longer part of science fiction’, said Airbus CEO Guillaume Faury. ‘RATP is one of the major players for urban mobility solutions. Its knowledge of passengers and their needs, as well as associated services, makes it the ideal partner for Airbus.’
Astra Vagoane Calatori wins Tram Contract in Arad; Romania

June 4, 2019

The Representatives of Arad Municipality, a city in the west of Romania, and Astra Vagoane Călători signed a contract for the delivery of 28 new trams worth EUR 46.15 million.

The vehicles are expected to be delivered in the next four years. The new trams will be funded through the Regional Operational Programme (ROP) 2014-2020. 18 trams will be delivered in the first phase. For the rest of ten trams, the municipality submitted the documentation to obtain European funds. If the EU will not finance the procurement of the ten trams, the authorities say they will be purchased nonetheless and financed with local resources.

Next to the procurement project, the authorities plan to announce a new tender for the modernisation of 20 trams of the fleet of 138 vehicles. 54 trams will be upgraded by 2025. “We will organise another tender for the rehabilitation of 20 old trams so that we will have a fleet of 54 new and upgraded trams by 2025. Per capita, this means Arad will be the city with the highest number of trams. No other city in Romania has as much trams as we will have based on the number of people living in the city”, declared Gheorghe Falcă, Mayor of Arad.

Metro with modern Condition Monitoring, Train Information
Mitsubishi Electric Europe B.V. delivers its Train Information Monitoring and Analysis System for the new Tokyo Metro 2000 Series Trains of the Marunouchi Line.

**TIMA**, short for **Train Information Monitoring and Analysis**, provides faster responses to operational disruptions and an optimized maintenance procedure for routine inspections and necessary repairs.

The new system takes advantage of IoT (**Internet of Things**) capabilities, along with **Big-Data Visualizations** and the analysis of information from operating trains to achieve particularly safe and reliable train operations.

TIMA will assist the Tokyo Metro with IoT-based train data monitoring and analysis services to optimize the timing of scheduled and **Condition-based Maintenance**. TIMA also supports driverless trains with preventive maintenance and remote monitoring functions. Furthermore, Tokyo Metro is considering releasing selected information collected by TIMA for value-added third-party services that may be made available via smartphone applications or other technologies.

**Visualisation of the Operating Status**

The Train-Control Information Management System (N-TIS, a subcomponent of TIMA) collects information about trains in operation, such as location, interior temperature and occupancy rate, and transmits this information over a wireless high-speed data link to a data centre for the visualisation of the current train status providing a comparison with historical data, if required.
N-TIS monitors the connected vehicle components and constantly alerts the operations control centre and the depots of any abnormalities, such as the fault status and the respective train location. The driver cab monitors can be mirrored in the operations control centre and the depots, thus enabling a fast and precise information exchange to initiate corrective action and thus to minimize the downtime of the train.

**Optimised Maintenance Cycles and minimised Repair Effort**

By analysing the data of each train component, such as power consumption and voltage, recorded with N-TIS, it is possible to determine the optimum inspection time and the time interval for the replacement of wear components. The Marunouchi line operates 336 railcars on a 24.2 kilometre route with 28 stations. It runs between the Ogikubo Station in the east of Tokyo and the Ikebukuro station in Tokyo’s north and leads through Tokyo’s centre and the business district Marunouchi, that provided its name. According to Tokyo Metro, in 2017 daily an average of around 1.6 million passengers are transported.

“*We need to build Metro and Suburban Lines much faster*” Mezghani’s rallying Cry, Global UITP Summit, Stockholm; International

Jun. 5, 2019
Written by David Briginshaw

*The UITP’s Secretary General, Mohamed Mezghani*, talks about how rail transit can play a greater role in helping to solve urban congestion and pollution.
The UITP’s Secretary General, Mohamed Mezghani, talks to David Briginshaw about how Rail Transit can play a greater Role in helping to solve urban Congestion and Pollution

THE planet is facing a potential catastrophe if global warming predictions come true, and yet pollution is still rising in most cities around the world as more and more cars and trucks choke urban streets. A major expansion of electric public transport along with more cycling and walking and measures to restrict road users should help reduce pollution and CO\textsubscript{2} emissions. But are we building new rail networks in our cities fast enough to meet the challenge?

“It’s never fast enough because demand for mobility is growing,” Mr Mohamed Mezghani, secretary general of the International Association of Public Transport (UITP), told IRJ. “We need mass transit but the time to market and commissioning is very long. We need to build metro and suburban lines much faster.

“The decision-making process takes a long time. It is not just the time needed to build a new line. It is also our dependence on politicians which has an effect especially when there are elections, as new-elected politicians can change direction. Continuity in transport policy is vital.”

Some cities have managed to maintain a consistent transport policy. “In London there has been continuity in maintaining the congestion charge and developing the transport system despite a change in the ruling party,” Mezghani says.

Mezghani believes turnkey projects can also help to save time, by avoiding the need for multiple tenders. “The tender process is very long, so if we can group tenders together we can save time,” he says.

Construction causes a lot of disruption for citizens, so some cities try to limit its impact which often means projects take longer to complete than is strictly necessary. “We should find ways to compensate people for the disruption to ensure we make adequate progress with the project,” Mezghani suggests.

In 2018, 121 urban rail projects were completed totalling 1270 km, compared with 1348 km in 2017 which the UITP says was a record year. The 6% reduction in 2018 compares with an annual average growth rate of 36% over the past four years.

Last year’s slowdown was caused by a reduction in the number of new metro openings. Nevertheless, 75 metro infrastructure projects were completed last year in 17 countries and 39 cities adding another 960 km to metro networks around the world. Of these, 62% were new lines and 38% extensions. Urumqi in China opened its first metro line in 2018, bringing the total number of cities with a metro to 181. In 2018, 46 single LRT infrastructure projects were completed in 40 cities totalling 309.4 km

While China has built around 100 metro lines in just 10 years, the speed of construction in China is incomparable with the rest of the world. Nevertheless, major projects are underway in other countries, such as the ambitious Grand Paris Express scheme, and in Riyadh where six metro lines are being built simultaneously.

With the exception of China, Mezghani says funding is a global concern both in emerging and developed countries. “On the one hand, we need to invest more in public transport to reduce CO\textsubscript{2} emissions, while on the other hand there are fewer public resources available,
and public transport has to compete for funding with other sectors such as health. It is important to have dedicated funding for public transport. For example, in Switzerland a fixed amount is dedicated to rail each year. Morocco has a fund fed by VAT managed by the Ministry of the Interior, which is responsible for urban transport, to which cities can apply. The US state sales tax initiatives are another example.

“We also need to look at non-fare revenue generation. For example, JR East earns 36% of its revenue from non-transport activities – public transport is not subsidised in Japan. The Hong Kong model involving property development over stations and depots is another example. Riyadh has already earned €250m by selling naming rights for stations even before the first train has run. Dubai is also offering naming rights for stations. New York will introduce congestion charging soon, following Singapore, London and Stockholm.”

The UITP’s role is to support its members and promote public transport solutions. However, Mezghani says the UITP is mode-agnostic. “We don’t favour one mode over another, or give visibility to any industrial interests. However, it’s important that we increase awareness on the pros and cons of each mode, in terms of costs, technology, easiness of integration with the existing network, operations, maintenance, staff qualifications, and so on.

“Long-term implications for the viability and cost-efficiency of the solutions are critical. UITP encourages the use of conventional technologies over proprietary solutions. We encourage sharing between members to make it possible to learn from their experiences, and we disseminate case studies or develop benchmarking initiatives. Very importantly, we organise many training sessions covering the modal choice. We encourage our members to think medium and long term and avoid taking decisions to build systems that can’t be extended easily or are not standardised.”

There is also a lot which can be done to increase the capacity of existing systems to get more out of what already exists, for example by replacing old rolling stock with new trains which have more doors, a better internal layout and full-width inter-car gangways, or where the loading gauge permits replacing single-deck trains with double-deck trains, as happened on RER Line A in Paris. “In Moscow the new Moskva metro cars have 10% more capacity,” Mezghani observes.

Introducing signalling systems that permit shorter headways between trains is another way to increase capacity. “Automating existing lines is part of the solution, such as on lines 1 and 4 in Paris for example, and many are following, the next being Glasgow, one of the oldest metros in the world,” Mezghani says. “There are now around 1000 km of driverless metro lines in the world, and almost all new metro lines are driverless. Increasing capacity through technical innovation and optimisation is one of the key objectives of Shift2Rail.

“There are also examples where demand management makes it possible to better use the existing capacity to avoid investing immediately in new rolling stock. For example, in Singapore and Melbourne free journeys are offered before 07.00 to encourage customers to avoid travelling during the peak hour thereby optimising train loading. However, in congested cities, if we are serious about becoming the backbone of mobility, optimisation is not enough and new schemes are unavoidable to absorb the growing patronage.

“Public transport is not simply mass transit anymore, but the means to improve the quality of life in cities. The development of new mobility solutions such as ride hailing and car sharing is redefining public transport. It is about doubling this combined mobility so that we don’t need to use a car anymore.
“In Europe, and even the United States, we are seeing a reduction in the number of people with driving licences. Those who are 25 years old today have fewer driving licences than people who are 35 or 45. However, in developing countries the growth of car ownership is very strong because there are often no alternatives. In these countries road congestion is becoming much worse even though car ownership is still relatively low. In Africa, there is one car for every 10 people compared with one car for every two people in Europe.”

The UITP’s PTx2 initiative to double the market share of public transport by 2025 compared with 2005 is continuing. “The trend is positive but unequal,” Mezghani says. “In some countries, particularly in the Middle East, we will more than double public transport’s market share. Conversely, in Russia the challenge is to sustain the use of public transport because it was already very high.

“We were very ambitious for Africa when we started PTx2, but the pace of development is very slow. The challenge in Africa is creating an awareness of the need for public transport in the first place. The image of public transport is that it is only for poor people who have no choice, so governments tend to invest in roads instead which simply acerbates congestion in the long run.

“The need for some form of public transport is greatest in sub-Saharan Africa. But we can’t simply say that informal public transport must be replaced with mass transit. Indeed, on-demand transport was born in Africa, and to a certain extent in Asia. Ride hailing is a digital form of on-demand transport through an app.”

Mezghani says one of the problems is that African cities do not have transport authorities as transport planning is centralised in national ministries of transport or simply lacking. “It is only through transport authorities that you can have a comprehensive approach. Dakar in Senegal is developing its public transport well because it set up a transport authority 10 years ago. We are working with organisations like the African Development Bank and the African Union to convince politicians of the importance of decentralising responsibility for public transport to cities. The next step is to bring in the skills needed to analyse the problems and come up with solutions.

“We have training programmes in Ivory Coast, Ethiopia, Nigeria, Senegal, South Africa and Tanzania to address this problem.

“African cities often don’t have any bus networks, and with the limited funds available, we need to accept that they need to start with Bus Rapid Transit (BRT),” Mezghani explains.

**Seamless Travel**

Unlike the private car, public transport is rarely door-to-door and often involves different modes to complete a journey. The challenge is to make it as seamless and as easy to use as possible. Commuters know their regular route to work without giving their journey a moment’s thought, but for occasional users and visitors public transport can be daunting with complicated fare structures, difficult-to-use ticket machines, and poor signage.

As Mezghani points out, there are many cities, such as Amsterdam, Hong Kong, London, Milan, Singapore, Stockholm and Vienna, where it is easy to move around using public transport, but there are far more where it is not.
Stockholm is the host of this year’s Summit and is praised by Mezghani for high public Transport Accessibility

“Seamless public transport starts with the way we define our networks and not mode by mode,” Mezghani explains. “Singapore wants 80% of its population to be within 15 minutes of a metro station, You clearly need to create an integrated system at the planning stage to achieve this.

“It is very important that we don’t define the service technically, but from the customer’s point of view, and we must have integrated ticketing systems which are easy to understand.”

Mezghani says the Mobility as a Service (MaaS) approach will help by integrating information, journey planning and payment systems so each solution is defined by the journey, the time of day and affordability. “This will generate diversity in the way we use public transport so that we become very flexible in how we use different modes,” Mezghani says.

There are already examples of such integration. On January 31, Uber announced its first integration with public transport: a partnership with Denver’s Regional Transportation District (RTD). Uber users can now plan their trip with real-time information and end-to-end directions in the Uber app. Soon, passengers will also be able to purchase and use RTD tickets through the Uber app.

Uber says it recognises that public transport and Uber can be a powerful combination. On May 7, Uber relaunched its London app to integrate live rail and bus data from Transport for London so that users can compare modes when planning a journey.

In January 2018 a new law was introduced in Finland to allow public transport agencies to sell their tickets to third parties for resale with other services. “In Helsinki, users can buy monthly passes which give them access to all modes of transport,” Mezghani says.

Since January, the UITP has acted as the coordinator of the €1.5m EU-funded Shift2MaaS project within Shift2Rail. The objective is to create one app for Europe which combines all modes and enables passengers to buy one ticket covering several modes.
When defining jobs and recruiting staff, we need to include women on the panel because men tend to recruit men.

Shift2MaaS will benefit from technologies developed within the Shift2Rail Innovation Programme 4 such as ticket booking, validation, payment and journey tracking. Concepts and solutions will be tested in Lisbon and Malaga and the project will conclude in January 2021.

“Digitalisation is the main trend which is impacting our business,” Mezghani asserts. “But we need the right people. Everywhere we are struggling to build the capability of our workforces. Despite increasing automation, public transport is still labour intensive, and we need people to provide good customer service. In Amsterdam and Hamburg, for example, public transport is the number one employer.

“We are competing with other employers to attract the right people, and we have more and more international players so employment is becoming global. In the Middle East operators are recruiting people from Europe and India because they don’t have skilled people locally. Even Singapore is recruiting worldwide. Public transport operators are also competing with other industries such as banks and telecoms companies, and for cyber security specialists.

“We need to build strong employer branding in public transport, and we need to involve more women. On average, only 17% of public transport employees in Europe are women. The proportion is higher in Russia but lower in developing countries except for Kochi in India, which is the only metro in the world to employ more women than men – 52% of its employees are female. We are starting to see more women on the boards of public transport companies. Paris Transport Authority (RATP) has a balance board, for example.”

The UITP’s PT4ME campaign is aimed at serving women passengers better and involving more women in public transport by promoting the benefits of a diverse workforce. “When defining jobs and recruiting staff, we need to include women on the panel because men tend to recruit men,” Mezghani says.

“We signed a joint declaration with the International Transport Workers Federation in February to encourage more women to work in public transport. This is an opportunity, because we need people and the potential is there. It’s a win win solution if we can get more women to work in public transport,” Mezghani concludes.

IRJ on Tour

MEMBERS of the IRJ team will attend three important railway events this month. Publisher Jonathan Chalon, together with David Briginshaw and Keith Barrow, will be in the Swedish capital Stockholm visiting the UITP Global Public Transport Summit which takes place on June 9-12. IRJ will also report from the event and provide a daily e-mail newsletter, keeping our subscribers up-to-date with the latest news from the summit. IRJ’s sales team represented by Louise Cooper and Michael Boyle will also be in Stockholm to discuss marketing opportunities along with Chloe Pickering from IRJ Pro.

Kevin Smith will be in Narvik, Norway, to report on the latest developments in heavy-haul freight from the International Heavy Haul Association’s STS conference which runs from June 10-14.
Finally, David Briginshaw will attend the International Wheelset Congress taking place in Venice from June 16-20.

Categories: Commuter RailEuropeMetrosPassengerRolling stock
Tags: emissionspollutionStockholmTransitUITP
MAIN THEMES FOR 2019:

- URBAN RAIL AND THE CHANGING MOBILITY LANDSCAPE
- IMPLEMENTING COMMUNICATION-BASED TRAIN CONTROL (CBTC)
- SUSTAINABLE, CONNECTED URBAN MOBILITY NETWORKS OF THE FUTURE
- EXTENDING ASSET LIFE CYCLES AND ARTIFICIAL INTELLIGENCE
- MOBILITY AS A SERVICE AND ALTERNATIVE MODELS FOR THE FUTURE
- HOW WILL AUTOMATION AND MACHINE LEARNING DISRUPT THE URBAN TRANSPORT BUSINESS MODEL?
- INCREASING CAPACITY ACROSS THE URBAN TRANSPORT NETWORK
- MISSION CRITICAL COMMUNICATIONS
- DIGITAL INFRASTRUCTURE AND DISRUPTIVE TECHNOLOGY
- REAL-TIME PASSENGER INFORMATION SYSTEMS
- SKILLS GAPS AND GENDER IMBALANCES IN THE WORKFORCE
- CONNECTIVITY AND DATA

MEET SENIOR-LEVEL ATTENDEES FROM:

- IT AND DATA
- MAINTENANCE
- WIFI
- CUSTOMER EXPERIENCE
- MARKETING AND COMMUNICATIONS
- ENGINEERING
- CBTC
- TELECOMS
- FARE REVENUE
- RESEARCH AND DEVELOPMENT
- FINANCE
- SIGNALLING
- INFRASTRUCTURE

2018 AUDIENCE BREAKDOWN:

**INTEREST AREA**

- SIGNALLING AND TRAIN CONTROL 33%
- URBAN MOBILITY 25%
- IT AND DATA 15%
- PASSENGER SERVICES AND FARE COLLECTION 9%
- TELECOMMUNICATIONS AND CONNECTIVITY 8%
- SAFETY AND SECURITY 9%
- PROFESSIONAL SERVICES AND CONSULTANCIES 9%
- ENGINEERING, PROCUREMENT AND CONSTRUCTION (EPC) 1%
- ROLLING STOCK TECHNOLOGY 1%

**SENIORITY**

- C-LEVEL / VP / DIRECTOR 55%
- SENIOR MANAGER / MANAGER 45%

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MAIN THEMES FOR 2019:

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- Increasing ridership and meeting consumer demand
- Predictive maintenance and artificial intelligence
- Mobility-as-a-service and alternative models for the future
- Making transit safer
- Mission critical communications for transit
- Digital infrastructure and disruptive technology
- Connectivity and data
- Real-time passenger information systems
- Zero emission and environmentally friendly transport
- Skills gaps and gender imbalances in the workforce

MEET SENIOR-LEVEL ATTENDEES FROM:

- IT and Data
- Telecoms
- Engineering
- Infrastructure
- Finance
- Customer Experience
- Maintenance
- Fare Revenue
- Advertising
- PTC/CBTC
- Signalling
- Marketing and Communications
- WiFi
- Research and Development

“It is a great networking platform where you get updated about the newest technologies in the industry.”
Constantin Zacharia, Sales Manager, Lufthansa Systems

2018 AUDIENCE BREAKDOWN

INTEREST AREA

- IT and Data: 24%
- Telecommunications and Connectivity: 20%
- Urban Mobility: 14%
- Safety and Security: 10%
- Passenger Services and Fare Collection: 8%
- Engineering, Procurement and Construction (EPC): 8%
- Rolling Stock Technology: 8%
- Professional Services and Consultancies: 4%
- Signalling and Train Control: 4%

100+ attendees from transit agencies & government

“I thoroughly enjoyed the SmartTransit Congress. The topics were relevant and the networking was incredible.”
Michael J. Rock, Acting Director, System Safety and Security, SCIRCA

SENIORITY LEVEL

- 49% C-Level/VP/Director
- 51% Senior Manager/Manager
AN annual growth rate of 15% for metro cars is forecast for Europe up to 2023, according to a report on the world metro market published by SCI Verkehr.
Metro Car Demand is forecast to increase by 3% per Annum in Europe up to 2023.

The global market for metro vehicles is expected to continue to grow at the rate of about 3% per annum, despite an already high market volume. Growth in metro car orders is being fuelled mainly by the need to replace trains nearing the end of their life together with the steady expansion of existing metro networks and the construction of new ones.

**Age Structure [number of cars]**

**World Market**

According to SCI Verkehr, there were 185 metro systems in operation worldwide last year compared with 159 in 2016, 107 in 2000 and 84 in 1990.

The metro car after-sales market is expected to continue to expand by almost 6% annually due to the continually increasing size of metro train fleets.
China

China continues to be the largest market for metro trains with 46% of the global market volume, even though the Chinese metro market is stagnating. Almost 50% of metro cars globally were procured in the last 10 years, particularly in China.

Between 2014 and 2018, CRRC dominated the world market for new metro vehicles and now holds a share of 60%. This compares with the next largest suppliers, Bombardier and Alstom, which each have a 7% market share globally. Although most of CRRC’s metro car production is for Chinese operators, SCI Verkehr says it now has a leading position in Asia, and has won contracts in India, Turkey, and the United States.

CRRC unveils Driver-less Metro Train; International

Jun. 4, 2019
Written by David Briginshaw

CRRC has published photos of an automatic metro train, which it has developed for China’s Next Generation Metro Vehicle Technology Research and Demonstration Application project being led by the Ministry of Science and Technology.
The metro train is designed for unmanned operation conforming to GoA4, the highest level of automatic train operation.

CRRC says all the tasks are completed by the train itself and do not require human involvement. For example, the system will wake up the train in the morning, carry out a self-check, exit the depot and enter passenger service. At the end of the day, the train will return to the depot and pass through the train washer automatically.

The train features a panel imbedded in a window which can be used to provide passenger information or display advertising.
Window Information Display in the new CRRC automatic Metro Train

Categories: AsiaMetrosNewsRolling stockTechnology
Inspiro
The metro platform from Siemens

siemens.com/mobility
To meet the diverse demands posed by public transportation in the cities of tomorrow, we have developed a metro that sets new standards in its class: Inspiro – the new metro from Siemens.

The new Inspiro is designed to meet people's needs for a better quality of life. Passengers travel in a pleasant, stress-free environment – thanks to the bright interior, attractive lighting, and draft-free air-conditioning. The natural materials in warm colors enhance the relaxing and revitalizing atmosphere of the Inspiro metro.

The Inspiro also delivers maximum advantages with its high passenger capacity and low operating costs, combined with the Siemens environmental benefits: energy efficiency and eco-friendliness – from its production and daily operation to its almost total recyclability.

Energy efficiency
The Inspiro’s energy efficiency is based on two factors – its weight-saving design and energy-efficient technologies. The light-weight carbody and a weight-optimized bogie reduce the overall weight of a single car by more than three tons compared with the previous generation. LED lighting in the passenger compartment and a demand-responsive, air quality-controlled air-conditioning system reduce the Inspiro’s energy consumption even more.
The option for driverless operation – a unique feature offered in combination with conventional operation – guarantees the highest level of energy efficiency by controlling braking and acceleration throughout the entire metro system. Recuperated brake energy can be used immediately by simultaneously accelerating trains.

Flexibility
The Inspiro platform allows up to eight-car train configurations with varying degrees of motorization – up to 100 percent. The interior can be equipped with longitudinal, transversal, or mixed seating configuration, depending on customer needs.

In addition, the length and width of the car bodies can be varied. The trains can also be configured with three or four doors per side – with outside sliding or sliding-plug door types as options.

Optimized capacity
There are no electrical or appliance cabinets in the passenger area, creating more space for riders and enabling operators to optimize passengers capacity.

Large doors 1,400 mm wide make it easier for passengers to board and exit the Inspiro.

The doors can be equipped with easy-to-see light strips. In conjunction with the octagonal door shape, they help guide passengers into the cars from the platform.

This reduces the dwell time in stations, which makes the fleet operation more efficient and increases system capacity.
Extraordinary design
The Inspiro’s modern and distinctive vehicle design is immediately impressive. It was developed in collaboration with Designworks, a BMW Group Company.

The exterior’s dynamic front end and large windows are striking and elegant, and make a lasting impact on the city’s image.

High level of passenger comfort
The Inspiro has large entrance doors and a thoughtfully designed interior with wide passageways that impart a generous feeling of space. The innovative ambient lighting system, with its carefully placed groups of lights, creates a pleasant atmosphere not previously seen in metros.
New grab-handle concept

Instead of the usual grab poles and handrail, Inspiro offers innovative and distinctive supports in the form of a stylized branched tree: the lighttree, it allows several passengers to hold on while maintaining a comfortable distance from others.

Innovative passenger information system

Some of the passengers supports in the Inspiro also feature large displays that provide information at convenient places throughout the car. Known as "Virtual conductors," they can also be used for other purposes, such as advertising or entertainment. Additional displays can be installed on the ceiling.

Safety

The vehicle concept was developed in accordance with the latest crash and fire protection standards, and the car body has an enhanced compressive strength of 1,000 kN. Ultramodern interior video monitoring, fire alarm, and firefighting systems can be installed.

A derailment detection system and highly sensitive door monitoring can also be provided to maximize passenger safety.

Reliability

The Inspiro platform is a product of Siemens' wide-ranging experience with metro systems. After all, Siemens metros are in use in large cities all over the world. The new Inspiro modular vehicle concept is based on tried and tested components.

During development, special attention was given to ensuring easy replacement of worn parts and spare parts and to component reliability. Sensors in the traction motors could be completely eliminated. Maintenance activities can be facilitated even more by the optional use of remote diagnosis, which increases the metro trains' availability for passenger transport.

To ensure high quality and reliability, every vehicle is thoroughly tested before delivery at Siemens' own test center in Wegberg Wildenrath.
Cost-efficient and environment-friendly

The low operating and maintenance costs, reduced energy consumption, and the natural and recyclable materials used offer benefits for operators and the environment alike.

The Inspiro’s environmental impact has been reduced throughout the entire product lifecycle. As a result, the train has a recyclability rate of up to 95 percent at the end of its service life (ENIFE Recyclability Calculation Method for Rolling Stock).

References

The first Inspiro trains were put into service in Warsaw. In February 2011 Metro Warsaw ordered 36 six-car trainsets for the existing Line 1 and to expand the city’s network.

References based on the Inspiro platform:

- 2010: Order for 21 six-car trains for Munich – first Inspiro components
- 2011: Order for 35 six-car trains for Warsaw
- 2012: Order for 58 four-car trains for Kuala Lumpur
- 2013: Order for 67 two- and four-car trains for Riyadh
- 2015: Order for 21 four-car trains for Nuremberg
- 2015: Order for 20 three-car trains for Sofia
<table>
<thead>
<tr>
<th>Technical data</th>
<th>Basic configuration</th>
<th>Variants</th>
</tr>
</thead>
<tbody>
<tr>
<td>Train configuration</td>
<td>6-car train, 66% motorization</td>
<td>2 to 8-car train, up to 100% motorization</td>
</tr>
<tr>
<td>Car body material</td>
<td>Aluminum</td>
<td>Stainless steel</td>
</tr>
<tr>
<td>Traction power supply</td>
<td>750 V DC, 3rd rail</td>
<td>1,500 V, pantograph</td>
</tr>
<tr>
<td>Car length (overcoupled)</td>
<td>20.1 m (19.4 m braked car, intermediate cab)</td>
<td>18.6 m to approx. 22.0 m</td>
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<tr>
<td>Car width (over door step)</td>
<td>2.77 m</td>
<td>2.63 m to approx. 3.0 m</td>
</tr>
<tr>
<td>Door type</td>
<td>Interior sliding doors</td>
<td>Sliding plug doors</td>
</tr>
<tr>
<td>Number of passenger doors per car side / door width</td>
<td>4 / 1,400 mm</td>
<td>2 / 1,400 mm</td>
</tr>
<tr>
<td>Maximum axle load</td>
<td>Approx. 12 t</td>
<td>Approx. 16 t to 17 t</td>
</tr>
<tr>
<td>Seat arrangement</td>
<td>Longitudinal configuration</td>
<td>Transversal and mixed configuration</td>
</tr>
<tr>
<td>Passenger capacity per train (7 pass/m²)</td>
<td>1,471 passengers</td>
<td>Depending on train car body and seat configuration</td>
</tr>
<tr>
<td>Seats per train</td>
<td>256</td>
<td>Depending on train car body and seat configuration</td>
</tr>
<tr>
<td>Gauge</td>
<td>1,435 mm</td>
<td>–</td>
</tr>
<tr>
<td>Maximum operational speed</td>
<td>80 L/min</td>
<td>100 L/min</td>
</tr>
</tbody>
</table>
Subject to changes and errors.
The information given in this document only contains general descriptions and/or performance features which may not always specifically reflect those described, or which may undergo modification in the course of further development of the products. The requested performance features are binding only when they are expressly agreed upon in the concluded contract.

Inspiro®, Lightree®, and Virtual Conductor® are trademarks of Siemens AG.
Any unauthorized use is prohibited. All other designations in this document may represent trademarks whose use by third parties for their own purposes may violate the proprietary rights of the owner.
In October 2012, the consortium SSSC (Siemens Malaysia, Siemens AG and SMH Rail) was awarded the contract to supply 58 new driverless four-car metro trains for the Metro Klang Valley MRT Project (Projek Mass Rapid Transit Lembah Klang–Tanjong Bunga). These trains will be used on the newly built 51-kilometer-long Sungai Buloh–Kajang Line, which connects Kuala Lumpur with the Klang Valley area. The vehicles are part of the new Inspiro family. The car bodies for the trains will be produced by CSR Fuzhou in China. The final assembly of the vehicles will be performed in Malaysia by the consortium partner SMH Rail.

Dynamic commissioning of the trains, including type testing, will take place at the test track in the Sungai Buloh Depot and subsequently on the routes. The first two trains were delivered to Sungai Buloh Depot in December 2014. The completion of the project (Phase 2) is scheduled for the end of July 2017.

Train design:
Each train comprises four stainless-steel cars in a M-T-T-M configuration. Each car is carried by two bogies. The trains are capable of carrying up to 1,554 passengers (at 8 passengers/m²), with a total of 174 seats and standing room for up to 1,380 passengers. The train is designed for operation in tunnels and on elevated tracks. The cars in each train are interconnected with semi-permanent couplers. The end cars are equipped with automatic couplers.

siemens.com/mobility
### Technical data

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Train configuration</strong></td>
<td>M-T-T-M</td>
</tr>
<tr>
<td><strong>Wheel arrangement</strong></td>
<td>Ø960 x 22.5 x 22 x 80%</td>
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<tr>
<td><strong>Car body material</strong></td>
<td>Stainless steel</td>
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<tr>
<td><strong>Traction gauge</strong></td>
<td>1,435 mm</td>
</tr>
<tr>
<td><strong>Length over couplers</strong></td>
<td>approx. 89,500 mm</td>
</tr>
<tr>
<td><strong>Width of car (access door leaves)</strong></td>
<td>3,100 mm</td>
</tr>
<tr>
<td><strong>Floor height above top of rail</strong></td>
<td>1,100 mm</td>
</tr>
<tr>
<td><strong>Wheel diameter max. (mm)</strong></td>
<td>850/775 mm</td>
</tr>
<tr>
<td><strong>Tare weight/full weight (8 pers./m²)</strong></td>
<td>approx. 150,000 kg / approx. 251,000 kg</td>
</tr>
<tr>
<td><strong>Max. acceleration</strong></td>
<td>1.2 m/s²</td>
</tr>
<tr>
<td><strong>Number of doors</strong></td>
<td>12</td>
</tr>
<tr>
<td><strong>Person capacity (8 pers./m²)</strong></td>
<td>1,554</td>
</tr>
<tr>
<td><strong>Max. curve radius service line (m)</strong></td>
<td>150 m / 140 m</td>
</tr>
<tr>
<td><strong>Max. gradient</strong></td>
<td>4.0 %</td>
</tr>
<tr>
<td><strong>Max. speed</strong></td>
<td>100 km/h</td>
</tr>
<tr>
<td><strong>Max. starting acceleration</strong></td>
<td>1.0 m/s²</td>
</tr>
<tr>
<td><strong>Max. dynamic service brake</strong></td>
<td>1.1 m/s²</td>
</tr>
<tr>
<td><strong>Power supply</strong></td>
<td>750 V DC / 750 V AC</td>
</tr>
</tbody>
</table>

The wide and open gangways between the cars (vertical clearance approximately 1,030 mm, clear width approximately 1,600 mm) enable unrestricted passage through the train.

All cars have four electrically operated exterior sliding doors per side with an opening width of 1,400 mm.

The trains meet the high fire protection requirements according to BS 6853 Cat. 1a.

In addition, implementing the Inspiro design solutions ensures optimized energy consumption, low maintenance costs, and high recyclability of the trains at the end of their service life.

### Design concept

Designworks, a BMW Group Company, developed the interior and exterior design of the trains. The "Racing light" design concept was inspired by the architectural characteristics of modern Malaysia and reflects the dynamism, elegance, and technological progress of Kuala Lumpur.

The interiors are equipped with LED lighting; indirect lighting below the passenger seats generates a pleasant sense of space and supports safety and cleanliness in the train. The interior color concept with varying shades of blue and traditional symmetrical patterns with a modern interpretation in the entry area symbolizes the vitality and cultural diversity of Kuala Lumpur. Color contrasts in the door entrance areas provide the passengers better orientation, making it easier for them to get in and out of the train.

**Fully automated operation**

The trains are equipped for fully automated, unattended train operation (GoA 4).

A state-of-the-art train automation system is integrated into the train, ensuring reliable and highly available operation. In addition, the train is equipped with an array of safety systems, including obstruction sensors at the end bodies and a fire detection system. Auxiliary driver's cabs at both ends of the train enable manual operation in emergencies and in the depot. The auxiliary driver's cabs are equipped with convenient touch-screen displays and all necessary controls for train operation.
Car bodies
The metro train has been designed with a lightweight stainless-steel construction. The exterior car body surfaces are painted, and the color stripes are made of adhesive foil.

Traction system
The trains are electrically driven. The traction power is supplied from the third rail via current collectors. Two of the four cars in the trains are motorized. Each motor bogie is driven by two self-ventilated traction motors from the proven TTB 20 series. The motors are controlled without speed sensors for a high level of reliability.

The two traction motors in the motor bogies are each controlled by a natural air-cooled Silencio® KTB traction inverter.

Bogies
The bogie SF 3000, developed for advanced metro vehicles, has been further optimised and is suitable for operating speeds up to 100 km/h and for axle loads of approximately 17 tons. The bogie frame consists of high-strength low-alloy steel.

Each wheelset of the bogie is equipped with one brake disk and one compact brake caliper unit. The bogies are equipped with spring brake actuators that serve as parking brakes.

Secondary suspension is provided by an air spring, and a metal-rubber spring is used for primary suspension. One current collector is mounted on each side of the motor bogies. The traction motors are transversely installed and fully suspended on the bogie frame.
Passenger Safety and Information Systems

The Passenger Information Display and Announcement System provides both visual and audio information inside and outside the train. Displays for the train's destination are installed on the exterior surfaces of the cars. In the interior, dynamic map displays are installed above each door to show the current position of the train and the name of the next station. Each car also includes displays above the windows for emergency and operation news and for advertisements.

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METRO NEWSLETTERS

on

“URBAN MOBILITY AS A SERVICE”

PUBLIC MULTIMODAL URBAN, SUBURBAN AND INTERURBAN PASSENGER TRANSIT SYSTEMS WITH METRO-BUS, LIGHT-RAIL, TRAM-TRAIN, METRO-RAIL, METRO-TRAIN, REGIONAL RAPID TRANSIT, COMMUTER-RAIL, ROPE-WAY/TRAIN, MAGLEV AND HOVERCRAFT TRANSIT/PEOPLE MOVER, WATER-METRO, AUTONOMOUS PEOPLE-MOVER

TRANSPORTATION AND ECONOMIC DEVELOPMENTS IN MODERN URBAN/MEGAPOLIS ENVIRONMENT

METRO Newsletter by Dr. F.A. Wingler
METRO 72, June 2019

Multimodal Hub for Integrated Transport (IT)
Bombardier to supply more Movia Metro Trains to Delhi; India

05 Jun. 2019

**Bombardier Delhi Metro MOVIA Car**

**INDIA: Delhi Metro Rail Corp.** has awarded Bombardier Transportation a contract to supply more 40 Movia Metro Cars for use on three of its 1 676 mm gauge lines.

Bombardier will supply the rolling stock from its Savli and Maneja sites in Gujarat. The trains will be equipped with Mitrac Traction Equipment and Flexx Metro 3000 Bogies. Each eight-car trainset will have capacity for 2,960 passengers.

**DMRC already has 776 Movia Cars.** ‘Since 2007, in partnership with Delhi Metro, we have been supporting Delhi National Capital Region’s ambitious expansion plan and we are proud to move safely around two million people every day in India’s capital city with our trains and signalling’, said Bombardier Transportation’s Managing Director, India, Sudhir Rao on June 4.

Related news
PART II: GLOBAL ACTIVITIES FOR URBAN MOBILITY AS A SERVICE

UITP PUBLIC TRANSPORT SUMMIT, Stockholm: The Art of public Transport; Global

07 Jun. 2019

In June 9-12, 2019, the international public transport community will come together in Stockholm for the UITP Global Public Transport Summit.

More than 2,500 decision-makers, operators and suppliers from across the public transport and mobility sector are about to gather in Stockholm for UITP’s 2019 Global Public Transport Summit, which takes place on June 9-12.

Hailed by the international association as ‘the world’s biggest event dedicated to sustainable mobility’, the summit is intended to cover all urban and regional transport modes, as well as emerging technologies such as mobility as a service.
This year’s conference theme is ‘the art of public transport’. Pointing out that public transport is constantly evolving, as industry professionals strive to meet the changing needs of their cities, UITP says ‘we are all visionaries in this sector, as we build connections and provide services to create a culture that brings people together’. To this end, it has selected as a motivational keynote speaker the artist, author and animator Christoph Niemann, who last year completed a tiled mural for DB at Berlin’s Wannsee S-Bahn station.

As well as the plenary sessions, the parallel conference streams have been designed to ‘explore the strategic vision and business activities of an evolving sector’. Topics to be covered will include management structures, financing, customer relationships and safety, as well as digitalisation, electro-mobility, and the relationship between public transport and autonomous vehicles.

The host city has much to contribute, having increased the proportion of trips taken on public transport steadily since 2000 to the current level of 49% of all journeys in greater Stockholm. Regional operators contracted to county transport authority SL carry almost 800 000 passengers/day, and the figure is expected to increase as various metro and light rail expansion projects come to fruition.

Congress delegates will be able to sample recent transport investment in the capital with a range of technical visits, including the deep-level stations on the Citybanan suburban rail link, SL’s Stadshagen security and safety control centre, the Gullmarsplan metro control centre, Arriva’s Tvärbanan tram depot and light rail control centre at Ulvsunda, the state-of-the-art Red Line metro depot at Norsborg and a short trip with open access operator MTR Express between Stockholm Central and Södertälje Syd.

Occupying 40 000 m² of exhibition space, the accompanying trade fair is expected to attract around 350 exhibitors and more than 15 000 international visitors. Industry associations taking part include Japan’s JORSA and Spain’s Mafex, as well as the Latin American metro association Alamys.

09 Jun 2019 - Embedded glass technology on show at UITP

- 08 Jun 2019 - Thales addresses the big questions at UITP
- 07 Jun 2019 - Alstom focuses on ‘green, fluid, safe and inclusive’ mobility at UITP 2019
- 04 Jun 2019 - Safra to present Businova model at UITP 2019
- 30 May 2019 - Motors, coupler tools and on-board IT
- 28 May 2019 - Init to show electromobility tools at UITP 2019
- 08 May 2019 - Driving towards a digital future

SIEMENS MOBILITY: Welcome to the Future of Urban Mobility; Global.

As the trend toward urbanization accelerates worldwide, cities need solutions for some of their most pressing demands: the need to transport growing numbers of people in an efficient, reliable, safe and sustainable way. Therefore comprehensive mobility concepts and seamless intermodal solutions are becoming increasingly important.

Siemens Mobility has the extensive expertise and experience to deliver digital innovations that increasingly cross-link the “complete mobility system”. Under the slogan “Shaping
connected mobility,” we showcase those pioneering solutions at this year’s UITP Summit – solutions that guarantee availability, make trains and infrastructures intelligent, increase value sustainably over the entire lifecycle, and improve passenger comfort and travel experience.

Welcome to Stockholm and welcome to the future of urban mobility.

Our Highlight Themes

Rolling Stock

Siemens Mobility is one of the leading providers of rolling stock for mass transit and regional transport, equipped with state-of-the-art drive and train control systems as well as the latest digital onboard technologies. These solutions increase energy and economic efficiency and improve availability and travel comfort and convenience – sustainably over the entire lifecycle:

- Autonomous Trams
- Avenio Tram, Light Rail:

- Inspiro Metro
- Fully Automated Val People Mover
- Desiro and Mireo Regional Trains
- Alternative Drive Systems
- Digital Vehicle Technologies

Mobility Services

The economic efficiency and availability of rail service are the keys to your success. With our innovative service portfolio and the combination of domain know-how, data analysis expertise and a worldwide network of experts, Siemens Mobility Services helps you optimize your operations. The result: keeping your customers satisfied by enhancing passenger experience and increasing value sustainably over the entire lifecycle. We guarantee up to 100% system availability with:

- Railigent® - powered by MindSphere
- Easy Spares Next Generation
- Fully Digitalized Depot
Intelligent Infrastructure

Digitalization is also transforming transport infrastructures. For example, Siemens uses its open IoT MindSphere operating system to comprehensively manage data from the Internet of Things and provide completely new cloud-based solutions. This reduces the need for hardware components, optimizes rail and road traffic and is vital for greater operational flexibility as well as smart process automation and networking:

- Digital Station
- MindConnect Rail / Data Capture Unit DCU
- Mass Transit/Bike Priorization Stream
- eBus/eVehicle Charging Infrastructure
- Building Information Modeling

Intermodal Mobility Solutions

Together with Hacon, eos.uptrade, Bytemark and Padam, we offer a unique ecosystem of digital services and networked solutions for optimal travel comfort and convenience. Passengers are offered travel alternatives tailored specifically to their individual situation and needs for getting from A to B simply, comfortably and safely. At the same time, transport operators can use Intermodal Data Analytics to continuously optimize their mobility services and increase customer satisfaction:

- Mobility as a Service (MaaS)
- Demand Responsive Transport
- Smartphone-based Ticketing
- Mobility Data Analytics

Bombardier at UITP Global Public Transport Forum: The Art of Public Transport; Global

Bombardier Transportation is delighted to be exhibiting at the UITP Global Public Transport Summit in Stockholm, Sweden from June 9-12, 2019. Supporting UITP’s theme, The Art of Public Transport, we are showcasing how our well designed, sustainable and innovative solutions are perfectly addressing our customers’ needs and major mobility challenges.

Our presence at the UITP Summit 2019 will leverage the latest multimedia technology to show how our performance helps urban areas grow and economies develop:
Experience our Mobility Solution Configurator. Its tangible, multi-touch technology illustrates how our holistic approach delivers sustainable, end-to-end mobility solutions that grow along with a city.

Visit our immersive Virtual Reality Experience to see how our turnkey mass rapid transit solutions are improving the lives of millions in cities like Stockholm, Bangkok and Zurich.

Journey through our Services Explorer tool to learn how our predictive and optimized service solutions enhance reliability and lower lifecycle costs, or use the Signalling Configurator and discover how intelligent rail control can solve the toughest capacity challenges.

Visit Bombardier Transportation at stand #A3030 in Hall A at the Stockholmsmässan congress.

Bombardier Transportation is a global mobility solution provider leading the way with the rail industry’s broadest portfolio. It covers the full spectrum of solutions, ranging from trains to sub-systems and signalling to complete turnkey transport systems, e-mobility technology and data-driven maintenance services.

Combining technology and performance with empathy, Bombardier Transportation continuously breaks new ground in sustainable mobility by providing integrated solutions that create substantial benefits for operators, passengers and the environment. Headquartered in Berlin, Germany, Bombardier Transportation employs around 40,650 people and its products and services operate in over 60 countries.

**Bombardier MOVIA Metros – flexible Solutions for growing Cities, from London to Delhi; Global**

As a leading metro solutions provider, we’re shaping the future of mass transit and daily commutes. Our high-tech, highly efficient MOVIA metros deliver rapid, reliable and cost-effective transport solutions around the globe.
Congestion, budget constraints, and connectivity are major challenges facing growing cities today. Metros are one of the most efficient means of moving high volumes of people safely, conveniently and cost-effectively to their destinations.

From London to Delhi, New York to Shanghai, MOVIA metros move more than seven billion passengers every year. MOVIA metros are renowned over the world for their operational reliability, appealing design and enhanced safety features – everything that makes a metro an attractive mode of transport.

As part of a new or existing network, fully automated or with a driver, the MOVIA metro family’s modular approach ensures the right solution for each customer.

- Bombardier has delivered its MOVIA metro solution to more than 40 cities worldwide, representing some 4,700 cars.
- 775 MOVIA metro vehicles to San Francisco
- 300 MOVIA metro vehicles to New York
- 1,771 MOVIA metro vehicles to London Underground
- 276 fully automated MOVIA metro vehicles for the Singapore Downtown Line
- **776 MOVIA Metro Vehicles for the Delhi Metro**

Siemens Mobility driving towards a digital Future; Global

08 May 2019 | by Dr Harry Hondius
Siemens Mobility is providing its C2X Technology for the Navya autonomous Vehicles in Seestadt Aspern (Photo: Harry Hondius)

Siemens Mobility plans to focus on aspects of digitalisation at the forthcoming UITP Summit in Stockholm, presenting three key streams ahead of the event.

Using the slogan ‘Mobility Made Easy’, Siemens Mobility has embarked on a global strategy to harness digital technologies to provide seamless transport by a variety of modes. Presenting the highlights of its plans for this year’s UITP Global Public Transport Summit during a visit to Wien last month, the company emphasised its investment in firms specialising in transport planning, ticketing and information.

These include HaCon, which provides the HAFAS timetabling and planning software, now branded as a Mobility Ecosystem. The Hannover-based company employs 370 IT and transport planning specialists covering many aspects of intelligent transport systems. Siemens has also invested in Eos-Uptrade, which provides online sales systems and ticketing solutions for public transport operators throughout Europe notably those in Hamburg, Berlin, München and Wien. Meanwhile New York-based Bytemark, Inc works with 20 public transport agencies around the world offering mobile ticketing. Padam Mobility of Paris provides demand-responsive transport-as-a-service.

As an example of co-operation projects, Siemens says it has worked with Bytemark to provide a common payment solution for the smart travel app in Columbus, Ohio, and with HaCon to provide the BART Trip Planner in San Francisco. Siemens is now working closely with transport authorities in Luxembourg to deliver a ‘complete mobility app’ to support the country’s free public transport initiative that comes into operation from March 2020.

**Autonomous Operation**
Digitalisation will also play a role in the operation of urban transport services, with Siemens Mobility working on autonomous operation for trams and electric buses.

During InnoTrans 2018 Siemens and ViP demonstrated autonomous driving with a modified Combino tram on a 6 km route in Potsdam. Their view is that if all traffic is operating autonomously at some point in the future, trams would have to be part of it. In the short term, the company says the driverless technologies will be perfected for shunting within the depot, before being introduced more widely.

Meanwhile, June 6 will see the launch of an autonomous electric bus shuttle in the new Wien suburb of Seestadt Aspern, providing ‘last mile’ connectivity to and from Seestadt station on metro Line U2. Siemens Austria and vehicle manufacturer Navya are partners in the project consortium along with local operator Wiener Linien, AIT, KFV and TÜV Austria.

Under the €1·5m project, two Navya shuttles will run for a year on a 2 km route serving five stops, at a maximum speed of 20 km/h, and there will be a trained attendant on board to supervise. The 4·75 m long 10-seat vehicles are powered by a 15 kW motor, which is fed from a 16 kWh battery that will enable it to operate for up to 9 h. Charging from a 16 A 220 V AC supply is expected to take 4 h to 8 h.

Siemens is supplying its C2X (car-to-X) technology which enables the autonomous buses to interact with the roadways and surrounding infrastructure. The vehicles are fitted with a range of sensors and GPS, while at key road crossings four fixed cameras are provided to relay video images to the onboard computer.

**Easy Spares digitised**

Siemens Mobility is also promoting its ‘Easy Spares’ digital supply chain concept. Back in 2000, the company introduced a programme enabling its rail vehicle customers to order parts for delivery within 24 h. This concept has been enhanced by an app with photo matching for component identification, allowing defective items such as door knobs, seat covers or windows to be identified and ordered in 3 min to ensure the 24 h delivery times.

Once photographed, the item is checked in Siemens Mobility’s cloud-based CAD database, and experience suggests that around 90% of the parts can be identified within 10 sec. The functionality is already available for the Avenio and Neoval platforms, whose components were designed using 3D CAD systems, and will be extended to future vehicle platforms.

**EASYMILE Driver-less Shuttle upgraded for unattended Operation, last Mile People Mover; France**

10 Jun 2019
EASYMILE: Toulouse-based EasyMile unveiled an upgraded version of its EZ10 driverless electric shuttle at the UITP Global Public Transport Summit 2019.

As well as a redesigned sensor providing a wider field of vision, the vehicle has a new safety architecture that enables operation without an on-board attendant, according to EasyMile. Other improvements include more comfortable seats, seat belts and ADA-compliant wheelchair anchor points.

EasyMile launched the EZ10 in April 2015, since when several passenger-carrying tests have taken place with an onboard attendant.

‘EasyMile’s technology has now reached a maturity and reliability level that allows us to deploy EZ10 shuttles without an attendant on board’, said CEO Gilbert Gagnaire. ‘Passengers’ feedback has been very positive on all our tests and the legislation around the world is now coming together to enable this step forward.’

Thales addresses the big Questions of Digitalisation at UITP; Global

08 Jun. 2019
THALES: A series of talks on the challenges facing the transport industry as digital technologies develop will take place on Thales’ stand at the UITP Global Public Transport Summit 2019.

Arnaud Besse will address the future development of Communications Based Train Control, CBTC, Signalling, while Walter Kinio will give a presentation entitled ‘The path to an autonomous train’. Amaury Jourdan, meanwhile, will consider how artificial intelligence is going to impact rail networks and their operations.

Pierre-Antoine Benatar will take a slightly different angle by looking at what lessons on digitalisation the transport industry can learn from nature, and Victor Borges will examine how value can be extracted from data, which is being collected in volumes and at speeds hitherto impossible.

Looking to the future, Trude Solvang will address the topic of skills. As digitalisation changes the nature of jobs in the rail sector, how do businesses change their culture to avoid a skills shortage in the coming decades?

Bombardier unveils Compas LRV Safety System; Global

Jun. 10, 2019

Written by David Burroughs

IRJ at UITP Summit: Bombardier has presented its new Compas (Collision and Overspeed Monitoring and Prevention Assistance System) safety system for urban LRVs at the UITP Global Public Transportation Summit in Stockholm.
The technology was developed in cooperation with Bombardier's research partners, the Austrian Institute of Technology and Mission Embedded.

Compas combines two driver assistance functions, a vision-based over-speed prevention and an automated obstacle detection assistance system. It is designed to ensure the driver always maintains full control over the vehicle by using digital track data and visual odometry to prevent the vehicle from exceeding its pre-defined speed limits.

“We have completed the development phase of Compas and will shortly start the operational evaluation in two existing vehicle fleets,” says Mr Christian Diewald, managing director of Bombardier Transportation in Austria. “I am especially happy that we are testing this safety innovation in the new vehicles for our customer Wiener Linien in Austria, but also with our customer in Blackpool, Britain.”

The new system is expected to be granted commercial service authorisation by mid-2020, with additional functions, such as increased vehicle autonomy enabling automated operation in depots, planned to for future integration.

Compas builds upon Bombardier's Obstacle Detection Assistance System (ODAS) introduced in Frankfurt, Germany, in 2017.

Categories: EuropeLight RailNewsTechnology
Tags: BombardiersafetyUITP

Tram Collision and Overspeed Safety System to be tested in Wien and Blackpool; Austria, UK, Global

10 Jun. 2019
SAFETY: Bombardier Transportation launched its Collision & Overspeed Monitoring & Prevention Assistance System for trams and light rail vehicles at the UITP Global Public Transport Summit 2019. Testing of the technology will soon begin on trams in Wien and Blackpool.

Developed in co-operation with the Austrian Institute of Technology & Mission Embedded, COMPAS builds on Bombardier’s Obstacle Detection Assistance System that has been in service since 2017 and is now used by five light rail operators.

COMPAS incorporates vision-based overspeed prevention and automated obstacle detection assistance. In the future, additional functions could be added such as increased vehicle autonomy that would enable automated operation in depots.

Bombardier expects COMPAS to be granted commercial service authorisation by mid-2020.

Transit agencies across the country are facing similar challenges around increasing capacity and safety, meeting riders’ mobility demands, and keeping up with the rate of digital change.
As the only dedicated strategic technology congress for North American bus, rail and metro, the SmartTransit Congress brings together senior representatives from transit agencies, railroads, governments and solution providers to tackle these challenges and develop strategies to deliver a Seamless Transit Systems.

If your solution can help transit agencies with asset management, digitalization, signalling and telecommunications, enhancing the passenger experience or building mobility partnerships then this is the event for you!

Take a look at the 2018 audience to see what types of people you can meet and if you think this event could be a good fit for you then please get in touch!

Sydney’s first Metro Line a Revolution for Australian Transport; Australia

Jun. 10, 2019
Written by

The opening of the first stage of the Sydney Metro Project on May 26 heralds a new era of passenger rail transport, not just for Sydney, but Australia as a whole, as Mark Carter explains.

The new Metro Line includes a 15.5 km twin-bore Tunnel Section between Bella Vista and Epping

IN a major departure from its reliance on a surface commuter rail for the Sydney area, the New South Wales (NSW) state government has adopted driverless metro operation, much of it underground, for most of its future network expansion. The first line opened on May 26, an extension will open in 2024, followed by a second metro line and a link to Sydney’s new airport.
Australia’s largest city, Sydney is experiencing the same congestion challenges facing most major global cities as a result of continued population growth. Medium growth forecasts predict that Sydney’s current population of around 5 million will reach more than 6 million by 2027, and 8.3 million by 2050.

The newly-opened $A 8.3bn ($US 5.7bn) Sydney Metro Northwest Line is Australia’s most costly public transport project to date and was first envisaged in 1998 as an extension of the heavy rail suburban network to Sydney’s expanding north-western suburbs.

Progress was severely hindered with frequent politically-influenced policy changes and government budgetary constraints over a 15-year period. Political change in 2011 saw firm plans implemented for the project and tenders for major works called by early 2013.

Much of the 23km line between Tallawong and Epping is underground with 15.5km in twin tunnels between Bella Vista and Epping, plus a 4.4 km viaduct between Kellyville and Rouse Hill. At Epping, the new line connects with the former Sydney Trains 13 km Epping – Chatswood line which was converted for metro operation during an eight-month shutdown.

“The metro trains have longitudinal seating with seats for 378 passengers, and a total capacity of 1100.”

The 13 stations on the line will be the first in Australia to be equipped with platform screen doors. Chatswood will be the major interchange between Sydney Metro Northwest and the Sydney Trains network for access to the city centre until the Sydney Metro City and Southwest extension opens in 2024.

**Rolling stock is provided by 22 six-car Alstom Metropolis EMUs built in Sri City, Andhra Pradesh, India.** Power supply is 1.5 kV dc overhead, similar to the rest of the Sydney suburban network, however, the single-deck trains are a major departure from Sydney’s double-deck commuter fleet. The metro trains have longitudinal seating with seats for 378 passengers, and a total capacity of 1100. The rolling stock maintenance facility and operations control centre are based at the northern end of the line at Tallawong.

The trains are fitted with **Alstom’s Urbalis 400 CBTC System** which ensures trains are capable of operating automatically at all times including door closing, obstacle detection and in emergency situations.

Sydney Metro Northwest is not only the first line in Australia to have driverless trains, it is also the first to have been built and operated by the private sector from the outset, albeit under contract to the NSW government. The Northwest Rapid Transit Consortium (NRT) comprising MTR, John Holland, Leighton Contractors, UGL Rail Services and Plenary Group won the $A 3.7bn Public Private Partnership (PPP) contract for the trains and systems, which includes a 15-year operation and management contract. However, ticketing and pricing for the metro will remain within NSW’s existing Opal Card regime.

In another first, services will not be timetabled, but operate on a turn-up-and-go basis for commuters with 4-minute headways during peak periods. Sydney Trains has introduced additional services on the North Shore Line during the morning peak in preparation for the thousands of commuters who will change to and from the metro at Chatswood each day.
This interchange will disappear in 2024 when the second stage of the metro opens between Chatswood, the city centre and Bankstown southwest of Sydney.

Major works on the $A 12.5bn Sydney Metro City & Southwest extension started last year. The 30km extension will comprise a completely new line with seven stations running from the current terminus at Chatswood, under Sydney Harbour and through the central business district before taking over the existing heavy rail line to Bankstown which will be converted for metro operation. The 11 existing stations on this section will be upgraded.

Seven major contract packages have already been awarded for Metro City & Southwest.

Tunnelling commenced last year with four of five tunnel boring machines now in the ground to complete 31 km of tunnels between Marrickville and Chatswood. A fifth machine has been specially designed to bore the twin tunnels under Sydney Harbour.

Evaluation of the trains, systems, operations and maintenance tender is currently underway. At the end of 2018 Sydney Metro executed a Contract Finalisation Deed with Northwest Rapid Transit – the consortium delivering stage 1 of the Sydney metro – for the potential alteration of their contract to take into account the delivery of extra trains and some key rail systems for stage 2, as well as the operation and maintenance of the entire line.

Even though the two stages are being procured under different contracts and are several years apart, the OTS augmentation provisions allow it to operate as one integrated line. This means the contract for stage 1 can be altered to include elements for stage 2.

Major civil works will start this year at a number of sites, including the extensive works required to transform the interchange at Sydney Central between existing heavy rail services and the metro.

Ultimately there will be capacity for a metro train every two minutes in each direction through the city centre, providing capacity for around 40,000 passengers per hour. Sydney’s current suburban system can reliably carry 24,000 passengers per hour per line.

Together with signalling and infrastructure upgrades across the existing Sydney rail network, the number of trains entering central Sydney will increase from about 120 per hour up to 200 beyond 2024, an increase of up to 60%.

Sydney Metro West will be a new 25 km underground line linking the centres of Parramatta and Sydney. This $A 18bn-plus project is the city’s most ambitious metro scheme as it will double rail capacity between the area’s two biggest commercial centres.

Sydney Metro West will serve Greater Parramatta, Westmead, Sydney Olympic Park, the Bays Precinct and Sydney city centre. It is expected to open in the second half of the 2020s. The NSW state government has so far allocated $A 6.4bn in future budgets towards the cost of the project.

A journey time of around 20 minutes is envisaged between Parramatta and Sydney, compared with 26 minutes today by commuter rail.

The current scope of the works includes:

- a new underground metro station at Westmead, to support the growing residential area as well as a health, research and education precinct
• an underground interchange with an existing suburban station on the T1 Western Line – either at Parramatta or Westmead – to provide a fast and easy interchange with heavy rail services, and
• at least one Sydney Metro West station in central Sydney, delivering an easy interchange between suburban rail, new light rail and the new metro stations currently under construction.

Contract procurement and subsequent delivery of works, goods and services for Sydney Metro West is expected to start this year. Given the scale of the project, the first major contracts will be for tunnelling. The potential for greater private sector participation through a PPP is being investigated.

**New Sydney Airport Link**

With a decision having been made in March 2018 on the location of Sydney’s second international airport at Badgery’s Creek, the federal and state governments announced that the airport, together with an associated manufacturing, research, medical, education and commercial hub, to be known as Aerotropolis, will be served by an initial 22 km metro-style link. Airport link passengers will interchange with the existing Sydney Trains suburban network at St Marys on the Sydney – Emu Plains line.

A detailed business case, to be delivered by the end of 2019, is already underway to consider final corridor identification, station locations and detailed costs.

The new Sydney metro line runs on a 4.4 km viaduct between Kellyville and Rouse Hill. Located directly outside the Rouse Hill Town Centre and above the existing T-way, the new Rouse Hill Station will service this growing retail and entertainment precinct.

The two governments have agreed that they will construct the line as equal partners with the federal government suggesting its previously announced share of $A 3.5bn will come from the $A 10bn National Rail Programme announced in the 2017-18 federal budget.

The NSW government has so far allocated $A 2bn over the next four years, while a market sounding process will also be used to test private sector interest in station developments and explore innovative financing solutions.

The Metro is a bold and expensive experiment by the NSW state government.
Construction is planned to start in 2021 with the opening of the line coinciding with the opening of the new airport in 2026. Long-term options could see the airport metro eventually connected to either, or both, of the Ruse Hill and Bankstown metro lines to create a much larger metro network for Australia’s largest city.

Sydney Metro is a major departure for Sydney’s public transport, breaking a more than two-decade reliance on heavy rail and double-deck trains for the city’s suburban rail needs. The Metro is a bold and expensive experiment by the NSW state government, but something that was sorely needed following years of inertia in transport policy planning.

Sydney often sells itself as “Australia’s only global city” so arguably a largely-underground metro is something that will help further enhance that claim.

The shift in emphasis has not been without its critics, but with work on the second stage Sydney Metro City and Southwest Line now well underway, there is no turning back on the commitment to this mode for future rail expansion in Sydney.

**Second Light Rail Line to open in December**

TRACKLAYING is complete and trial running has commenced on sections of Sydney’s troubled 12 km South East Light Rail project. Most of the line is expected to open in December, almost a year behind schedule and $A 500m over budget.

The $A 2.1bn ($US 1.45bn) project has caused major disruption for local businesses along the route during construction with many claiming severe hardship despite a compensation scheme operated by the NSW government. Additionally, a $A 1bn lawsuit lodged by major contractor Acciona, against Transport for NSW, alleging “misleading or deceptive conduct” before signing the design and build contract in 2014, has also cast a cloud over the project.

The line, which will have 19 stops, extends from Circular Quay along George Street to Central station, and then through Surry Hills to Moore Park with branches to Randwick and Kingsford. Work on the latter branch is behind schedule and will not open before March 2020.

The existing 12.7 km long Inner West light rail line connecting Dulwich and Central station, which carries more than 9.7 million passengers a year, will connect with the new line at Central station. The two lines will be incorporated under the Sydney Light Rail banner.

Integration of local bus services with the light rail network is aimed at improving public transport access to major sporting and entertainment facilities at Moore Park and Randwick, along with the University of NSW and health precincts. Services will be stepped up to provide extra capacity for major sporting events.

Transdev, which has the contract to operate light rail services, has begun recruiting drivers, and training is expected to start soon on the 60 Alstom Citadis X05 LRVs being delivered for the project.

**Paramatta LRT**

Light rail will also form a major part of the NSW government’s revitalisation of Sydney’s western suburbs. Contracts were signed in December 2018 for the $A 2.4bn 12 km long Parramatta Light Rail Stage 1. The line will open in 2023, and will run from Westmead via Parramatta to Carlingford and then along the existing commuter rail line to Camellia.
Paramatta Stage 2 will connect with Stage 1 at Camellia and run via Ermington, Melrose Park, and Wentworth Point to Sydney Olympic Park. The 9 km line will provide travel times of around 25 minutes from Sydney Olympic Park to Camellia, and a further eight minutes to Parramatta where it will connect with the planned Sydney Metro West. The NSW government is considering a final business case for Stage 2, with an investment decision and details on the timing of construction to follow.

Categories: Australia/NZ
Tags: Australia New South Wales Sydney Sydney Metro Transit Tunnelling

'Make in India' Initiative: India manufactures driverless Train for Sydney Metro; India

These metro trains were assembled in Andhra Pradesh's Sri City, which is a smart integrated business city:

Another major milestone for the 'Make in India' initiative, coaches assembled in India will be running in the Sydney Metro Line. Sydney has recently opened its first driverless metro line that will be served by 22 Alstom six-coach trains, which are fully automated and consist of various modern features including LED lighting, emergency intercoms, CCTV camera, etc.

These metro trains were assembled in Andhra Pradesh's Sri City, which is also known as Satyavedu Reserve Infarcity Pvt. Ltd, situated in Chittoor district. It is a smart integrated business city in the state.

Alstom India, an Indian subsidiary of a France-based multinational company- Alstom SA, delivered the last of the 22 Metropolis trains for Sydney Metro.
The company was given a contract by North West Rail Link (NRT), which travels from Tallawong station to Chatswood station, with 13 stations along 36 km in total, to design, manufacture, supply, test and commission 22 six-card Metropolis train along with Urbalis 400 signalling systems. The company has won a 15-year maintenance contract for the trains, depot operations and signalling systems.

Metropolis trains is an electric multiple unit (EMU) built by Alstom designed for high capacity rapid transit or metro rail infrastructure systems. Currently, the trains are in service in 22 major cities including Chennai and Kochi.

**Urbalis** is the advanced signalling solutions for all metro and transit rail applications.

In December 2018, the Alstom India had planned to double its metro rail production at its plant in Sri City.

### Alstom focuses on ‘green, fluid, safe and inclusive’ Mobility at UITP 2019; Global

07 Jun. 2019

**ALSTOM:** Alstom will use the UITP Global Public Transport Summit 2019 to show how public transport can offer passengers a ‘fluid, secure and enjoyable travel experience’ while remaining environmentally friendly, sustainable and accessible.

Visitors to the company’s stand will be able to learn about the latest developments in the StationOne business-to-business online marketplace, which Alstom launched at InnoTrans 2018. The platform is designed as a way for vendors to promote their products and for operators to access a broader range of products and services. The single catalogue approach will enable buyers to compare products and source alternatives for obsolete components. StationOne operates as an independent legal entity from Alstom to ensure complete neutrality and confidentiality.
Other technology on display at Alstom’s stand includes its Mastria surveillance and control system, the Dynamic Maintenance Planning system, Appitrack tracklaying technology, the Travel Assistant platform that connects passengers and operators in real time, and Iconis software that integrates management of security operations, passenger information and communications in a control centre.

Safra to present Businova Model at UITP 2019; France, Global

04 Jun. 2019

SAFRA: This year French bus manufacturer Safra SAFRA Constructeur is attending the UITP Global Public Transport Summit for the second time.

The company’s stand will feature a model of the Businova that Safra recently delivered to Castres-Mazamet. With a two-part chassis and three axles, the Businova is available in electric, hybrid electric and hydrogen versions. The three vehicles in Castres-Mazamet are hybrid electric and use plug-in charging.

Safra is currently in the process of manufacturing six hydrogen Businvo vehicles for Artois-Gohelle, and will shortly begin work on five vehicles for Be Green in Versailles. It expects to begin production this year on buses destined for Albi and Le Mans.
INIT to show Electromobility Tools at UITP 2019; Germany, Global

28 May 2019

Init already works with electric Bus Operators, such as Wiener Linien.

INIT: Karlsruhe-based Telematics and Ticketing Systems Company INIT will be highlighting its role in electric and multi-modal mobility at the UITP Global Public Transport Summit 2019.

As more electric bus fleets enter service around the world, Init has developed a suite of tools to help operators plan their deployment. Its eMobile-Plan planning and simulation software can be used as a module of the Mobile-Plan suite or as a stand-alone programme. The electromobility version forecasts the effects of route planning, range and weather conditions, and can estimate required personnel and total costs.

The Mobile-ITCS intermodal transport control system enables dispatchers to monitor onboard battery charge levels, while the charging process itself can be managed and monitored using MOBILEcharge. The MOBILEfficiency driver assistance software provides real-time energy consumption data, and MOBILErange calculates ranges. Init has also developed its Mobile-DMS depot management software for use with electric bus depots.

RATP to test Solaris Hydrogen Bus; France, Italy

10 Jun. 2019
FRANCE: RATP is to test a hydrogen fuel cell bus in passenger service next year, after signing an agreement with manufacturer Solaris at the UITP Global Public Transport Summit 2019 on June 10.

RATP will test a bus over a 10-week period between April and June as part of a project to have a fully zero-emission bus fleet by 2025. The leased bus will be stabled at RATP’s bus centre in Thiais.

Solaris premiered the Urbino 12 hydrogen at the UITP exhibition in Stockholm. Two 125 kW electric motors are powered by 60 kW fuel cells, which are in turn fed by hydrogen stored in Type IV tanks at a pressure of 35·5 MPa. The five roof-mounted tanks have a total hydrogen capacity of 36·8 kg, which the manufacturer says enable the bus to run for up to 350 km before needing to refuel. Waste heat from the fuel cells is used to heat the interior via a CO₂ heat pump.

The vehicle is also fitted with a small Solaris High Power traction battery to assist at times of high energy demand. The battery stores energy from regenerative braking and from hydrogen, and can also be charged through traditional plug-in charging at the depot.

The launch customer for the Urbino 12 hydrogen is SASA Bolzano. The contract for 12 vehicles signed last month includes eight years of service and maintenance.

Mobility Innovation Partnership launched; Germany , Global

10 Jun. 2019
GERMANY: The UITP Global Public Transport Summit 2019 saw the official launch of the Mobility Innovation Partnership between UITP and Technology Region Karlsruhe, that was concluded in April. This includes UITP’s establishment of a training centre in Karlsruhe, which will reveal its initial programmes at the summit.

Firms in the transport sector in the Karlsruhe region are exhibiting on the TRK stand. The aim of the organisation is to encourage players from academia, business and the public sector to work together to address what it sees as ‘challenges presented by the mobility revolution’ that need to be tackled at a regional level. In line with this view, the partners are working to create a single multimodal transport network for the whole region under the Regiomove project.

Part of the Regiomove project involves installing facilities and services to improve the user experience when changing mode, including to car- or bike-sharing from public transport. Interchange points have been moved to more attractive public spaces, and services such as catering facilities were added.

Conference delegates can listen to presentations from TRK members on June 11, who will be talking about topics including developments in self-driving road vehicles.

Flexible, integrated Software – the Key to planning and operating attractive, high-Quality Rail Service; Global
GIRO has been helping public transport operators keep their services efficient – and attractive to the public – for 40 years.

GIRO’s HASTUS is trusted as the flexible, modular software solution for all modes of public transport. More than 100 passenger-rail operators worldwide rely on HASTUS to help them plan, optimize and operate their services.

Integrated tools, combined with powerful optimizers, help rail operators plan and manage timetables, rolling stock, and on-board and station staff:

• Design robust, optimized transport plans covering a range of scenarios
• Optimize rolling-stock resource-planning, taking account of maintenance and operational constraints
• Achieve maximum efficiency with operational-staff assignments that respect safety rules and labour regulations
• Increase employee satisfaction, and decrease absenteeism, by taking employees’ preferences into account when building schedules

HASTUS is used by operators as diverse as SNCF, one of the largest rail operators in the world, operating urban, suburban, regional and national high-speed networks all over France; MTR Express, the premium express-train service linking Stockholm and Gothenburg; and Queensland Rail, the regional and long-distance passenger-rail operator in Queensland, Australia.

Visit us at Stand A4058 to discover how HASTUS can help you ensure the quality of your passenger-rail services.

**Masabi launches Justride Validator Ticket System; Global**

Jun 11, 2019
Written by David Burroughs

**IRJ at the UITP Stockholm Summit:** Masabi has launched its Justride Validator, a multi-format ticket validation device for buses and LRVs designed to allow passengers to tap a contactless payment card, linked smartcard or mobile device to travel, without needing to purchase a ticket or understand the fare system.
The Justride Validator supports all major ticketing formats including paper and mobile barcodes, contactless bank cards (cEMV) and smartcards (NFC), as well as bluetooth. Masabi says the system possesses the necessary capabilities to meet the demands of account-based ticketing (ABT), including in large cities, but has a price point that makes next-generation ticketing accessible to transit agencies and operators in smaller towns and cities.

“Ticketing using contactless bank cards and smart devices – it’s what passengers are expecting and what transport providers are demanding,” says Mr Brian Zanghi, CEO of Masabi. “However, the reality is that the hardware requirements have made it cost-prohibitive for many transit authorities around the globe. By failing to make tap and ride ticketing accessible to all transport agencies, the industry has been failing passengers.

“Through combining our Software as a Service (SaaS) approach, together with this innovative affordable hardware, we are fundamentally changing the economics of ABT, opening it up to cities and transport authorities of any size and budget.”

The new device provides a pole-mounted validation solution, which has been designed to meet accessibility standards, including the United States Americans with Disabilities Act. It is also EMV Level 1 and 2 Compliant with support for MasterCard, Visa, American Express, Apple Pay, Google Pay and others.

In addition, the device includes features such as built-in GPS and cellular connectivity, vehicle-wide and network-wide pass-back protection.

Categories: Light RailNewsTechnology
Tags: Masabiticketing

Stockholm Passenger Information Framework extended; Sweden

Jun 11, 2019
Written by David Burroughs
AddThis Sharing Buttons

IRJ at the UITP Summit: Greater Stockholm Transport (SL) has extended its framework agreement with Teleste Corporation, which was signed in 2014 and includes
the installation of Teleste’s latest RGB LED and TFT LCD passenger information displays at SL’s stations and platforms.

The display solutions include a 55-inch touch screen information pillar for travel planner services and weather information, as well as platform and multiline displays with integrated diagnostics, good visibility from all viewing angles and advanced features for displaying information.

Categories: EuropeLight RailNews

New York Subway to trial Underground GPS

Jun. 6, 2019
Written by

IRJ at Wheel Detection Forum 2019, Vienna: New York City Transit (NYCT) has awarded Syntony Corporation a contract for the trial deployment of its SubWave underground GPS technology on the city’s subway network.
SubWave uses leaky coax cables to extend the reach of GPS positioning to underground infrastructure. The technology, which is already in use on the Stockholm metro network, enables accurate location of trains and other assets in tunnels.

Syntony says SubWave can already be used for non-safety-critical applications but it expects to gain SIL 2 certification for the technology this year and aims to achieve SIL 3 and SIL 4 certification within two years.

The trial deployment in New York will cover around 1km of tunnel.

Categories: MetrosNewsNorth AmericaTechnology
Tags: New YorkNYCTSyntony Corporation

Huawei launches LTE-R Solution; Global

Jun. 11, 2019
Written by David Burroughs

IRJ at the UITP Summit: Huawei, along with its partner Tianjin 712 Communication & Broadcasting (TCB 712), have jointly released an LTE-R solution for rail wireless communications.
The solution, which is already being deployed in China, was developed to ensure information synergy between passengers, trains, and infrastructure, and cope with the higher-speeds and more intelligent wireless communications technologies needed for autonomous operation, intelligent trains, and smart stations.

Huawei says the LTE-R solution supports 5G Evolution and interconnectivity with GSM-R. Features include multiple trunking services such as Mission Critical Push-to-Talk (MCPTT) voice, video, and data, and leveraging one LTE-R network to enable train control, train dispatching, passenger information system (PIS), CCTV, and other services.

The LTE-R solution enables wireless voice and data communications onboard, from train-to-ground and from train-to-train.

TCB 712 has worked with Huawei in developing GSM-R solutions and the LTE-R solution since 2010, and the system has also been used by customers in South Africa.

Categories: AsiaEuropeNewsSignallingTechnology
Tags: GSM-RHuawei

Dodoma, Tansania, Commuter Rail Study commissioned; Tansania

11 Jun. 2019
TANZANIA: Tanzania Railways Corp has awarded an international consortium a €2.5m nine-month contract to undertake feasibility and preliminary design studies for a commuter rail network in the capital Dodoma.

The consortium is led by Spanish consultancy Ardanuy Ingenieria and includes Intercontinental Consultants & Technocrats from India and South Korea’s Soosung Engineering.

The technical, economic, financial, environmental and social feasibility of the project is to be analysed, and various routes and alignments evaluated. The consortium would also be responsible for preparing preliminary designs, calculating the estimated costs of the works and drafting tender documents.

Ardanuy Ingenieria said the aim was to design a railway system, which was ‘efficient, sustainable, safe, cost-efficient and satisfies the travel demands of the city and its surroundings.’

Announcing the contract on June 11, the Spanish consultancy said the project would help to reinforce its presence in Africa, where it has already worked in Algeria, Egypt, Morocco, Mauritania, Tunisia, Burkina Faso, Togo, South Africa, Mozambique, Ghana and Kenya.

Tanzania Railways Corp currently operates some long-distance passenger services on its metre-gauge network, as well as weekday peak commuter train services into Dar es Salaam from Ubungo Maziwa (12 km) and Pugu (20 km).

Related news
- 22 Feb 2017 - Nairobi moves ahead with transport plans
- 17 Dec 2015 - Kampala light rail agreement signed

Siemens wins Portland Light Rail Vehicle Overhaul Contract; USA

05 Jun. 2019
USA: Portland Transport Agency TriMet has awarded Siemens Mobility a contract to undertake the mid-life overhaul of 79 SD660 light rail vehicles.

Due to be completed in 2025, the €80m contract includes options worth a further €25m. Following two pilot overhauls at the Siemens Mobility West Coast Rail Services Hub in Sacramento, the work will be carried out at a new facility in Clackamas, Oregon.

TriMet ordered 46 SD660 vehicles from Siemens in 1995, with orders for 33 more following over the next five years. Siemens has also supplied 40 S70 LRVs to TriMet.

Hyundai Rotem to develop Hydrogen Fuel Cell Tram; South Korea

11 Jun. 2019

Hyundai Rotem has previously supplied Trams to Cities in Turkey including Antalya

SOUTH KOREA: Hyundai Rotem has signed a memorandum of understanding with Hyundai Motor’s Mabuchi Research Institute for the development of a hydrogen fuel cell tram.

The agreement announced on June 10 would see Hyundai Motor, which already has hydrogen fuel cell cars and buses in its portfolio, supply fuel cells that would be fitted to a Hyundai Rotem low-floor tram. Hyundai Rotem will also be responsible for developing and testing interfaces between the fuel cells and the vehicle.

The prototype due to be completed in 2020 would have a 200 km range between refuelling and a maximum speed of 70 km/h.

Yutong to supply Electric Buses to Newport; UK, China

06 Jun. 2019
UK: Newport Transport has ordered 15 battery electric buses from Chinese manufacturer Yutong.

The order is being partly financed through a funding line from battery manufacture Zenobe Energy, and the buses will be supplied in partnership with Yutong’s UK distributor Pelican Engineering.

The first of the 12 m E12 buses is due to arrive next month, with seven following in February 2020 and the remaining seven in April.

The buses have an operating range of up to 330 km. They are equipped with LED lighting, USB sockets and 39 seats.

CAF wins Docklands, London, Light Railway Train Order; UK, China

Jun. 12, 2019
Written by David Burroughs

TRANSPORT for London (TfL) has awarded CAF a contract to design, manufacture and supply a fleet of 43 driverless metro trains for the Docklands Light Railway (DLR).
The contract includes an agreement to provide technical support services and spares supply.

The five-car trains will be based on CAF’s Metro product platform, with the first trains entering passenger service from 2023.

The first 33 sets will replace DLR’s B90 trains, which are nearly 30 years old, while the remaining 10 will increase frequency and capacity across the network.

The new walk-through trains will be a similar length to the three-car trains currently operating on the DLR and will be equipped with a number of passenger-focused improvements. These include audio and visual real-time travel information, air conditioning, mobile device charging points, multi-functional areas for pushchairs, bicycles and luggage, and dedicated wheelchair spaces.

CAF was shortlisted by the DfT in November 2017 alongside Alstom, Bombardier, and a consortium of Siemens, Stadler Bussnang, and Stadler Rail Valencia.

Categories: EuropeLight RailNews
METRO NEWSLETTERS on “URBAN MOBILITY AS A SERVICE”

PUBLIC MULTIMODAL URBAN, SUBURBAN AND INTERURBAN PASSENGER TRANSIT SYSTEMS WITH METRO-BUS, LIGHT-RAIL, TRAM-TRAIN, METRO-RAIL, METRO-TRAIN, REGIONAL RAPID TRANSIT, COMMUTER-RAIL, ROPE-WAY/TRAIN, MAGLEV AND HOVERCRAFT TRANSIT/PEOPLE MOVER, WATER-METRO, AUTONOMOUS PEOPLE-MOVER

TRANSPORTATION AND ECONOMIC DEVELOPMENTS IN MODERN URBAN/MEGAPOLIS ENVIRONMENT

METRO Newsletter by Dr. F.A. Wingler
METRO 73, June 2019

Control Desk for Communication Based Train Control, CBTC
PART I: INDIAN ACTIVITIES AND INITIATIVES FOR URBAN MOBILITY AS A SERVICE

New Body formed to run upcoming Metro Corridors in Mumbai; India

June 17, 2019 Rail News

Mumbai: A new body has been formed to run the Metro corridors in Mumbai, according to a report. The MMRDA (Mumbai Metropolitan Region Development Authority) has established the Mumbai Metro Operation Corporation Limited (MMOCL) to run the upcoming Metro corridors.

More Information:

- The MMOCL will carry out the “business and operation” of the upcoming 13 Metro corridors in the Mumbai Metropolitan Region (MMR), HT reported.
- The MMRDA had got the Centre’s approval to set up MMOCL on June 10.
- Now, the authority is finalising a logo for the company.
- The idea behind forming MMOCL is to integrate the operations and maintenance of all Metro corridors under one authority.
- The state government has written to the Centre to bring Colaba-Bandra-Seepz Metro Line-3 corridor under the MMOCL after its construction is completed.
- In November last year, Chief Minister Devendra Fadnavis approved the establishment of the company.
- “The company will be set up under MMRDA and undertake all Metro operations,” Dilip Kawathkar, joint projects director, MMRDA told the HT.
MMOCL will run using the ticketing and non-ticketing revenue earned from all Metro corridors.

PART II: GLOBAL ACTIVITIES FOR URBAN MOBILITY AS A SERVICE

First Day of the London Tube, January 1863; UK

The Capital went underground on 10th January 1863.

Richard Cavendish | Published in History Today, Volume 63, Issue 1 January, 2013

Illustration of a Train at Praed Street Junction near Paddington, 1863.

Work on the world’s first underground railway started in 1860 when the Metropolitan Railway began building a tunnel more than three miles long from Paddington to Farringdon Street. It was largely financed by the City of London, which was suffering badly from horse-drawn traffic congestion that was having a damaging effect on business. The idea of
an underground rail transport had originated with the City solicitor, Charles Pearson, who had pressed for it for years. It was he who persuaded the City Corporation to put up money and he was probably the most important single figure in the underground’s creation. He died in 1862, only a few months before his brainchild came to life.

The first section linked the City with the railway stations at Paddington, Euston and King’s Cross, which had been built in the previous 30 years. The chief engineer was John Fowler, the leading railway engineer of the day, who would go on to create the Forth Bridge in Scotland. He did not come cheap and his Metropolitan Railway salary of £137,700 would be worth about £10 million today.

A deep trench was excavated by the ‘cut and cover’ method along what are now the Marylebone Road and the Euston Road and turning south-east beside Farringdon Road. Brick walls were built along the sides, the railway tracks were laid at the bottom and then the trench was roofed over with brick arches and the roads were put back on top, though the last stretch to Farringdon was left in an open, brick-lined cutting. Stations lit by gas were created at Paddington, Edgware Road, Baker Street, Great Portland Street, Euston Road and King’s Cross on the way to Farringdon, which was at ground level and was built, not entirely inappropriately as things turned out, on the former site of the City cattle market. W.E. Gladstone, who was Chancellor of the Exchequer at the time, and his wife Catherine were passengers on a trial trip in May 1862.

Built round the clock by shifts of navvies, the line had to avoid numerous water and gas pipes, drains and sewers. There was a problem when the noxious Fleet Ditch sewer flooded the works in Farringdon Road, but that was dealt with and on January 9th, 1863 the line’s completion was celebrated at a gathering of railway executives, Members of Parliament and City grandees including the lord mayor. The Prime Minister, Lord Palmerston, had declined his invitation, saying that at 79 he wanted to stay above ground as long as he could. Starting from Paddington, some 600 guests were carried in two trains along the line to Farringdon Street station, where a banquet was held, speeches made and due tribute paid to the memory of Charles Pearson. Music was provided by the Metropolitan Police band.

The line was opened to the public on the following day, a Saturday, and people flocked to try it out. More than 30,000 passengers crowded the stations and pushed their way into packed trains. The underground had been mocked in the music halls and derisively nicknamed ‘the Drain’. There were predictions that the tunnel’s roof would give way and people would fall into it, while passengers would be asphyxiated by the fumes, and an evangelical minister had denounced the railway company for trying to break into Hell.

In fact the railway was a tremendous success and The Times hailed it as ‘the great engineering triumph of the day’. In its first year it carried more than nine million passengers in gas-lit first-class, second-class and third-class carriages, drawn by steam locomotives that belched out choking quantities of smoke. The fact that the passengers were at first forbidden to smoke in the carriages was not much help.

Over the next two years the line was extended further east into the City to Moorgate and, in the other direction, to Hammersmith. Other lines were soon added to the growing network, deeper underground tunnelling was introduced and the steam trains were replaced by electric trains. The first underground electric railway, the City and South London, which ran from near the Bank of England under the Thames to the South Bank, opened in 1890. It was the first line to be called ‘the tube’ and the windowless carriages with their heavily upholstered interiors were popularly known as ‘padded cells’.
As far as the City was concerned, the corporation was able to sell its shares in the Metropolitan Railway at a profit and the underground did ease congestion for a time. A more lasting consequence was to make commuting far easier and so cause London to sprawl out even more from its centre, while the number of people actually living in the City itself declined sharply.

World’s oldest Metros in Brief; Global

Source: Magdalena Dugdale
28 May 2019
Analysis; railwaytechnology.com

**Metros across the World** have been in operation since the late 1800s and transport millions of commuters across cities every day. There are now more than 185 Metro Installations globally with an average of 168 million daily passengers. We take a look at the world's ten oldest metros.

**London Underground in England**

The UK’s London Underground was originally opened in 1863 for locomotive trains. In 1890, it became the world’s first metro when electric trains began operating on one of its deep-level tube lines.

It is the world’s third longest metro, spanning 402 km with 270 stations across its 11 lines. Only 45% of the network actually runs underground, mainly in the city centre, with lines in the suburbs mostly running overground.

The network handles approximately five million passengers a day, with as many as 540 trains operating throughout the network at peak times. With increased usage, the network has undergone a number of extensions and upgrades since it was first opened but overcrowding is a common problem across the network.

London Underground has been owned and operated by Transport for London subsidiary London Underground Limited since 2007. Originally, tube lines were owned by various private companies until 1933, when the London Passenger Transport Board was introduced. Ownership of the London Underground was then passed to London Regional Transport in 1984.
Budapest Metro in Hungary

*Budapest Metro in Hungary* first became operational with the opening of Line 1 in May 1896. In 2002, the line was listed as a World Heritage Site by Unesco.

The network comprises four lines. A fifth line to connect the suburban rail system has been proposed but construction has not yet been planned. Lines M1 and M2 were extended in 1973 to their current respective lengths of 4.4 km and 10.3 km.

Line M3 was opened in 1976, which marked the start of the three lines being colour-coded yellow for M1, red for M2 and blue for M3.

The Metro features the first automated metro route in Eastern Europe on the M4 line, which opened in March 2014. It was estimated that the line would save passengers 14 million hours of travel time each year, as well as lowering the amount of road traffic. While initial planning for the line began in the 1970s, construction did not begin until 2006.
Europe’s oldest Subway: M1, Budapest; Hungary

Glasgow Subway in Scotland

Glasgow Subway in Scotland is the world’s third oldest metro system, opening in December 1896. The system runs along an underground 10.5 km loop in the city and is one of the only metros in the world not to have been expanded beyond its original route.

“A number of upgrade works are being undertaken across the subway as part of its largest project in 30 years.”

The system carries approximately 13 million passengers every year. It features an outer and inner circle, with services operating the same route in separate tunnels clockwise in the outer circle and anti-clockwise in the inner circle.

Towards the end of the first day of service, an accidental carriage collision caused four injuries and forced the network to close. It reopened on 19 January 1897.

A number of upgrade works are being undertaken across the subway as part of its largest project in 30 years. It includes modernisation of all stations, 17 new trains from Swiss train manufacturer Stadler, and replacement of the ramps and turnouts that allow trains to access the upgraded depot overground.
Chicago ‘L’ in USA

The Chicago elevated ‘L’ Metro in Illinois, US, began operating as an electrified system in 1897. With 230.2 million passengers in 2017, it is the second busiest metro in the US. There is a 24-hour service available on two lines of the network, which is only featured on four other rapid transit systems in the country.

The network is approximately 165 km long with eight lines, which includes a loop in the city centre that services run through or circle to return to their starting point. Tower 18 junction located at the intersection of Lake and Wells in the ‘Loop’ is one of the world’s busiest railway junctions with six of the system’s lines running through it.

Stations in the Loop have undergone a number of changes, with the most recent being the closure of Randolph / Wabash and Madison / Wabash stations, which were replaced with the Washington / Wabash station in August 2017.

In June, the Boring Company secured a contract to expand the network with a high-speed Chicago Express Loop link to O’Hare International Airport.

Paris Métro in France

Paris Métro in France was opened on 19 July 1900. It was one of the first to use the term ‘metro’, which was abbreviated from its original operating company’s name, ‘Compagnie du chemin de fer métropolitain de Paris’. In 2016, Paris Métro had approximately 1.52 billion passengers.

There are 16 lines with 302 stops on the 214 km-long network. The average distance between them is 548 m and stops are often located within a short walking distance of each other in the city centre. A total of 197km of the network runs underground.
Paris Métro stations are known for their Art Nouveau style and 83 of the original entrances are still in place. Most station interiors were renovated after the Second World War with various redecorations following.

Construction of the metro system began in 1898 with a cut-and-cover method that allowed for the track to be built underground. The lines did not extend to Paris’ inner suburbs until the 1930s with Line 9 terminating at Boulogne-Billancourt in 1934. Planned expansions were put on hold during the Second World War, which resulted in a number of stations being closed.

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**Paris Métro Stations are known for their Art Nouveau Style**; Credit: Moonik / WikiCommon

**MBTA Subway in Boston Massachusetts, USA**

Massachusetts Bay Transportation Authority (MBTA) operates passenger bus, light and heavy rail services in Boston, Massachusetts, US. Its subway has three main lines and the first electrified rapid transit line, now the Orange Line, was opened in 1901.

Boston Elevated Railway was the original Orange Line before its elevated sections started being demolished in the 1920s. The line was renamed after Metropolitan Transit Authority, later MBTA, took over operations in 1964 and introduced the colour coded system.

The 9.7 km Blue Line is the system’s second metro line, which opened in 1904, and it is the shortest of the three routes. Plans to extend the line to the city of Lynn have been proposed multiple times since the 1940s but the work has never begun.

The system’s first service was the Green Line, which is a light rail underground system that was opened in 1987 running through the Tremont Street Subway.
Berlin U-Bahn in Germany

The U-Bahn in Berlin, Germany, began operating in 1902 and has since expanded across ten lines with more than 151 km of track. Approximately 80% of the lines run underground.

“During the First World War, expansion of the network was stopped and when it restarted, progress on the U-Bahn was affected by lack of funding.”

It is estimated that every year trains on U-Bahn travel a total of 132 million kilometres and carried more than 553 million passengers in 2017.

Berlin’s U-Bahn was built as a solution to increasing amounts of traffic around the city and began as an elevated transport link between Stralauer Tor and Zoologischer Garten. The underground network opened in 1910, linking Wilmersdorf with the capital city.

During the First World War, expansion of the network stopped and when it restarted, progress on the U-Bahn was affected by lack of funding. Passenger numbers increased during the Second World War as car use decreased. Some parts of the system suffered from damage caused by bombs and the whole network was shut down in April 1945 following the failure of a power supply system.
Stations in East Berlin were closed following the construction of the Berlin Wall and those on the north-south lines became ‘ghost stations’ as trains were prohibited from stopping at them.

**Athens Metro in Greece**

*Athens Metro in Greece* operates within Greater Athens and East Attica, where it terminates at Athens Airport. The line began operating as an electrified rapid transport system in September 1904, when it was converted from the former Athens-Piraeus Electric Railways, which was opened in 1869.

The system comprises Line 1, which was the original network until Line 2 and Line 3 opened in 2000. The 25.6 km-long Line 1 runs mostly over ground and was operated separately to the rest of the city’s transport network until 2011 when the Greek Government created the Athens Mass Transit System to merge services.

Construction on the 17.9km-long Line 2 and 18.1 km-long Line 3 began in 1992, aiming to offer alternative transport to car users in an effort to lower pollution levels.

A fourth line has been planned since 2005 and is expected to open in 2026. It will add 33km to the network with 30 new stops. Trains on Line 4 would operate automatically without a driver present.
New York City Subway

The New York City Subway in the US opened in October 1904 with the Interborough Rapid Transit Company (IRT) division, which is now known as the A division, and the Brooklyn-Manhattan Transit Corporation (BMT). When it first opened, a single fare cost $0.05.

It is the largest system in the world by the number of stations, totalling more than 420 stops across 380 km. The New York City Subway handles more than 1.72 billion passengers a year, making it the busiest out of the metro systems in this list and eighth busiest in the world.

There are 36 different lines with 27 services operating on them. Due to the subway operating all day and night, the lines operate across different service patterns and can change while maintenance takes place. The subway has suffered from a backlog of maintenance work since the 1970s when ridership fell as crime and vandalism increased.

One part of the subway being modernised is the signalling system. Originally, vehicles operated using block signalling, which can limit operations due to its lack of precision. Some lines have incorporated communications-based train control (CBTC) signalling, which optimises line usage and allows trains to operate through the blocks at the same time.
SEPTA in Philadelphia, USA

Southeastern Pennsylvania Transportation Authority (SEPTA) in Philadelphia, US, operates two rapid transit lines along with four other major public transport services in the city, similar to the MBTA’s operation.

Market-Frankford Line (MFL) is the oldest, having opened in 1907, while Broad Street Line was opened in 1928. Broad Street Line (BSL) operates completely underground apart from the terminus Fern Rock station, while MFL has underground and elevated stations.

The original MFL track split and looped around the foundations of Philadelphia City Hall at the end of the line, but in 1908 the track was extended and redirected underneath the city hall. BSL originally operated from the city hall to Olney Avenue. Since then, it has been expanded to Fern Rock in the north and to the sports and entertainment complex in the south, offering access to the city’s main stadiums and arenas.

The two lines have a combined weekday ridership of more than 310,000 passengers a day and are both approximately 20 km long. MFL is the busier line, with more than 185,000 passengers a day.
Buenos Aires Underground “Subte”, Argentinia

The **Buenos Aires** Subterráneos de Buenos Aires, Subte, was the first underground Metro (Subway) in Latin America (line A opened in 1913), and it’s often the quickest way to get around the city, especially when travelling to and from the downtown area. ... Lines A, B, C, D and E converge in the centre of the city.

**Learning to adapt in a multimodal Transport Area; Global**

18 Jun. 2019 | by Benjámin Zelki
Among the main messages from the UITP Global Public Transport Summit 2019 was that operators have to adapt to changing mobility needs as new modes emerge.

The UITP Global Public Transport Summit 2019 was held in Stockholm on June 9-12 with ‘the art of public transport’ as its theme.

The conference programme and related exhibition provided a snapshot of innovation across the rapidly changing sector. This year many of the summit’s highlights related to autonomous vehicles. EasyMile announced that its driverless shuttle is now equipped for unattended operation, while Navya said that it had sold 115 of its own version by the end of 2018.

Uber has also achieved important milestones since the previous UITP Summit, which was held in Montréal in 2017. In December that year Uber became a UITP member, in the Digital Platforms Category. Then, in July 2018, the on-demand taxi company reached an agreement with Nice transport operator Lignes d’Azur for passengers to use Uber services for a flat fare from six suburban tram stops after the departure of the last connecting bus to residential areas.

But an important message in Stockholm was that while technology develops and new modes spread, urban rail is still the optimal solution for moving people in cities efficiently, reliably and sustainably. Autonomous vehicles and on-demand taxi services were therefore mostly mentioned as complementary to an effective public transport network, best applied in low-density areas and for solving the last-mile problem.
Riyadh Metro, one of the main sponsors of this year’s summit, presented a video of the city’s public transport network, which is to be launched this year. **Six metro lines and a fleet of 3 500 buses** will introduce a formal city-wide public transport network for the first time.

**A multimodal Approach**

Public transport operators need to adapt to the new mobility landscape in several ways. Multimodality is an important trend, and it must be easy for passengers to change modes — not only between different forms of public transport, but also to car- and bike-sharing, scooters, and other alternatives.

An increasing number of platforms are available that offer **Mobility as a Service**: end-to-end trip planning that includes all available transport modes. The winner of UITP’s award for multimodal integration was the Weego app, which allows users to plan an optimal end-to-end journey. The app is similar to Nugo, launched by Italian state railways FS in June 2018; Nugo even includes trains operated by FS’s largest competitor NTV Italo.

**Technology Region Karlsruhe**, working jointly with UITP, presented its Regiomove initiative. This aims to create a single **multimodal transport network for the whole region**, which includes redesigning public spaces to improve the user experience when changing between modes.

The main themes of the plenary sessions suggested that operators have to be more adaptive to **passengers’ changing mobility needs** and react quickly to their behaviour. **Big Data Tools** can help with this. Thales presented its NAIA software, which captures data on passenger flow. This can be used to help reduce platform crowding and adjust headways in line with train occupancy, but it can also build up a picture on how particular passengers move, such as those with reduced mobility. This could be used to determine which stations would benefit most from the installation of lifts, for example.

**Preparing for Digitalisation**

Rail modes are increasingly heading in the direction of autonomy, UITP’s Director of Rail Transport Laurent Dauby told *Metro Report International*. He added that both infrastructure and rolling stock are increasingly interacting with the environment, with local sensors rather than the commands of the control centre responsible for many actions.

Dauby reports ‘a very strong confirmation and deepening of the impact of **Digitalisation**’ in the two years since the previous UITP summit. This includes autonomous tram operation. He predicts that in the future fully automated metros might have additional features using **Artificial Intelligence and Autonomous Decisions**, that could be used to in a degraded mode scenario.

- The next UITP Global Public Transport Summit will be held in Melbourne on June 6-9 2021.
Next Generation Train Control for today`s Railways

The Next-Generation Train Control Conference will feature in-depth technical sessions and comprehensive project updates on Communication Based Train Control, CBTC, for rail transit and PTC for main line railways presented by leading experts from around the world.

Now in its third decade, this conference is the rail industry's single-most important gathering of communications and signaling professionals from around the globe. It is the place where suppliers and consultants interface directly with customers.
Keolis and Ericsson demonstrate 5G on autonomous Vehicles; Global

Jun. 12, 2019
Written by David Burroughs

**IRJ at the UITP Summit, Stockholm:** Keolis and Ericsson are jointly showcasing the use of 5G Technology to remotely control and supervise autonomous vehicle fleets.

The demonstration is part of the ‘Drive Sweden’ strategic innovation program (SIP) and visitors are invited to remotely test drive a prototype vehicle built by the KTH Royal Institute of Technology in Stockholm.

Keolis says **5G Technology** offers high-speed data transmission with very low latency and high reliability, enabling remote and real-time vehicle control. 5G also improves Networked Transport of RTCM via Internet Protocol (NTRIP) connection, enabling greater localisation precision.

To guarantee safety, the vehicle features geo-fencing to prevent collisions as well as a dedicated IT system for the demonstrations, ensuring very high cybersecurity standards. A driver also remained on board them test vehicle throughout the demonstration to guarantee safety.

Based on the results of this initial phase, Keolis’ says the goal is to widely deploy **5G** capabilities for autonomous electric shuttles.

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Huawei launches 5G Communications Tools at UITP; Global

13 Jun. 2019
Huawei and Shenzhen Metro are testing the Use of 5G for smart Metro Applications.

COMMUNICATIONS: Huawei used the UITP Global Public Transport Summit 2019 to launch three tools designed for urban rail operators.

The Urban Rail Light Cloud is used to store data from various physical devices across an urban rail network in a central server. Huawei says that it is suitable for low and medium passenger capacity rail modes such as light rail.

Huawei also launched its next-generation LTE-R telecoms network, which supports 5G and interconnectivity with GSM-R. LTE-R offers multiple trunking services such as mission-critical push-to-talk voice, video and data, and the same network can be used for functions such as train control, dispatching, passenger information systems and CCTV.

The 5G Digital Indoor System is a tool for smart transport hubs. It includes 5G Lamp Site, which supports LTE and 5G.

Communication Based Train Control World Congress, Paris, 29-31 October; Global
SmartMetro returns for its 9th year in a new location near L’arc de Triomphe and is the meeting place for senior metro, tram, and light rail technology experts from all global regions to discuss the major challenges cities are facing such as digitalisation, congestion, automation and shared mobility. Delegates attending the show this year will be able to:

- Have the choice of three focused streams covering signalling systems, assets and digitalisation and operational excellence and smart mobility
- Attend a site visit organised by our supporters SNCF and RATP
- Listen to C-level global speakers from operators such as Lisbon Metro, Lagos Metro, Crossrail 2, Copenhagen Metro, Transport for Greater Manchester, Public Transport Victoria, Metro Istanbul and more
- New roundtable format where delegates can participate in multiple roundtables with topics covering CBTC, automation, data analytics and more
- Attend our co-located event, Transport Security Congress; an event that brings together security experts from all modes of transport to share best practice

**Bombardier Launches Updated MITRAC Solutions, MITRAC CONTROL and MITRAC BATTERY, Global**

12 Jun. 2019 | Railway-News

Bombardier launched its latest Version of its MITRAC Solution at UITP in Stockholm.
The Mobility Provider has updated its MITRAC solution to reduce life-cycle costs. This reduces both investment and running costs for operators. Further, the new solution will have a smaller negative impact on the environment. At the same time Bombardier says the new MITRAC generation benefits from better overall energy efficiency.

This MITRAC technologies have already been put through their paces in real-life operations. The MITRAC Pulse, for example, is a traction battery Bombardier has tested in its TALENT 3 battery train. The MITRAC Power 1500 traction converter prototype, which features silicon carbide semiconductors (SiC) was fitted on a MOVIA C20 Metro Train in Stockholm last year.

The final aspect of Bombardier’s MITRAC solution is the MITRAC Control. This is Bombardier’s Train Control and Management System (TCMS). It oversees the flow of information both on the trains and between a train and wayside systems. Bombardier first developed this system more than 20 years ago.

Bart Vantorre, Head of COO Equipment at Bombardier Transportation, said:

“We are very proud that the extensive redesign of our MITRAC portfolio is delivering such impressive benefits to our customers, including 35% higher reliability. Our Bombardier engineers evaluated each MITRAC component in terms of reliability, availability, energy efficiency and maintainability, based on our experience and feedback from our customers and suppliers. The result is a fully renewed portfolio which provides outstanding performance and higher customer value.”
MITRAC is a complete propulsion and control product portfolio for all rail applications.

Light Rail Vehicles
A smooth start, rapid acceleration, constant speed and low noise are the basic prerequisites for economical, comfortable travel. And the less space the technology takes up, the more room is left for passengers. The result is increased operational efficiency that enhances the competitiveness of public transportation.

MITRAC Control TCMS (Train Control Management System); Global

The MITRAC Control TCMS (Train Control Management System) is a modular, scalable, secure and open-standard control and communication platform. It manages and controls the flow of information both on board between different sub-systems such as converters, doors, heating, ventilation and air-conditioning, and also between the train and ground.
Modular Design
Comfort for passengers

**Fully integrated Product Portfolio built on a generic Concept**

It can be adapted to the individual needs of different vehicle types simply by adding self-contained modules for clearly defined functionalities. This allows for efficient and reliable train operation at a high level of safety and security, providing excellent and convenient services for passengers.

The *MITRAC Control TCMS Platform* offers a modular concept at a high degree of standardization, offering great flexibility in terms of configuration, scalability and interfacing to sub-systems, with the additional benefit of being cost-effective.

*It provides control, monitoring, capability for inter-operation and sharing solutions such as fleet management based on diagnostics combined with train-to-ground communication for urban vehicles such as metros, tramways and LRVs.*

**Keolis to operate Paris light Rail Line T9; France**

Jun. 17, 2019
Written by Keith Barrow
AddThis Sharing Buttons

*ILE-DE-FRANCE Mobility* has selected Keolis for a contract to operate Paris light Rail Line T9, which is due to open at the end of this year.

The choice of bidder will be put to the board of Ile-de-France Mobility for approval at its meeting on July 2.
The selection of Keolis will end Paris Transport Authority’s (RATP) domination of light rail operations in the French capital. With the exception of tram-train lines T4 and T11, RATP has operated all tram lines in Ile-de-France since the opening of Line T1 in 1992.

The contract begins at the end of this year and runs until the end of 2022.

The 10 km line will run south from an interchange with metro Line 7 and light rail line T3 at Porte de Choissy, serving six districts including Vitry sur Seine, Choisy-le-Roi, Thais, and Orly. Line T9 will serve 19 stations, including an interchange with the future Grand Paris express metro Line 15 at Hotel de Ville de Vitry.

In addition to the tram line, Keolis will also operate a network of six bus lines serving Ablon, Athis-Mons, Choisy-le-Roi, Juvisy-sur-Orge, Orly and Thiais. Several of these routes will interchange with Line T9.

Ile-de-France Mobility says this will enable the operator to offer more complete mobility solutions and provide options for alternative transport if operation of Line T9 is disrupted.

Categories: Light RailNews

Thales picked for Canadian LRT Confederation Line Expansion with CBTC; Canada

- June 14, 2019
- Light Rail, News, Passenger

Written by Andrew Corselli, Managing Editor

East-West Connectors has chosen Thales to provide its SelTrac™ Communications Based Train Control (CBTC) for the City of Ottawa’s Stage 2 O-Train Confederation Line Extension project.

The Stage 2 Confederation Line extension will expand the initial Stage 1 Confederation Line farther east to Trim Road and farther west to Baseline Road and Moodie Drive, adding 28 kilometers of rail, 16 stations, and a maintenance and storage facility.

Following the expansion’s completion, the Confederation Line will consist of 29 stations spanning a distance of 40 kilometers. Thales noted that the completed project aims to take 780,000 annual rush-hour bus trips off the road and move upwards of 24,000 customers per hour.

Thales said its contribution to the Stage 2 O-Train Confederation Line extension project—it was the train control technology of choice for Stage 1—consists of “integrating control units onboard each train, the installation of guideway equipment, including zone controllers, as well as commissioning the system to be safely integrated within Stage 1 operations.”

“The Stage 2 O-Train Confederation Line Extension project allows Thales to continue to play an important role in providing a world-class transit system to Canada’s national capital,” said Dominique Gaiardo, VP, Managing Director, Thales’ urban rail signaling business. “Continuing our work from Stage 1, our local, made-in-Ontario SelTrac™ CBTC technology is a key part of the O-Train system, bringing to life the next important phase of Ottawa’s long-term transit vision, providing passengers a faster, safer and greener way to commute.”

Photo Credit: RTG: Rideau Transit Group
Almaty Bus Rapid Transit, BRT Route extended; Kasachstan

21 Sep. 2018
KAZAKHSTAN: Almaty Municipality has inaugurated the second phase of its first bus rapid transit route. Linking the Orbita district with the city centre, the 4 km section doubles the length of the BRT route.

Work began earlier this year and was completed at a cost of 4·2bn tenge. The full 13·2 km route crossing the city southwest-northeast is expected to be completed by 2021.

In addition to BRT services, parts of the route are served by trolleybuses. The journey time on this section has been reduced from 22 min to 14 min. Four further BRT lines are planned to be built in the city by 2023.

On August 29th the municipality called tenders for a contract to build and operate the city’s first 22 km Light Rail Transit Line.

Four shortlisted Bidders for Almaty LRT Project; Kasachstan

June 12, 2019
“We have selected four consortia that enter the second phase of Almaty LRT project. We want to modernise and develop our transport system based on sustainable solutions,” said Yelena Yerzakovich, the representative of Almaty Electrotrans, at UITP Global Public Transport Summit held in Stockholm.

Jakarta Light Metro opens; Indonesia

17 Jun 2019

**INDONESIA:** The first section of the Jakarta **Light Metro** started trial operation on June 14, ahead of the planned launch of revenue services on June 21.

The 4.5 km elevated route between Kelapa Gading Mall and Velodrome serves five stations. A northern 1.3 km one-station extension from Kelapa Gading Mall to Pegangsaan Dua is due to open on June 21. Headways are currently 10 min, and this will change to 5 to 15 min once revenue services begin.

The main civil works contractor was PT Wika, and a consortium of Korea Rail Network Authority, Daea TI, Samjin, Woojin Industrial Systems and LG CNS supplied railway systems.

Hyundai Rotem has supplied eight two-car trainsets from its Changwon factory in South Korea. These draw power from a third rail and are stabled at a depot north of Kelapa Gading Mall.

Further extensions are planned at both ends of the route. The light metro is a separate project from Jakarta’s underground heavy metro which opened in March.
The FV-E991 Prototype is expected to start Test Run in the 2021 financial Year.

JAPAN: East Japan Railway has started work on a new generation of hydrogen fuel cell trainsets, a decade after early experiments with its prototype New Energy Train.

The railway set an objective to ‘diversify energy’ as part of its ‘Move Up 2027’ 10-year vision adopted last year, and it hopes its efforts to use hydrogen fuel will accelerate its move towards a low carbon society.

The company announced on June 4 that it is investing ¥4bn on the development of a two-car trainset, which will be equipped with fuel cells and lithium-ion batteries as well as high-pressure hydrogen tanks. The Series FV-E991 unit will be formed of one motor car and a driving trailer, using hydrogen technology supplied by Toyota Motor Corp under a business co-operation agreement signed in September 2018. Toyota has been using a 114 kW fuel cell hybrid drive in its Mirai cars since 2015.

Two 180 kW polymer fuel cell stacks able to operate at temperatures down to -10°C will feed two 25 kWh li-ion batteries, powering a VVVF converter with twin inverters to feed the four 95 kW traction motors. Hydrogen will be stored in four banks of carbon fibre composite tanks, each comprising five 51 litre modules. At a maximum pressure of 70 MPa this will give a range of 140 km, compared to 80 km at 35 MPa. Maximum speed of the 1 067 mm gauge trainset will be 100 km/h.

JR East hopes to begin test running in the 2021 financial year, and to have the technology ready for commercial applications by 2024. A series of demonstration tests ‘in a normal operating environment’ would confirm the safety, performance and environmental impact
of the fuel cell trainset, and inform the ‘future practical use of fuel cell vehicles’, including optimisation of the control technology and development of support infrastructure.

Trials are to be undertaken on various routes in Kanagawa prefecture, primarily the outer end of the Nambu Line between Kawasaki and Musashi Nakahara, and the 4·1 km branch from Shitte to Hama-Kawasaki. The train will also be tested on the Tsurumi Line near Yokohama.

In January 2015 JR East concluded a ‘smart co-operation agreement’ with the prefecture and the cities of Kawasaki and Yokohama aimed at the development of low-carbon initiatives. On June 3 the operator signed a further agreement with JR Freight and Showa Denko Co to provide infrastructure facilities for the test programme.

**Ulan-Ude becomes Launch Customer for PK TS Lionet Tram; Russia**

17 Jun. 2019

*PK TS presented the first Lionet Tram last Year (Photo: Vladimir Waldin).*

**RUSSIA:** Sole bidder PK TS has won a contract to supply 15 trams to Ulan-Ude. The 498m rouble order is being finance mostly through a government grant via the Ministry for the Development of the Russian Far East.

PK TS will supply its unidirectional single-section Lionet model. The 100% low-floor trams will be 16·7 m long with capacity for 155 passengers including 40 seated. The first two vehicles are due to arrive by September 2 and the remaining 13 by the end of November.

The trams for Ulan-Ude will be the first series-built Lionet vehicles. PK TS displayed the first Lionet at the InnoTrans trade fair in Berlin in September 2018.
BYD wins Contract to supply 183 electric Buses to Santiago; Chile

14 Jun. 2019

CHILE: BYD has won a contract to supply 183 battery electric buses to Santiago. Deliveries are due to start in August, and the buses will be operated by Metbus.

The buses will have 38 seats, air-conditioning, wi-fi and USB sockets, and will have a range of 250 km. They are to operate along Avenida Grecia, which BYD says would become the first route in Latin America to be operated exclusively by battery electric buses.

Last year BYD won an order to supply 100 K9FE electric buses to Transantiago in collaboration with energy distributor ENEL. When deliveries of the latest order are completed, Santiago will have a fleet of 411 electric buses. According to BYD, this will be the largest fleet of battery buses outside China.

'Ve hope that during the next year, Electromobility will continue to be strengthened in the capital and in other regions’, said Director of transport authority DTPM Fernando Saka. Concepción is the next Chilean city in line to receive electric buses.
Mobile Train Radio Communication

Presented By:
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Submitted To:
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(Seminar Coordinator)
Contents

- Introduction
- Background & Origin
- Main Features
- Main applications & Benefits
- Risks
- Architecture
- Projects
- Mobile Train Radio Communications in India.
Introduction

- Mobile Train Radio Communication (MRTC) is a railway signaling system that makes use of the telecommunications between the train and track equipment for the traffic management and infrastructure control.
- By means of the CBTC systems, the exact position of a train is known more accurately than with the traditional signaling systems.
- This results in a more efficient and safe way to manage the railway traffic

Contnd .................
The main aim of this MRTC system is to increase capacity by reducing the time interval (headway) between trains travelling along the line.

In Signal System based in the detection of the trains in discrete sections of the track called 'blocks.'

Each block is protected by signals that prevent a train entering an occupied block.

Since every block is fixed by the infrastructure, these systems are referred to as fixed block systems.
Nowadays, Moving Block is used. Unlike traditional Fixed Block each block is not traditionally defined by the infrastructure.

Besides, the trains themselves are continuously communicating their exact position to the equipment in the track by means of a bi-directional link through Radio Communication.

Bombardier opened the world's first radio-based CBTC system at San Francisco airport's Automated People Mover (APM) in February 2003.
A few months later, in June 2003, Alstom introduced the railway application of its radio technology on the Singapore North East Line.
Main Features

☐ In the modern CBTC systems the trains continuously calculate and communicate their status via radio to the wayside equipment distributed along the line.

☐ This status includes, among other parameters, the exact position, speed, travel direction and braking distance.

☐ It also enables the wayside equipment to define the points on the line that must never be passed by the other trains on the same track.
Safety distance (safe-braking distance) between trains in fixed block and moving block signal system.
CBTC systems based on moving block allows the reduction of the safety distance between two consecutive trains. This distance is varying according to the continuous updates of the train location and speed, maintaining the safety requirements.

Modern CBTC System allows different levels of automation like GoA1, GoA2, GoA3, GoA4........
Main Applications & Benefits

- CBTC systems allow optimal use of the railway infrastructure as well as achieving maximum capacity and minimum headway between operating trains, while maintaining the safety requirements.

- The evolution of the technology and the experience gained in operation over the last 30 years means that modern CBTC systems are more reliable and less prone to failure than older train control systems.
Risks

- The primary risk of a CBTC system is that if the communications link between any of the trains is disrupted then all or part of the system might have to enter a failsafe state until the problem is remedied.

- Communications failures can result from equipment malfunction, electromagnetic interference, weak signal strength or saturation of the communications medium.

- In this case, an interruption can result in a service brake or emergency brake application as real time situational awareness is a critical safety aspect of CBTC.
CBTC systems that make use of wireless communications link have a much larger attack surface and can be subject to various types of hacking.

With the increasing application of CBTC system, there is an immense pressure over the international community to reserve a frequency band especially for Train Radio Communication. Such decision would help to standardize the CBTC systems across the market and ensure availability for those critical systems.
Architecture

- The typical architecture of a modern CBTC system comprises the following main sub-systems:
  
  Wayside equipment, which includes the interlocking and the subsystems controlling every zone in the line or network (typically containing the wayside ATP and ATO functionalities). Depending on the suppliers, the architectures may be centralized or distributed. The control of the system is performed from a central command ATS, though local control subsystems may be also included as a fallback.
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- Wayside equipment, which includes the interlocking and the subsystems controlling every zone in the line or network (typically containing the wayside ATP and ATO functionalities). Depending on the suppliers, the architectures may be centralized or distributed. The control of the system is performed from a central command ATS, though local control subsystems may be also included as a fallback.
- CBTC onboard equipment, including ATP and ATO subsystems in the vehicles.
- Train to wayside communication subsystem, currently based on radio links.
- CBTC onboard equipment, including ATP and ATO subsystems in the vehicles.
- Train to wayside communication subsystem, currently based on radio links.
- **Wayside ATP system.** This subsystem undertakes the management of all the communications with the trains in its area. Additionally, it calculates the limits of movement authority that every train must respect while operating in the mentioned area.

- **Wayside ATO system.** It is in charge of controlling the destination and regulation targets of every train. The wayside ATO functionality provides all the trains in the system with their destination as well as with other data such as the dwell time in the stations.
- Communication system. The CBTC systems integrate a digital networked radio system by means of antennas or leaky feeder cable for the bi-directional communication between the track equipment and the trains. The 2.4GHz band is commonly used in these systems (same as Wi-Fi).

- ATS system. The ATS system is commonly integrated within most of the CBTC solutions. Its main task is to act as the interface between the operator and the system, managing the traffic according to the specific regulation criteria.
Automatic Transit System (ATS)
Projects
Mobile Train Radio Communication (MTRC) over IR was introduced during 1980’s in Nagpur – Durg, Nagpur – Itarsi and Nagpur – Bhusawal sections of SER and CR zones of IR.

Although the system met, the requirements of MTRC, yet bulky handsets provided to drivers and guards and logistic for it’s charging made this system very unpopular.
- GSM(R) based MTRC works were sanctioned during 2005 and deployed over NFR, ER, NCR and NR zones purely for train control communication purpose.
- The investment of around 975 million INR remains gainfully unutilised.
As per report published on Nov. 10, 2013 in Times of India

"We are implementing Mobile Train Radio Communication (MTRC) system which would provide better communication between the control room and the driver in speeding trains," said a senior Railway Ministry official involved with the project.

The system will provide control rooms with emergency brake for trains which can be used in case of signal violation by drivers.

While the MRTC system is currently being installed in the 2264-km route including Delhi-Ludhiana, Howrah-Mughalsarai and Kolkata Metro sections, 2235-km-long route including the New Delhi-Howrah and New Delhi-Jammu will be equipped with the modern communication system by March next year.
References


PUBLIC MULTIMODAL URBAN, SUBURBAN AND INTERURBAN PASSENGER TRANSIT SYSTEMS WITH METRO-BUS, LIGHT-RAIL, TRAM-TRAIN, METRO-RAIL, METRO-TRAIN, REGIONAL RAPID TRANSIT, COMMUTER-RAIL, ROPE-WAY/TRAIN, MAGLEV AND HOVERCRAFT TRANSIT/PEOPLE MOVER, WATER-METRO, AUTONOMOUS PEOPLE-MOVER

TRANSPORTATION AND ECONOMIC DEVELOPMENTS IN MODERN URBAN/MEGAPOLIS ENVIROMENT
India, one of the fastest growing economies in the world, is achieving a growth rate of 7.5% per annum. With a growing population too, the country is working hard to transform itself over the next few decades. Improving public transportation is high on the agenda and Jaspal Singh, Head of the UITP India Office, writes that although private-vehicle
ownership in India is growing and therefore causing major congestion problems in cities, there are however many plans to revamp bus systems and invest in metro networks.

The cities of this diverse country and its urban population play an important role in the growth of the country. As per the 2011 census, 31.2% of India’s population (377 million) is living in urban areas. As the UN estimates, these numbers will grow to 40% (590 million) by 2030 and 58% (875 million) by 2050. While only 30% of the total population live in urban areas, approximately 63% of India’s Gross Domestic Product (GDP) is contributed by those urban areas.

**India’s Transport Problems**

Even with the current size of the urban population, Indian cities are facing a multitude of issues such as severe congestion; deteriorating air quality; increasing greenhouse gas (GHG) emissions from the transport sector; increasing road accidents; and an exploding growth in the number of private vehicles (largely motorcycles). With the urban population projected to more than double in the next generation, the situation could easily get out of control and thwart India’s economic development efforts unless remedial measures are soon taken.

In a move to recognise and act upon urban mobility issues, in 2006 the federal government of India introduced the National Urban Transport Policy (NUTP), setting the policy framework for providing sustainable mobility for the future (see Figure 1). In 2015 the government unveiled its new plan to upgrade 100 cities into ‘smart cities’ and to ‘renew’ 500 cities.

**Growth of private Vehicle Ownership**
The growth of vehicles has been much faster than that of the population. The number of registered vehicles increased from 55 million in 2001 to 142 million by 2011, with a currently-estimated 195.6 million in 2016\(^2\). Seventy-five per cent of these registered vehicles (147 million) are motorcycles. Furthermore, the physical infrastructure hasn’t been able to keep pace with the growth in demand. The urban road length has increased from 252,001km in 2001 to 411,840km by 2011. In the last decade registered vehicles per million population has increased by 219% while urban road infrastructure per million only increased by 124%.

This rapid motorisation has led to severe congestion, longer journeys and higher per capita trips. Indian roads are also popular for heterogeneity of vehicles sharing the same road space. There are around 32 different vehicle types in India such as bicycles, cycle-rickshaws, auto-rickshaws (‘tuk-tuk’), motorcycles, cars, buses and trucks.

**Congestion**

The rapid growth in private-vehicle ownership has led to increased congestion problems in cities. The average speed of a vehicle on Indian roads is just 17-19km/h between 9:00 and 21:00, with the slowest times witnessed during the evening hours. The average speed of traffic in key Indian cities is just 17-23km/h while the average cycling speed is 15-16kmph\(^3\).

**Road Accidents**

India recorded a total of 501,423 road accidents and 146,133 road accident deaths in 2015; this equates to 1,374 accidents and 400 deaths on India’s roads every day. Sadly, 54.1% of people killed in road accidents are in the 15-34 years age group. It is estimated that the economy lost around 3% of GDP (1999-2000) due to road mishaps\(^4\).

**Air Pollution**

In the Global Burden of Disease 2010 (GBD) study, ‘outdoor air’ pollution is among the top 10 risks worldwide and the top six risks in the developing countries of Asia. Air pollution has greater...
impact on developing countries such as India, as 1.4 million people lost their life due to air pollution; US$ 505 billion towards welfare losses; and US$ 55.4 billion towards lost labour.  

**Declining Share of Public Transport**

With Population Numbers growing and an Increase in private Vehicle Use, India currently experiences major Road Congestion on a daily basis.

The share of public transport is decreasing in India. The federal government has recently published the results of the mode of transport people take to commute to work for the latest Census 2011 data in March 2016. According to the survey more than 50% of the workforce (excluding domestic and agriculture) continue to work at home or travel to their workplace by foot in the absence of adequate transport facilities. Citizens are largely dependent on private transport. The share of public transport is just 18.1% of work trips.

The data indicates that there is lack of public transportation facilities and citizens are largely dependent on private modes of transport, such as bicycles (26.3 million) and motorcycles (25.4 million) in rural and urban India. More people use motorcycles than travel by bus (22.9 million). In 2015 the number of daily trips using a motorcycle for commuting was 35 million (excluding personal trips); this is based on the increase in vehicle registration.

**Development of ‘Smart Cities’**

The federal government of India has launched two flagship programmes – 100 Smart Cities and Atal Mission for Rejuvenation, and Urban Transformation (AMRUT) for 500 cities that have a population of 100,000 or more, with funding of $8 billion and $8.3 billion, respectively. The smart cities initiatives focus on core infrastructure service, whereas, AMRUT will adopt a project approach to ensure basic infrastructure services.

A ‘Smart City’ is an urban region, that is highly advanced in terms of overall infrastructure, sustainable real estate, communications and market viability. It is a city where information technology is the principal infrastructure and the basis for providing essential services to residents. Until now the federal government has shortlisted the establishment of ‘109 smart cities’ in India. The key idea of smart cities is the alliance of public services with an integrated
public transport system. Information Technology, therefore, will play a crucial role in both integrating and automating these services.

The 20 cities in the first stage will receive INR 2 billion (US$ 30 million) in 2015-2016 and INR 1 billion (US$ 15 million) every year for the following three years; a total of INR 5 billion (US$ 75 billion). State governments and respective urban local bodies will also contribute the same amount. Many foreign countries, including Japan, France, Germany, Singapore etc. have come forward to support the federal government’s plan to develop smart cities.

**Smart Cities cannot be built without smart public transport.** Under the smart cities programme, the cities are required to build efficient urban mobility and public transportation by creating walkable localities, as well as promoting a variety of transport options. However, there is no clear guideline for developing a sustainable public transportation system. An urban transport system is subject to planning, execution and development by the states and union territories; hence, under the smart cities programme each city can prepare its ‘Smart City Vision’ document, highlighting the city’s vision and funding proposal.

**The Emergence of Metro Technology**

After the success of the Delhi Metro, lots of Indian cities are exploring the option of implementing metro rail networks. The Ministry of Urban Development (MoUD) estimates that there is approximately 316km of metro lines currently in operation and more than 500km of metro lines under construction across the country. This includes metro/mono rail systems promoted by state governments and private bodies.

**Delhi Metro** is India’s largest and most successful Metro Installation, carrying approximately 2.8 Million Passengers a Day.

Delhi Metro is the largest metro system with a total length of 213km, carrying 2.8 million passengers a day. Some of the new metro systems are still facing issues with building ridership; for example, Jaipur Metro carries only 20,000 passengers per day, incurring a loss of INR 30 million (US$ 500,000) every month.
Most of the systems are developed by public authorities with external funding and support from federal government. However, some of the cities have developed the system in partnership with private players e.g. Gurgaon (operated by IL&FS), Mumbai (operated by RATP) and Hyderabad (operated by Keolis – under development). In the Union Budget 2014-2015, the government emphasised that the planning of metro projects must begin now. The federal government has earmarked INR 100 billion (US$ 1.5 billion) for metro projects in the fiscal budget 2016-2017.

**Revamping City Bus System**

![Fig.: How India travels.](image)

Buses are the most popular and convenient mode of transportation in urban cities. More than 1.6 million buses are registered in India, and the public bus sector operates 170,000 buses carrying roughly 70 million people per day. However, bus transportation has not been able to cater to the growing travel demand. There are only 30,000 buses serving the city areas, out of which approximately 3,500 buses are operated under a public-private partnership agreement. All bus operators are incurring huge losses and do not have funds for the capital investment needed to procure new vehicles and technology. The average age of the fleet ranges from two years to 11.8 years for state bus transport undertakings.

The National Sample Survey Office (NSSO) carries out an annual survey of household expenditure on service and durable goods in India. As per the details of expenditure on transport, buses are the most preferred mode of transport in both rural and urban India, followed by auto rickshaws.

The federal government launched National Urban Renewal Mission (NURM) in 2009 and embarked upon a massive programme of revitalising urban areas by allocating national funds to
speed up the creation of much-needed infrastructure. The programme was split in two phases and was concluded in 2015. Approximately 222 km of Bus Rapid Transit (BRT) systems are operational and the remaining 282 km are under construction. MoUD has provided financial assistance to 11 cities for the construction of 504 km Bus Rapid Transit System (BRTS).

According to estimates from ICRA Limited (2016), 100 of the largest Indian cities require approximately $15.4 billion to procure 150,000 new buses and upgrade ancillary transport infrastructure. It will be difficult for state governments or local bodies to invest such a large sum without further federal government support.

In order to generate more investment in the sector, the federal government has proposed to open the public bus sector to private companies. This will allow buses to operate on nationalised routes. According to the Road Transport Ministry, the opening of the sector will increase the passenger ridership to 120-150 million per day.

**Future Bus Technology**

The federal government has unveiled an ambitious project to replace all public bus transport fleets with hybrid technology. The government launched the full indigenous retro-fitted electric bus, converting existing conventional fuel buses into electric buses, developed by KPIT Technologies and Central Institute of Road Transport (CIRT).

A main hindrance to the adoption of new technology is the financial implication and capital cost. The average cost of a hybrid bus in India is around INR 23 million (US$ 375,000), compared to INR 9 million (US$ 150,000) for a premium diesel bus. In order to incentivise the operators to procure electric and hybrid buses, the federal government has launched the ‘Faster Adoption & Manufacturing of Electric and Hybrid Vehicle (FAME)’ scheme to provide a subsidy of INR 6.1 million (US$ 100,000) for electric and hybrid buses.

Currently Navi Mumbai Municipal Transport (NMMT) has procured five hybrid city buses from Volvo and MMRDA has procured 25 hybrid buses from Tata Motors. There are currently no fully electric buses in commercial operation. BYD has completed a pilot in Bangalore (2014) and Delhi (2016) to demonstrate electric bus technology.
Innovative Technology

The Mumbai Metro currently has one Line and 12 Stations. There are Plans to extend the Network.

Integrated Transport, IT, Solutions are important for public transport systems and information is becoming critical for any service planning. The key factors such as passenger demand; journey demand; service hour; and service frequency have great impact on the expenditure and revenue of any authority or operator. IT tools can also help to refine processes and improve efficiency. Smart transportation systems should have fleet management, ticketing, security surveillance, traffic management and real-time passenger information.

The recent ‘Policy Road Map for City Bus Systems in India’ study identified that most of the city’s bus operators are still lagging behind in the implementation of an IT system. The survey revealed that nine out of 12 cities have implemented a vehicle tracking system and 11 out of 12 have implemented electronic ticketing machines (ETMs). However, no cities have yet implemented ‘planning and scheduling’ or ‘depot management’ systems; with the majority using manual systems for such operations. The availability of real-time information is equally important for commuters to plan their journey. In the absence of good quality data, commuters aren’t able to obtain accurate service information. However, there are some third party mobile app providers that provide offline information to users such as Trafi and Moovit.

Smart Ticketing has been slow to gain popularity in India. All metro systems have implemented smart ticketing solutions for its ‘closed’ environment; Delhi Metro sells approximately 16,000 smartcards a day and 1.8 million commuters use the card daily. However, the smart ticketing systems are not yet integrated with the bus system. The federal government did make plans to introduce a Smart National Common Mobility Card (NMC) to enable seamless travel using different modes of transport across the country as well as having retail purchasing benefits. However, the initiative did not take off. In July 2015 the government established a committee to recommend an inter-operable smartcard.
In June 2016 Bengaluru Metropolitan Transport Corporation (BMTC) became the first city in India to launch the Axis Bank BMTC Smart Card – an open loop EMV contactless smartcard. However, the system is not integrated with other modes such as metro. Mumbai is another example that has various modes of public transport including suburban railway lines, metro, buses, taxis and auto-rickshaws. The Mumbai Metropolitan Region Development Authority (MMRDA) has appointed London’s Transport for London (TfL) to prepare a detailed plan for an integrated ticketing system in the Mumbai Metropolitan Region. An integrated system is planned to be rolled-out by 2018.

**New Measures to strengthen Public Transport**

![Travel to work by Modes of Transport, 2011. 100% = 200.4 Million](image)

The federal government has recently ratified COP21 (Conference of Parties) agreement in Paris, France on 2 October 2016. India currently accounts for approximately 4.5% of global greenhouse gas emissions. Although the key focus is on clean energy generation, the federal government is also looking to reduce emissions from the transportation sector. Some of the key measures include the following:

**Movement in India**

The Ministry of Road Transport and Highway (MoRTH) has launched the “**Passenger Mobility Enhancement**” project in partnership with the World Bank. The federal government will be launching a scheme to encourage state bus transport undertakings to reduce their losses by investing in the technology. The operators will need to commit the reduction in the loss and the federal government will give funding.
Switching to Euro VI by 2020

The federal government has decided to shift to Bharat Stage VI (the equivalent of Euro VI) emission standards for various category vehicles by 2020. The decision has been made to leapfrog directly from Euro IV emission norms for petrol and diesel to Euro VI standards. This is a great move and demonstrates the commitment of the federal government to curbing air pollution.

Strengthening Water Transport

The Development of waterborne Transportation is one of the key priorities of the federal government in India. The 2016 National Waterway Act was enacted in March 2016 to regulate the development of 111 national waterways, out of which 106 are new national waterways. Currently India is conducting only 3.5% of trade through waterborne transport, compared to 47% in China; 40% in Europe; 44% in Japan and Korea; and 35% in Bangladesh.

India still has much ground to make up to achieve efficient and sustainable city public transport systems. The public infrastructure will improve the mobility of people and will open the door to new economic opportunities for the country. Investment in public transportation has a multiplier effect for the economy.

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By Shakti Foundation

Biography

Jaspal Singh is an Urban Transport Expert and is currently working as Head of the UITP India Office. He has been working with UITP since 2013. He has more than 10 years of experience in
urban transport and management consultancy roles. Prior to UITP Jaspal founded a consultancy firm which is engaged with companies in the areas of bus transport; tara-transit; transport planning; and intelligent transport systems. Previously Jaspal was Deputy Manager at Delhi Integrated Multi-Modal Transit System Limited – a joint venture of the Government of Delhi. He is also subject matter expert on taxi transportation and has been widely quoted in national and international publications. Jaspal has received several awards for his contribution to the field of public transport and social work.

PART II: GLOBAL ACTIVITIES FOR URBAN MOBILITY AS A SERVICE

Transforming the Rail Industry with Artificial Intelligence, AI, and Internet of Things, IoT, Technologies - Shaping the digital urban, suburban and interurban public Transport of the Future; Global
Artificial Intelligence (AI) Technologies are being adopted globally by all industries to drive efficiency, improve productivity and reduce costs. The railway and metro industries are no exceptions.

Fuelled by intelligence from AI-driven systems and applications, railway operations are becoming safer, smarter and more reliable, significantly enhancing the passenger travel experience and freight logistics services. For rail transportation, AI can provide improvements including fast and convenient ticket-free check-in, and accurate arrival-time predictions, personalised infotainment and on-board services, real-time track health diagnostics, and rapid response in an emergency.

These AI-driven applications only function with proper data input that is collected by massive numbers of Internet of Things (IoT) devices installed in stations, on trains, and along tracks. A successful implementation of such rail applications requires a seamless integration of AI and IoT technologies. By leveraging more than 20 years of expertise in developing highly reliable and available embedded computing systems, ADLINK brings advanced AIoT (AI and IoT)
solutions to rail transportation, enabling customers in developing a variety of applications that can deliver true value and performance. **ADLINK** is committed to helping customers gain competitive advantages by allowing them to focus their development efforts on differentiating their end applications.

**Rugged AIoT Platform for Real-Time Video/Graphics Analytics**

Powered by an Intel® Core™ i7 processor and integrated NVIDIA Quadro GPGPU module, **ADLINK**’s EN50155-certified PIS-5500 AIoT platform is not only ruggedised for both wayside and on-board deployment with its wide range DC input and isolated I/O design, but also provides an ideal edge solution for real-time video/graphic analysis applications that are vital to today’s increasingly complex railroad operations. The target applications include but are not limited to:

- Passenger information systems
- Railroad intrusion detection
- Train station surveillance
- On-board video security
- Railroad hazard detection

**ADLINK**’s PIS-5500 is being deployed commercially by leading rail system integrators worldwide. In one application, the intelligent platform is installed on special rail inspection trains to process captured images of key wayside equipment in real-time. With a sophisticated algorithm driven by parallel computing and deep learning, the application can effectively identify potential equipment faults at a train speed of 120 kmph, and raise the alarm to notify maintenance crews. In another application, the PIS-5500 is used in a train station control office to analyse the real-time video stream received from the platform. The application is able to not only detect suspicious behaviours and trigger alerts, but also conduct post-event analyses. To meet varying application requirements, the PIS-5500 is also available in variants featuring an additional two USB 2.0 via M12 connectors and two 2.5” SATA 6Gb/s drive bays, as well as a version supporting +12VDC power input only.
EN 50155-Certificated Driver-Machine Interface Panel Computer

Powered by the Intel Atom® x5-E3930 processor (formerly Apollo Lake) and featuring a 12.1” (4:3) high-resolution colour display, 5-wire resistive touch screen and securable I/O interfaces, ADLINK’s DMI-1210 is its latest Driver-Machine Interface (DMI) touch panel computer, designed specifically for deployment as a Human-Machine Interface (HMI) unit for driver’s desks, control panels for passenger information systems, surveillance system control/display units or in railway diagnostics and communications applications.

The DMI-1210 is an EN 50155-certificated, cost-effective, commercial-off-the-shelf (COTS) driver interface that offers train radio display, electronic timetable, and diagnostic display functions and additional functionality such as train data recorder. The DMI-1210 supports full range DC power input from +16.8V to +137.5V DC. Optional MVB, GNSS, 3G/LTE, WLAN, and Bluetooth through add-on modules give system integrators the necessary tools to expand use case possibilities.

With ADLINK’s built-in Smart Embedded Management Agent (SEMA) featuring management and status LEDs on the front panel, the DMI-1210 provides easy and effective health monitoring and system maintenance. In addition, system robustness and reliability are provided by careful component selection for extended temperature operation, isolated I/Os, conformal coated circuit boards, securable I/O connectors and high ingress protection rating (IP65 front, IP42 rear).

ADLINK’s Expertise and Commitment to Rail Transportation

ADLINK is a premier supplier to the rail market, enabling both wayside and on-board applications, such as Communications-Based Train Control (CBTC), Automatic Train Protection (ATP), Automatic Train Operation (ATO), Automatic Train Supervision (ATS), Computer-Based Interlocking (CBI) and Train Control Center (TCC), Passenger Information, and Passenger WiFi. ADLINK offers not only a field-proven, cost-effective and extensive COTS portfolio, but also a variety of fast time-to-market custom solutions with best-in-class ODM capabilities. Designed to meet harsh operating requirements, ADLINK’s industry standard-compliant products provide customers with a great level of flexibility in technology and roadmap planning.

ADLINK’s long-held support of COTS technology and open standard systems enables flexible platforms that are modular, scalable and rugged enough for extended deployment in both brown and greenfield projects. By leveraging its long-standing strategic partnerships with major hardware component and software vendors, ADLINK ensures best practices in product obsolescence and lifecycle management to deliver the supply longevity required by the industry. In addition, ADLINK offers design services in every major geographic region, benefiting customers with increased responsiveness, short delivery lead-times and ease of doing business. ADLINK focuses on continued development to build an even more comprehensive
and cost-effective product portfolio to help customers effectively mitigate budget constraints while smoothly and seamlessly taking on technology migration and product integration.
ARTIFICIAL INTELLIGENCE IN MASS PUBLIC TRANSPORT

Executive Summary
THE STUDY

The research topic: Artificial Intelligence (AI) in Mass Public Transport, is the first study to be conducted by UITP Asia-Pacific Centre for Transport Excellence (AP CTE) under a joint-funded research programme between International Association of Public Transport (UITP) and Land Transport Authority (LTA). The year-long project commenced in late 2017 with the following insight collection approach: review of literature, quantitative survey, use-cases, experts’ blogs, expert roundtable and ideation workshops.

The recent boom of artificial intelligence (AI) over the last decade has been triggered by advances in machine learning and deep learning. Many industries are adopting AI and integrating this technology into their services and products, impacting peoples' everyday life. The objective of this study is to demystify AI, raise awareness in the public transport sector by landscape analysis and provide insights to organisations who may be considering AI-powered solutions.

The report outlines current use-cases of AI applications in public transport and what the future might hold for AI in public transport systems. Early adopters and progressive public transport stakeholders anticipate that artificial intelligence is, and will be, further embedded in the future of mobility.

Our approach was to build upon the extensive network of UITP membership to get first-hand data and insights from authorities, operators, industry providers and research institutes on the current and future uses of AI in mass public transport. AP CTE received direct feedback on key lessons learnt and challenges to overcome for successful implementations of the AI technology.

The study focused on the use of artificial intelligence for customer excellence, operational excellence, engineering excellence, and security and safety management, while the use of AI in self-driving (private) vehicles was out of scope. The report equips the industry with a comprehensive collection of concrete examples and best practices to enable public transport stakeholders to be better prepared for the mobility of tomorrow.

This study is led by AP CTE in collaboration with Land Transport Authority of Singapore, and Trans-consult Asia as the lead partner.
FUNDING ACKNOWLEDGEMENT
This study was supported by funding received by UITP and LTA.

PROJECT TEAM

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TRANS-CONSULT ASIA LTD
Alok JAIN, Managing Director

The present document includes:
An overview of the content of the report.
The list of organisations, that contributed to the study.
An executive summary with key take-aways.
If you would like to purchase the full report, please contact asiapacific.cte@uitp.org.
INTERNATIONAL ASSOCIATION OF PUBLIC TRANSPORT (UITP)
UITP is a passionate champion of sustainable urban mobility and is the only worldwide network to bring together all public transport stakeholders and all sustainable transport modes. Established in 1885 and headquartered in Brussels, UITP has 16 offices across the world and 1,500 member companies giving access to over 18,000 contacts from 96 countries.

UITP ASIA-PACIFIC CENTRE FOR TRANSPORT EXCELLENCE (AP CTE)
The Asia-Pacific Centre for Transport Excellence was officially launched on 2 July 2012 with joint efforts between the International Association of Public Transport (UITP) and Land Transport Authority of Singapore (LTA). The Centre’s mission is to share and consolidate knowledge, conduct research and educational/training programmes to support the development of efficient public transport policies/ solutions, and foster sustainable mobility systems, which meet Asia-Pacific needs, and enhance life standards.

LAND TRANSPORT AUTHORITY OF SINGAPORE (LTA)
The Land Transport Authority (LTA) is a statutory board under the Ministry of Transport, which spearheads land transport developments in Singapore. LTA plans, designs, builds and maintains Singapore’s land transport infrastructure and aims to provide convenient options for walking, cycling or riding the trains and buses. LTA also leverages innovative technology to strengthen its infrastructure to provide exciting options for future land transport.

TRANS-CONSULT ASIA
Trans-consult Asia is an advisory enterprise specialising in urban transport operations and management, green transport solutions, and smart mobility solutions. Adopting a data and technology driven approach to enhance efficiency, performance and/or experience, it is committed to creating human-centric solutions and better living environments. Head-quartered in Hong Kong, it works on projects around the world.

DISCLAIMER:
Use cases, surveys and discussions are based on voluntary contributions by experts. UITP and LTA shall not be held responsible for the accuracy of the examples provided.
TABLE OF CONTENTS (full report)

ACKNOWLEDGEMENTS EXECUTIVE SUMMARY READING TIPS

1. ARTIFICIAL INTELLIGENCE DEMYSTIFIED

   ARTIFICIAL INTELLIGENCE – HYPE OR REALITY?
   Society is Entering the AI Era
   Artificial Intelligence Market Forecasts & Economic Impact
   What Is Artificial Intelligence? Why Is It Confusing?

   WHY ARTIFICIAL INTELLIGENCE MATTERS TO PUBLIC TRANSPORT
   AI in Everyday Life
   Adoption of AI Across Industries
   The Global AI Race

2. THE CURRENT STATE OF PLAY

   SUMMARY OF ARTIFICIAL INTELLIGENCE IN PUBLIC TRANSPORT: KEY STATISTICS
   AI Applications in Public Transport
   Key Enablers in AI Adoption
   5 Main Challenges Faced by Public Transport Authorities and Operators

   AI IN ACTION: PUBLIC TRANSPORT USE-CASES
   AI for Customer Excellence
   AI for Operational Excellence
   AI for Engineering Excellence
   AI for Safety and Security Management

3. SETTING AI UP FOR SUCCESS

   KEY BUILDING BLOCKS OF ARTIFICIAL INTELLIGENCE IN PUBLIC TRANSPORT GUIDING PRINCIPLES: TOWARDS NEW ORGANISATION CULTURE AND PROCESSES
   Building Block 1: Develop a Long-Term, Comprehensive and Sustainable Data Management Strategy
   Building Block 2: Foster a Multi-Disciplinary, Collaborative Stakeholder Management Approach
   Building Block 3: Move Towards a Data-Orientated Organisation Culture
   Building Block 4: Lead with an Innovation Mind-Set without Fear of Failure

   OVERCOMING THE CHALLENGES
   Challenge 1: Source Funding for AI in Mass Public Transport Projects
   Challenge 2: Reform Traditional Procurement Processes
   Challenge 3: Develop Legal and Policy Framework for AI in Public Transport
   Challenge 4: Develop Unbiased AI
   Challenge 5: Avoid the Trap of Over-Relying on AI
THE EVALUATION OF ARTIFICIAL INTELLIGENCE TECHNOLOGIES

4. REALISING THE BENEFITS OF AI

OPPORTUNITIES WITH ARTIFICIAL INTELLIGENCE

LOW HANGING FRUITS
  Chatbots
  AI-Powered Video Analytics

ARTIFICIAL INTELLIGENCE AND INTERNET OF THINGS
ARTIFICIAL INTELLIGENCE AND BLOCKCHAIN

5. THE FUTURE OF AI

AI PREDICTIONS: PUBLIC TRANSPORT IN THE NEXT FIVE YEARS
HOW AI COULD REVOLUTIONISE THE FUTURE

LIMITATIONS OF ARTIFICIAL INTELLIGENCE
  Artificial Intelligence ≠ Human
  External Hurdles and Constraints

6. OUTLOOK ON AI – WORDS OF WISDOM FROM EXPERTS

7. APPENDIX

SURVEY: AI IN PUBLIC TRANSPORT
  Notes on Methodology
  Survey Results - Landscape of AI in Public Transport

GLOSSARY

REFERENCES
ACKNOWLEDGEMENTS

We would like to thank all experts who have participated and contributed to the study.

Listed below (in alphabetical order) are the organisations that supported the project by either submitting a use-case, participating in a roundtable or workshop and/or writing a blog article for UITP Asia-Pacific website.

> AI Singapore
> Artificial Intelligence Society of Hong Kong
> Ansaldo STS | A Hitachi Group Company
> Atkins, member of the SNC–Lavalin Group
> Awaait Artificial Intelligence S.L.
> Axis Communications AB
> Axon Vibe AG
> Brookfield Centre in Real Estate and Infrastructure, Schulich School of Business, York University
> Cittati Technologia LTDA (Cittati)
> Concinnity Limited
> Delhi Integrated Multi Modal Transit System Ltd (DIMTS)
> East Japan Railway Company (JR-EAST)
> Efacec Engenharia e Sistemas S.A. (Efacec)
> EGIS Rail (Thailand) Co., Ltd
> Fancy Happiness Limited
> Frost & Sullivan
> Fujitsu TDSGmbH
> Giro Inc.
> GrabTaxi Holdings Pte Limited
> IBM China/Hong Kong Limited
> IBM Research, IBM Singapore
> INIT Innovations in Transportation, Inc.
> InTraffic B.V.
> Live With AI
> moovel Group GmbH
> MTR Beijing Corporation Limited (BJ MTR)
> MTR Corporation Limited (MTR)
> Nanyang Technological University (NTU)
> NEC Laboratories Singapore
> NEC Laboratories Europe GmbH
> New World First Bus Services Limited (NWFB)
> Passengera S.R.O
> PTV Asia-Pacific Pte Ltd
> Railway Technical Research Institute (RTRI)
> RATP Dev
> RATP Dev TransdevAsia
> Réseau Transport de la Capitale (RTC)
> Rocketbots Hong Kong
> Scania (Hong Kong) Limited
> Scooter Technology Limited
> Singapore University of Technology and Design (SUTD)
> Shenzhen Bus Group Company Limited
> Société de Transport de Montréal (STM)
> SMRT Buses Ltd
> SMRT Trains Ltd
> Siemens AG
> Sopra Steria Group SA
> Systra MVA Singapore Pte Ltd
> Systra Scottlister Pty Ltd
> Thales Transport and Security (Hong Kong) Limited
> The University of Hong Kong (HKU)
> Traffic Control Technology Co., Ltd
> Transport for London
> Tüv Süd Asia Pacific Pte Ltd
> TUM Create Ltd
> Urban Redevelopment Authority of Singapore (URA)
> Vincent Tan Consult
> WSP Singapore Pte Ltd
> Zhengzhou Yutong Bus Co., Ltd
> 9292 – RESinformatiegroep B.V

We would also like to thank the 48 organisations that completed our online survey to understand the scope and potential of AI in public transport.
EXECUTIVE SUMMARY

Today, the world has entered the Fourth Industrial Revolution, which is driven by seamless automation, endless connectivity and characterised by merging physical and digital advanced technologies such as artificial intelligence, big data analytics, the internet of things, and blockchain.

The growing importance and maturity of artificial intelligence (AI) bring opportunities to people and economies. As a disruptive technology, AI also poses risks and challenges to existing markets.

According to PwC’s analysis, the global GDP will be up to 14% higher in 2030 as a result of the accelerating development and take-up of AI. Accenture predicts AI could double annual economic growth rates in terms of gross value added (a close approximation of GDP) by 2035 across 12 selected countries.

44% of 203 senior executives (from various industries and countries) say delaying AI implementation will make their business vulnerable to new, disruptive tech start-ups.

AI – A MOVING DEFINITION

There is no universally accepted definition of ‘artificial intelligence’ because the meaning of ‘intelligence’ is arbitrary. Definitions of AI are debatable and some are even “self-defeating” (Antonio L. Elias, John D. Pararas). For instance, the World Economic Forum defines AI by its ability to “do things traditionally done by people”, which makes the definition subject to change as technology progresses and takes up more tasks.

What do our Public Transport Experts Think of AI?
Experts suggest that artificial intelligence should consist of the following qualities:
- Ability to learn.
- Ability to adapt.
- To mimic as well as exhibit creativity.
- To fulfil its purpose to improve existing processes.

GROWING IMPORTANCE OF ARTIFICIAL INTELLIGENCE

AI in Industry Sectors
Artificial intelligence is impacting all industry sectors with some industries, such as financial services, leading in AI adoption. The report highlights the impacts AI has on health care, retail, agriculture and the legal profession, all sectors that the public transport industry can learn from.

AI in Government Policies
The US and British governments were the first to heavily fund artificial intelligence research back in the 1960s.
In the recent years, there has been a growing interest, supporting policies and investment in AI by national governments. In particular China, a late adopter, announced the fundamental role of AI in its 13th Five-Year Plan in 2015.

The map highlights countries/regions, that have made major public announcements to support the development of AI technologies.
The scope of the study excludes AI technologies relating to autonomous passenger vehicles whilst autonomous shuttles/buses (as mass public transport) were included.

OUR RESEARCH METHODOLOGY

What we did....

> Quantitative Survey
  48 companies across the public transport sector
> Expert Roundtable (Karlsruhe, Germany) Attended by 28 public transport experts in IT, Innovation and Product R&D.
  Objective: To gain deeper insights on challenges faced and lessons learnt from experts who have experience in deploying or are currently considering deploying AI projects.

> 2 Ideation Workshops (Hong Kong & Singapore) Attended by 57 experts from public transport and the field of AI.
  Objective: To bring two worlds of experts to brainstorm the future of AI in public transport.
> 17 in-depth use-cases
  Contributions from organisations & CTE research
> 7 experts blog entries
  Expression of views and opinions

Where we focussed...

The project focussed on the use of artificial intelligence in the context of four main areas:

Customer Excellence:
Use of AI applications to achieve better customer service and intelligence amongst authorities and operators.

Engineering Excellence:
AI-powered solutions for inventory and asset management and predictive maintenance.

Operational Excellence:
Using AI to improve system and operational efficiencies through business process optimisation.

Safety and Security Management:
AI applications to improve operational safety and security measures, including offences that involve revenues and property.

The scope of the study excludes AI technologies relating to autonomous passenger vehicles whilst autonomous shuttles/buses (as mass public transport) were included.
The online survey conducted by UITP generated 48 responses from public transport related organisations, including 9 authorities, 15 operators, 22 industry providers and 2 research institutes. Key survey findings are outlined below.

Adoption of AI is gaining momentum in public transport...

62% of the surveyed public transport organisations are involved in AI technologies projects and solutions.

Among them:
> Half are at trial and R&D stage.
> Half have adopted AI technologies.

11% of the surveyed organisations are AI adopters who started their AI journey between January 2017 and March 2018.

... and currently led by industry providers.

4 in 5 surveyed industry providers are offering or trialling AI-powered solutions to public transport clients.

**Four key applications of AI in public transport**

- Real-time operations management
- Customer analytics
- Predictive Maintenance
- Network Planning and Route Design

In the future, 1 in 3 are considering the integration of AI technologies in these three applications.

**Five main challenges faced by public transport authorities and operators**

1. Improve data quality (i.e. reduce fragmentation and incompatibility of data)
2. Build capacity and knowledge in AI deployment
3. Overcome data privacy issues
4. Meet the requirement of data volume (i.e. sufficient data-sets)
5. Establish commitment from top management to drive the cultural and process change required
OVERVIEW OF CURRENT APPLICATIONS OF AI IN PUBLIC TRANSPORT

The study collected in-depth information on 17 use-cases across the four key areas of focus, with the applications and main stakeholder organisations listed below. AI is clearly gaining traction in the public transport sector.

AI for Customer Excellence
- MTR Chatbot
- TfL TravelBot
- JR East-Hitachi Communication Robot
- JR East-IBM Call Centre Support System

AI for Operational Excellence
- RTRI Predicting Method of Train Delay and Train Congestion
- SBB Reinforcement Learning for Railway Dispatching
- NEC Predictive Optimisation for Bus Operations
- Shenzhen Bus Group-Haylion Technologies ‘Alphaba’ Intelligent Driving Public Bus Trial
- RATP Dev ‘Interstellar’ Mass Transit Data Analytics System
- Siemens Mobility Data Analytics for Mobility Demand Prediction
- Axon Vibe-SBB Smart Travel Assistant and Travel Cockpit
- Alibaba ET City Brain
- LTA Automatic Traffic Monitoring on Drone Images

AI for Engineering Excellence
- RTRI Automatic Tunnel Lining Crack Detection
- Yutong Bus–Shanghai Bus Group Intelligent Charging Control System

AI for Safety and Security Management
- SMRT Buses ‘ProLearn’ Data Analytics and Accident Risk Prediction
- AWAAIT-FGC ‘Detector’ Fraud Detection System

Key outcomes from use-cases

AI applications have been deployed in public transport to:
- Improve the quality and efficiency of tasks undertaken by employees.
- Reduce employee workload from mundane tasks to focus on more value-adding activities.
- Tackle specific problems, in particular those that require solutions relying on complex analysis of data and predictions in dynamic, ever-changing environments.
- Provide efficient, safer and cost-effective services to customer.

Current AI applications in public transport have **NOT** been designed to replace staff.

The mindset of “Start small and grow incrementally” helps to the successful deployment of AI. It also allows organisations to source funding progressively and minimise risks.

Low hanging fruits

Not all AI applications require multi-million dollars investment. AI powered video analytics and chatbots are two types of applications that are relatively easy to deploy with fewer barriers to development. They can be viewed as a place to start when thinking about deploying AI technologies, with a view to developing more complex applications in future.
THE EVALUATION OF AI TECHNOLOGIES

During the evaluation of AI projects, there are a number of distinct areas that need to be considered to ensure a robust and relevant assessment has been undertaken:

> AI is new in public transport: be cautious of early results and adopt an inquisitive mind.
> AI is a self-learning technology that feeds on data: be aware of the learning curve.
> AI is only a tool: use common key performance indicators (KPIs) to measure its impact of solving a right problem statement.

TOOLBOX: LEARNING FROM AI ADOPTERS

The study collected knowledge from the public transport industry and UITP provided opportunities for extensive peer knowledge sharing that helped identify building blocks and commonly faced hurdles.

Four building blocks to follow for a successful deployment of AI

Lead with an innovation mind-set without fear of failure

Develop a long-term, comprehensive and sustainable data management strategy

Foster a multidisciplinary, collaborative stakeholder management approach

Move towards a data-orientated organisation culture

KPIs

Study of the impact of the 17 use-cases on KPIs revealed the following:

> AI applications have the greatest positive impact on customer service and operational reliability.
> Use of AI is expected to improve financial efficiency and uptake of public transport.
> Experts expect more safety- and security-related AI application to be developed.

Challenging requirements of AI in mass public transport projects

Develop Legal and Policy Framework

Avoid the Trap of Over-Relying on AI

Develop Unbiased AI

Source funding

Reform Traditional Procurement Processes
WHAT IS NEXT?

AI is already positively impacting the public transport sector and the technology is evolving and improving rapidly over time. Experts gave their valuable insights on the likely short to medium-term trends of AI in public transport.

...underpin Mobility as a Service (MaaS) platforms.
...be embedded in most customer touchpoints.
...enable Smart City initiatives to succeed.
...make on-demand public transport services a reality.

IN THE NEXT 5 YEARS, AI WILL...

...power the deployment of autonomous shuttles and buses in cities.
...transform the safety and security management of public transport systems.
...become a mainstream feature of predictive maintenance applications.

Combining AI with the internet of things or blockchain can give rise to further opportunities...

Internet of Things (IoT)

Devices and sensors connected through the IoT generate a significant amount of unstructured data, which AI can:
> Make sense of, or recognise patterns in.
> Provide optimised outcomes to specific problems and predict likely future outcomes.

Blockchain

Blockchain can:
> Improve security of AI-enabled tools.
> Track, understand and explain decisions made by AI.

WHAT COULD THE FUTURE OF AI LOOK LIKE?

AI experts and public transport stakeholders brainstormed the AI-driven innovative concepts, that could help overcome the rising challenges of the industry such as building intelligent transport systems, responding to the growth of on-demand mobility and sharing economy solutions, achieving safety and security of public transport systems and solving workforce shortages.
LIMITATIONS

AI, like any other technology, faces limitations. There is an important role for humans to play to maximise the benefit that can be realised from AI solutions and avoid undesirable pitfalls, there remains an important role for humans to play. These are summarised as follows:

Artificial is not Human:
> Public transport systems need human interactions.
> AI is task-specific; humans should manage the bigger picture.
> AI is only a tool and enabler to unlock creative ideas.

External Constraints:
> AI is human resource intensive: the right capabilities need to be strengthened and/or built to enable and exploit full potential of AI applications.
> AI cannot get smarter than its training data sets.
> Overly strong data-protection regulations or inadequate framework on data ownership and usage may slow down the progress of AI technologies.

OUTLOOK ON AI
Artificial Intelligence is developing and its capabilities are advancing over time. AI will inevitably transform the public transport sector. It is key to understand the impact or potential of AI for the industry. Public transport stakeholders should proactively look at the opportunities brought by AI to improve their services and build the urban mobility of tomorrow.

The report highlights the following expert conclusions:

- Data is the foundation of AI systems.
- All public transport stakeholders have a role to play including end-users because AI is a living application, which learns from user input.
- Stakeholders should engage in collaborative partnerships to build synergy and form highly-skilled multi-disciplinary teams.
- Management should lead the change to foster innovative culture and adopt ‘try-and-fail’ mind-sets. Most importantly, organisations should learn to ‘fail safely’ because AI requires a trial and error approach.
- With AI’s potential in taking over mundane and repetitive tasks, human resources must be continuously upskilled to respond to the needs of future public transport.
Lines of Data using Industrial Internet of Things, IIoT, and Artificial Intelligence, AI, to improve predictive Rail Maintenance; Japan

The Palo Alto Research Centre (PARC) uses the industrial internet of things and artificial intelligence to develop new predictive rail maintenance and performance management technologies. Julian Turner gets the inside track on its JR East project from strategic execution director Ajay Raghavan An.

From the opening of the first line from Tokyo to Yokohama in 1872 through to the shinkansen bullet trains of today, the evolution of the Japanese railway has been a triumph of ambition and a pioneering achievement in the fields of technology and engineering.

Passenger rail services in Japan have become a byword for efficiency, and the network spanning more than 27,000 km remains one of the most utilised, punctual and least subsidised in the world.

Ensuring that operations and maintenance (O&M) work is carried out in a timely fashion is central to this success. In recent years, however, operators such as East Japan Railway Company, or JR East, have faced multiple challenges including aging infrastructure, a dearth of new train maintenance specialists due to Japan’s decreasing population, and spiralling costs alongside shrinking budgets.

To help improve train efficiency and safety for the six billion passengers that use JR East services every year, the company turned to Palo Alto Research Centre (PARC), an open innovation company based in Silicon Valley focused on predictive analytics using the industrial internet of things (IIoT).

“Many of Japan’s capital-intense rail assets were deployed decades ago and JR East would obviously like to extract the maximum life out of them without compromising on safety,” says PARC strategic execution director Ajay Raghavan. “The shrinking population means that rail revenues are declining and so there is also pressure on O&M teams to be lean, plus a lot of more experienced technicians are beginning to retire.

“In light of these factors, JR East realised that its existing time-based maintenance (TBM) practices were not necessarily the best solution going forward, and approached PARC six years ago in search of a more effective and sustainable long-term solution.”

Train companies are moving away from time-based maintenance to a more predictive paradigm.

Window of Opportunity: Time vs Condition-based Maintenance

Traditional time-based maintenance (TBM), and reactive ‘fail and fix’ or planned maintenance practices, can be costly, prone to human error, or lead to downtime or accidents. Train companies are understandably moving away from TBM in increasing
numbers in favour of condition-based maintenance (CBM), in which servicing of machinery is performed when the need arises.

Raghavan uses an analogy of a car in order to illustrate the concept of CBM. A car needs an oil change every six to 12 months or 5,000–10,000 miles. Newer models have sensors that tell the owner when the service is due based on average usage time, but this may not take into account factors such as heavy loads or frequent use. The service schedule may be too conservative, for example.

The worst that can happen, of course, is that the car stops working, but extrapolate that out to a large complex asset such as a train and the problem immediately becomes much more significant.

“The traffic in the Tokyo Subway is crazy, especially during peak hours, and if a train stops working the entire system clogs up, or in the most extreme cases accidents can result in loss of life with operators liable,” says Raghavan. “TBM may have worked for assets that have similar usage patterns, but not necessarily for those with a significant geographical or climate spread, or those stretched beyond their original design life; in these instances TBM practices are no longer cutting it.

“Train companies are therefore moving away from TBM to this more predictive paradigm where O&M teams may get a week or even a month’s notice before assets fail, allowing them to prepare schedules and resources to avoid taking a critical train out of service and disrupting the system.

“Predictive analytics is also extremely valuable in terms of long-term planning. Providing operators with data on the remaining useful life of an asset one or even six months before it has to be retired enables them to plan ahead for a major capital outlay, for example.”
Artificial Intelligence, AI, Railway Applications made possible; Taiwan

Vecow, Taiwan, devotes to providing industrial-grade computer products and one-stop design & manufacturing services with leading performance, trusted reliability, advanced technology, and innovative concepts to meet your requirements for Artificial Intelligence, AI, applications.

Founded in 2010, Vecow is a team of embedded experts devoted to designing, developing, producing, and selling industrial-grade computer products. Vecow offers high-performance fanless systems, In-Vehicle Computing System, AI computing systems, 10GigE embedded systems, expandable fanless systems, ultra-compact fanless systems, industrial motherboards, multi-touch computers, multi-touch displays, frame grabbers, embedded peripherals, and design & manufacturing services with leading performance, trusted reliability, advanced technology, and innovative concepts.

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With experienced embedded computing expertise, leading integrated features, flexible tailor-made services and one-stop comprehensive solution, Vecow serves trusted products and services to make AI-oriented IoT infrastructure and performance-driven edge computing applications possible.
Leading Expertise

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Based on Vecow original design concepts, standard product deliveries and any our technical achievements, we are willing to carry out innovative ideas with new extension delivery for you. Seasoned Vecow Design & Manufacturing Service team offers quality and professional tailor-made service to you with well-organized project status, less project design, research & development efforts, reduced total cost of project ownership (TCO) and even faster time-to-market.

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**Compact Integrated Embedded Computing Solutions**

**Compact Integration**

Based on the ideas of a powerful embedded computing system, Vecow plans, designs and produce Vecow embedded computers as a compact integrated elite which brings advanced technology, outstanding performance, user-friendly features, flexible expansion functions, compact size, industrial-grade reliability, trusted CE, FCC, EN50155, EN50121 and E-Mark compliant, VMWare ready, smart manageability and intelligent protection functions together in this compact box computer.

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Powered by workstation-grade processor & chipset, advanced graphics technology, optional independent graphics engine, multiple WiFi/4G/3G/LTE/GPRS/UMTS wireless data transmission available, 10GigE (10G)/SuperSpeed USB 3.1 Gen 2 (10G)/SATA III (6G)/USB 3.0 (5G)/IEEE 802.3at PoE+ (1G)/Gigabit LAN (1G) high-speed data rate supported, Vecow embedded systems enable excellent system performance with less computing down time.
Intelligent Governor

Equipped with isolated digital I/O & isolated serial connections for circuit protection, RAID 0, 1, 5, 10 data protection supported, wide range 6V to 78V DC power input with up to 200V surge protection, manageable ignition control, remote power switch available, and smart remote system management functions ready, Vecow embedded systems preserve the damages from working environment in daily or accidental operations.

Rugged Reliability

Featuring reliable fanless thermal configuration with advanced air flow design, max -45°C to 85°C operating temperature, all-in-one single board solution, cable-less design, rugged X-coded M12 connection available, wide range of power input, anti-shock, anti-vibration, IP65, IP67, EN50155 and EN50121 compliant, Vecow fanless systems are your trusted embedded engines in harsh environments.

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Brussels: STIB buys additional 30 Bombardier FLEXITY Trams; Belgium

18 Jun. 2019  |  Railway-News

The Brussels Transportation Company (STIB) has placed an Order with Bombardier Transportation for 30 additional FLEXITY Trams.
This order is part of a framework agreement that the two parties signed in April 2018. The framework contract covered a maximum of 175 trams. The initial order STIB placed (also in April 2018) was for 60 trams.

This current order is worth around 67 million Euros (75 million USD). Bombardier says it will start delivering these trams starting in December 2020. The units will be five-car trams with a total length of 32 metres.

Thomas Ryckalts, President of the STIB Board, said:

“After a first order for 60 new trams, the STIB board took a decision in favor of our passengers by ordering 30 additional trams. These new vehicles will reinforce our mobility offering to the benefit of all.”

Laurent Bouyer, President of Bombardier Transportation France and Benelux, said:

“We are proud to be a key player in the ongoing mobility improvements for the city of Brussels. This additional order shows the confidence STIB has in our FLEXITY platform. The public showed much enthusiasm as they explored their new tram mockup that was on display in early May in Brussels.”

**Bombardier FLEXITY Trams for Brussels**

The trams for STIB will have a bright, spacious interior. Bombardier is always trying to increase capacity and provide more space for passengers with reduced mobility. It also wants to improve the ability of passengers to move around inside the tram during peak travel times.

The **FLEXITY** trams will come with a high-contrast LCD information display. To keep passengers comfortable, they will also feature an intelligent climate system with smart sensors. The FLEXX bogies meanwhile will ensure a smooth ride.
FLEXITY Safety Features

Not only is the driver's cab more comfortable. It also has an improved field of vision. The **Obstacle Detection & Assistance System (ODAS)** will help the driver. It comprises cameras and sensors that detect passengers, vehicles and other obstacles near the tram.

Bombardier has equipped these trams with a soft nose. This means citizens around the trams will also be safer.

Bombardier has supplied more than 400 trams to Brussels Transportation Company so far, starting in the 1970s.

Sound Transit reveals Siemens S70 LRV for Seattle; US

Jun. 20, 2019
Written by Keith Barrow

SEATTLE Public Transport Authority Sound Transit revealed the first Siemens S70 LRV for the city’s Link light rail network on June 19.

Sound Transit awarded Siemens a $US 554m contract in September 2016 to supply 122 S70s as part of the Sound Transit 2 network expansion programme. An option for a further 30 vehicles was subsequently exercised in 2017, taking the total value of the order to $US 642.5m.

Assembly is being carried out at Siemens’ plant in Sacramento, California, and the first vehicle was delivered to Sound Transit’s Link Operations and Maintenance Facility in Seattle on June 6.
The S70s will more than triple the size of Sound Transit’s LRV fleet, which currently comprises 62 vehicles supplied by Kinkisharyo.

Each S70 will seat 74 passengers and offers a number of improvements over the existing vehicles, including larger windows, a wider centre aisle, four bicycle hooks, dynamic passenger information displays and enhanced LED lighting.

Siemens will now deliver between one and three vehicles per month, with the final LRV due to arrive in Seattle in 2024. The first vehicle is expected to enter service early next year.

Forty new LRVs are required to serve the Northgate Link Extension when it opens in 2021. The network will also be extended to Bellevue in 2023, and to Lynnwood, Federal Way and downtown Redmond in 2024.

“The new vehicles are critical to meet ridership demand as we move forward aggressively in building our light rail network,” says Sound Transit CEO Mr Peter Rogoff. “These new cars will become the backbone of the fleet serving Northgate, Lynnwood, Federal Way, Bellevue and Redmond in the next five years.”

Categories: FleetLight RailNewsNorth America

Warsaw and Hyundai Rotem signed the Tram Contract; Pland/South Korea

June 19, 2019
Warsaw Tram Operator, Tramwaje Warszawskie, and Hyundai Rotem signed the contract for the supply of 213 low-floor tramways, with an option for 90 additional vehicles. Hyundai Rotem offer had a value of PLN 1.82 billion (EUR 428.2 million). The tram procurement is partially financed from EU funds in the amount of PLN 285 million (EUR 66.87 million).

“The procurement of new rolling stock and the construction of new tram routes will increase the attractiveness of the urban railway transport and will improve the quality of life of the capital’s residents. Warsaw Public Transport will be synonymous with modern and passenger-friendly transport system. This is the largest contract in our history,” Rafał Trzaskowski, the Mayor of Warsaw said.

The base order, for the 123 trams will be delivered at the end of 2022 and those built as part of the option, by the end of 2023. Under the contract, Hyundai Rotem will deliver 85 bidirectional and 18 unidirectional trams with a length of 32.5m, which is up to 2.5 meters more than the used low-floor trams. Each tram has a capacity of 240 passengers. The option for the other 90 trams includes 45 bidirectional and 45 unidirectional vehicles, with the same length.

They will be equipped with air-conditioning system, internal and external monitoring system and passenger information system. The new trams will be environmentally friendly, as they will meet the high requirements for sound emissions, and energy savings, ensured by energy storage system.

According to tender, 60% of the components of the new trams will come from Poland and European Union. The entire traction equipment will be supplied by Medcom, a Polish company and ATM, another Polish company, will deliver data collection equipment. Hyundai Rotem has planned that more than 40% of vehicles from the entire Warsaw contract will be built in Poland, as part of company’s plans to build a factory in Poland. In 2018, 286.5 million trips were made by Warsaw tramway system, a 6% increase (or 17 million trips) compared to 2017, which leads to a 24.2% market share. After the delivery of all new trams, 80% of Warsaw tramway fleet will be low-floor. The new trams will be deployed on city’s network, including on the 20-km extensions planned to Dworzec Zachodni, Wilanów and Gocław.

Transmashholding unveils St. Petersburg Metro Train Concept; Russia

June 20, 2019
Transmashholding has presented the next generation concept of St. Petersburg metro train at SmartTransport-2019.

With the active participation of St. Petersburg metro specialists, Transmashholding developed a number of technical solutions for the new train, in particular a “smart” window which can show the video image.

As part of the new state-of-art-train, an original exterior and interior design was created.

The new carriages have intelligent lighting, which can be changed during the day (cold in the morning, warm in the evening), new system ventilation and larger doors, as the width of the doorway will be increased up to 1400 or 1600 mm.

The new train will be equipped with sockets, Wi-Fi modules, as well as three types of screens which can be placed in the passenger compartments, showing an interactive metro map, door guides with creeping lines, screens for entertainment and information programmes. For passengers with reduced mobility and parents, the trains have special places.
The cabin of the new train is fitted with a control panel, air conditioning, a set of systems that provide noise reduction, and a modern assistance system that will monitor the driver’s health.

The train will be equipped with modern asynchronous traction, improving energy efficiency. The train is equipped with the latest data transmission system. TMH says that there is a technical possibility of transferring a new train to an unmanned mode.

The new train can be modified according to city’s and metro company’s proposals and requirements.

It is expected that in case of entering into an agreement with the Petersburg Metro, the trains will be manufactured Oktyabrsky electric car-repair plant located in the city.

Production of trains will be organized at the Oktyabrsky Electric Railway Car Repair Plant.

**Stadler receives first Flirt Akku Battery Train Order; Germany**

19 Jun. 2019
GERMANY: Schleswig-Holstein Transport Authority NAH.SH has selected Stadler to supply 55 Flirt Akku battery multiple-units to operate regional services and provide 30 years of maintenance.

Announcing its selection as preferred bidder on June 19, Stadler said that it will reveal more details when the contract is signed, which is expected after the 10-day standstill period. NAH.SH called tenders for zero-emission trains to run on non-electrified lines but did not specify the technology to be used.

NAH.SH becomes the launch customer for the Flirt Akku, which was officially unveiled last year at the Stadler Pankow factory in Berlin.

Skanska to build Light-Rail Line in Bergen; Norway

11 June 2019
Swedish construction company Skanska has secured an Nkr 982m ($113.4 m) contract to build a subsection of the light-rail system in Bergen, Norway.

The company signed the contract agreement with the Hordaland municipality.

The scope of the contract requires Skanska to build a light-rail line between Fyllingsdalen and Bergen city centre. It includes a 1,200 m-long tunnel and a station hall.

The overall project involves the construction of infrastructure surrounding the tram line, associated deconstruction work and the development of multiple huge concrete foundations.

Construction works will begin this month and are expected to be complete by the end of 2022.

During the project, a number of steps are scheduled to be taken to reduce its carbon footprint. These steps include utilising biofuels, electrical machines and the use of low-carbon concrete.

Skanska noted that the project will be certified by Ceequal, a global certifying system that assesses suitability within construction projects.

In March, Skanska signed a $57m contract with Sound Transit in the US to carry out enabling work for the Lynnwood Link L300 light-rail expansion project in Lynnwood and Mountlake Terrace in Washington, US.

The scope of works included demolition, temporary sediment and erosion control, advanced utility relocations, temporary parking construction, grading and earthwork across a 6km project before the construction of light-rail system commences.

Skanska is a development and construction company, with the majority of its operations concentrated across Sweden, Norway and Finland. Last year, the company reported sales of about Skr67bn ($7.11bn).
METRO NEWSLETTERS on “URBAN MOBILITY AS A SERVICE”

PUBLIC MULTIMODAL URBAN, SUBURBAN AND INTERURBAN PASSENGER TRANSIT SYSTEMS WITH METRO-BUS, LIGHT-RAIL, TRAM-TRAIN, METRO-RAIL, METRO-TRAIN, REGIONAL RAPID TRANSIT, COMMUTER-RAIL, ROPE-WAY/TRAIN, MAGLEV AND HOVERCRAFT TRANSIT/PEOPLE MOVER, WATER-METRO, AUTONOMOUS PEOPLE-MOVER

TRANSPORTATION AND ECONOMIC DEVELOPMENTS IN MODERN URBAN/MEGAPOLIS ENVIROMENT

METRO Newsletter by Dr. F.A. Wingler
METRO 76, June 2019
PART I: INDIAN ACTIVITIES AND INITIATIVES FOR URBAN MOBILITY AS A SERVICE

Varanasi to have Ropeways to ease Road Congestion - Proposal for Ropeways is taking Shape; India

Work has begun for improving public transport system. Varanasi is finally on its way to become a smart city.

The Econonmic Times TNN|
14 Jun. 2019, 01:40 PM IST

Work has begun for improving public transport system. As Metro Rail and Mono Rail are unfeasible here due to narrow roads, the proposal for ropeways is taking shape.

Survey has begun on three routes for ropeway and in a meeting held by Commissioner Deepak Agarwal, it was decided that RITES (Rail India Technical and Economic Service) and engineering consultancy company specializing in the field of transport infrastructure would supervise the project.

RITES official Vishakha said: "Ropeway is a good idea for old Kashi, where roads are narrow and it is not possible to break structures."

The first proposed route of the ropeway would be Shivpur to Sigra and Lanka while the second route would be from Kuccheri to Lahurabir, Maidagin and Gaudauliya. The third route would be from Lahartara to Banaras Hindu University.
Varanasi Development Authority (VDA) Vice-Chairman Rajesh Kumar said that the proposal for ropeways was presently under study.

"RITES is studying the feasibility of the project - whether a single ropeway or a double ropeway would be better. Once the initial study is completed which would take another fortnight or so, we will move on to the next stage of preparing a detailed project report (DPR)," he said.

Kumar said that no bids had been invited till now and the same would begin only after other modalities are worked out. The ropeway, he said, would ease road traffic congestion to a great extent. "We will also be focusing on Water Transport on the Ganga and Varuna Rivers," he said.

Ropeways and Cable Cars are Future of public Transport in India: Nitin Gadkari; India

He stressed upon the Need to cut down Congestion and resultant Pollution in Cities.

By Rajat Arora

Minister for Road Transport, Shipping and Water Resources Nitin Gadkari has said that the "country needs futuristic technology for developing its transport sector".

He stressed upon the need to cut down congestion and resultant pollution in cities. Reiterating his commitment for promoting transport innovations that are pollution free and cost effective, he said that ropeways, cable cars, funicular railways can be very useful means of transport for hilly and difficult terrains and as last mile connectivity options in congested cities. He said these transport options would also be very useful for tier two cities and hoped these would motivate people to shift from personal to public transport. Gadkari was speaking in New Delhi today at the MoU signing between WAPCOS and Doppelmayr for providing end-to-end solutions for passenger ropeway projects. WAPCOS is a leading engineering consultancy organisation of the Government of India, which has grown into an Indian multinational with projects in over 45 countries across the world.
Doppelmayr, Austria is the world’s largest ropeway manufacturers with cutting-edge ropeway technologies. It has set up more than 15,000 ropeway installations across the world.

The MoU includes the entire gamut of preparing feasibility studies, detailed project reports, construction, equipment supply, operation and maintenance, etc. It will enable development of ropeway projects in various states using globally accepted standards for passenger safety and reliability. These projects will not only reduce traffic congestion and pollution, but will also contribute towards development of tourism destinations and provide impetus to employment generation in the country. Gadkari again called for the use of alternate fuels in transport sector. He said, by use of methanol, ethanol and electric sources, the country can make huge savings on petroleum imports.

**Lucknow Metro gets Recognition at National Day of the Rail in Holland; India**

June 28, 2019 Press Release

**Lucknow Metro Rail Corporation** added another feather in its hat when it was recently recognized and acknowledge at the National Day of Rail in Holland. **MD, Kumar Keshav** presented the case study of Lucknow Metro via Skype at the conference organised to celebrate National Day of Rail.

Out of 38 speakers, he is the only one from different nation, who represented India across the globe with Lucknow Metro Rail Corporation Limited. He has been acknowledged for his firm determination and sprit of achieving the desire goal to construct Lucknow Metro project Phase-1(A) of 23 km before the given time schedule i.e., 36 days before the deadline in just less than 4 (four) years and 5 (five) months.
During his session, he mentioned about Lucknow Metro, which is one of the most prestigious and flagship Metro Rail Projects of the Government of India (GoI) and Government of Uttar Pradesh (GoUP). This project not only became the precursor for all other metro projects in Uttar Pradesh but also completed in the record time frame within the estimated cost.

“Lucknow Metro today, is a case study subject in various technical & non-technical institutions across the Country and the Globe. It has set new benchmarks in Metro Rail construction and operation in India and has ushered a revolution in bringing Mass Rapid Transit System (MRTS) in Uttar Pradesh”, he added.

All the audience and dignitaries present during the event appreciated him for his dedication and hard work for achieving the target within the time frame and gave him the standing ovation at the end of the session.

Proposal approved for Tripartite Agreement for Metro Projects in Bhopal and Indore; India

June 28, 2019 Rail News

The State Cabinet on Wednesday approved a proposal to enter into a tripartite agreement with the Union government and Madhya Pradesh Metro Rail Company for metro rail projects in Bhopal and Indore. The company’s managing director was authorized to ink the agreement.

More Information:

- Minister for Urban Administration and Development (UAD) Jaivardhan Singh said, “The metro project in Bhopal would cost Rs 6900 crore, while Rs 7,500 crore has been set aside for Indore.”
- He said that the state and Centre would bear 20% cost each, while the remaining 60% funds would be raised through loans.
- The metro lines are expected to start by 2023, he added.

Bhopal Metro:

- The Bhopal Metro comprising of two corridors will cover total length of 27.87 km.
- The two corridors are: (i) Karond Circle to AIIMS (14.99 km) and (ii) Bhadbhada Square to Ratnagiri Tiraha (12.88 km).
- The Karond to AIIMS corridor is mostly elevated and partly underground (at Bhopal Railway Station & Bus Station) and comprises of 16 Stations (14-Elevated and 2-Underground).
- The Bhadbhada to RatnagiriTiraha corridor comprises of 14 stations all elevated.
- The population of 23 lakh of Bhopal agglomeration area is expected to be benefitted by Bhopal Metro Rail Project directly and indirectly.
- The corridors will be having Multimodal Integration with Railway Stations & BRTS Stations and will have feeder network of Bus, Intermediate Public Transport (IPT) and Non Motorised Transport (NMT).
Karond to AIIMS corridor will pass through the heart of city and connect densely populated areas with Bus Station, Railway Stations and AIIMS.

Bhadbhada to Ratnagiri corridor will connect upcoming Smart City’s Area Based Development (ABD) with BFIEL and surrounding industrial areas.

**Indore Metro:**

- The Indore Metro Rail comprising Ring Line of length 31.55 km will connect major public nodes and city cluster areas of Indore.
- The Ring Line will be from Bengali Square – Vijay Nagar –Bhawarsala – Airport – Palasia – Bengali Square.
- Numbers of Stations on the Ring Line are 30.
- **The corridors will have Multimodal Integration with Railway Station & BRTS Stations and feeder network of Bus, Integrated Public Transport (IPT) and Non Motorised Transport (NMT).**
- The Ring line will connect densely populated areas of the city with the new developing areas along with Railway Station, Airport and ABD under Smart City project.
- The Metro will provide eco-friendly and sustainable **Public Transport** to residents, commuters, office workers, students, visitors and travellers.

**DPRs for Light Metro Rail Projects in Jammu and Srinagar ready; India**

June 28, 2019 Rail News

Detail Project Reports (DPRs) for Light Metro Rail projects in Jammu and Srinagar have been completed by RITES Ltd., a PSU under Ministry of Railways, according to sources. The reports will now be submitted before the Central Government for final approval by the next month.

**Srinagar Light Metro:**

- The Srinagar Light Metro will have 24 stations comprising of two corridors.
- The first corridor from HMT (Shalteng) to Indra Nagar will be 12.5km long.
- The second corridor from Osmanabad to Hazuri bagh will be 12.5km long.
Jammu Light Metro:

- The Jammu Light Metro will cover 23km length comprising of two corridors.
- The first corridor from Bantalab to Greater Kailash, will have 17 stations.
- The second Corridor from Udheywala to Exhibition ground, will have 6 stations.
- E Sreedharan, known as the metro man, who was appointed as an advisor by the J&K government, had also visited the sites of both the projects and given a go ahead.

The Jammu & Kashmir Governor administration has appointed ‘Metro Man’ E. Sreedharan as the principal advisor to two Mass Rapid Transit Systems (MRTS) to be built in Jammu and Srinagar.

PART II: GLOBAL ACTIVITIES FOR URBAN MOBILITY AS A SERVICE

Global Urban Transport News in Brief; Global

21 Jun. 2019

A prototype Solaris Trollino 24 double-articulated Trolleybus has started test running in Gdynia; Poland:

BYD has handed over 16 8.7 m electric Buses to Messina public transport operator ATM.

Woojin Industrial Systems Co is to supply 200 metro cars for Line 5 and 136 cars for Line 7 of the Seoul metro. Deliveries are due between August 2020 and November 2022.
Uralvagonzavod is to supply three three-section Trams to Kazan in a 135m rouble contract awarded to Fobos-TS.

Metro Warszawskie has called tenders for the construction of stations on metro Line 1 at Plac Konstytucji and Muranów. These were included in the original plans for the line, but later postponed. They are due to open in 2026.

Zagreb tram operator ZET has signed a 260 m kuna financing agreement with the Ministry of the Sea, Transport & Infrastructure and the Central Finance & Contracting Agency for the first phase of network modernisation. The project is financed 85% through EU funds and 15% from the state budget.

The city of Saarbrücken has renewed Saarbahn’s operations contract for a further 10 years from September 1 2019.

Stadtwerke Münster has ordered a further four Citeas SLFA-180 Electric Buses from VDL.

TMB has awarded Alstom a contract to supply a training simulator for Barcelona metro lines 9 and 10.

Keolis is working with Ericsson to use 5G Technology to remotely control and supervise autonomous vehicle fleets.

Solaris is to supply six Urbino 12 electric Buses to Kutno under a 14m złoty contract.

Grenoble public transport operator Semitag has ordered seven Aptis electric Buses from Alstom.

Transport for London has awarded Nel Hydrogen a €2·5m contract to supply a hydrogen refuelling station at Metroline’s Perivale bus garage. The station is to be installed in 2020, and Nel Hydrogen will maintain it for 10 years.

NFI Group has acquired bus manufacturer Alexander Dennis for £320m.

The Hop Fastpass mobile ticket for TriMet services in Portland can now be loaded onto Apple Wallet.

Beyond the Digital Buzzwords - The New European Rail Supply Industry’s Vision on Digitalisation; Global

24 Jun. 2019 | Railway News

By Tommaso Spanevello, Public Affairs Manager, UNIFE

In recent years, Digitalisation has been advancing at increasing speed across all industrial sectors, public entities and society at large; and the rail sector is no exception. While sometimes perceived as being conservative, the truth is that rail transport has always been a frontier of technological progress, with the supply industry leading the way. With Digitalisation, the pace of change in the sector has moved up a gear. There is a
tangible confidence and optimism, shared by all rail actors, in the way digital technologies have the potential to create new growth, more efficient transport networks, strengthened safety, more efficient logistics and better use of the existing infrastructure.

Tommaso Spanevello, UNIFE Public Affairs Manager

Back in September 2016, UNIFE launched its first ‘digital manifesto’ for European railways, outlining the necessary steps for the rail sector to keep pace with disruptive technologies and services. Three years on, the most recent advances of rail in the digital arena have certainly shown that there is a remarkable level of engagement by the whole sector. Therefore, a new digital vision from the European rail supply industry – with new priorities and ambitions – was deemed necessary in order to embrace the latest digital concepts & trends. On 15 April this year, UNIFE released its new Vision Paper ‘Digital trends in the rail sector’, highlighting once again how vital it is for rail transport to maintain its commitment to making digitalisation not merely an objective in itself but rather a means to achieving more ambitious and overriding goals.
Concurrently, we continue to pay a high degree of attention to the initiatives taken at EU-level by the European Commission, European Parliament and Council. The European rail supply industry is confident that EU legislation and regulations shall support and facilitate the process of digital transformation in transport and the rail sector in particular, whilst also providing the necessary tools to safeguard this process.

**A Comprehensive Look at UNIFE’s Vision Paper**

In order to present the Vision Paper, we must start with the end-customers, namely the final user of the rail transport chain – either the individual passenger or the freight load. UNIFE believes that the ultimate benefit of the ‘final transport user’ remains at the heart of every digital transformation within the rail sector. That is the core around which the European suppliers and manufacturers have built their new digital vision.

Five majors interrelated ‘focus areas’ have been identified as key for enabling Europe’s rail sector and its supply industry to achieve the ambition of enhancing the experience of rail passengers and optimising logistics and boosting capacity for carrying freight:

1. Big Data
2. Cybersecurity
3. Artificial Intelligence (AI)
4. **New Mobility Services**
5. Digitalisation of Freight Logistics Services

The first two subjects, Big Data and cybersecurity, can be assessed together due to their strong mutual interlink. On the one hand, the importance of effectively collecting, managing and processing data is being increasingly acknowledged in the rail sector. In fact, the huge amount of data produced by the rail system can be turned into relevant information which, subsequently, can be used for targeted, effective decisions. Data gives actionable insight, providing the business intelligence to enhance performance and optimise strategies. On the other hand, if processing data contributes to making rail transport safer and more efficient for both passengers and freight, it also exposes it to cybersecurity risks. Indeed, as rail exploits the benefits of digitalisation, cyber-attacks become ever-more sophisticated, versatile and dynamic.

Arguably, understanding how Big Data and cybersecurity interrelate can lead the rail sector to assess how it can take full advantage of the available data, whilst also protecting that data effectively. First and foremost, we believe that increased transparency regarding the categorisation of data in the rail sector is necessary, therefore promoting a more collective view about which data may be shared among stakeholders. Moreover, adequate rules to provide a framework for data and information-sharing across the whole sector should be established, in order to fully harness the benefits of Big Data. At the same time, UNIFE considers essential the development of targeted cybersecurity-related skills, notably when it comes to the detection of and response to cyber-threats, as well as increasing the cyber-awareness regarding cyber-threats within each company and organisation. Eventually, security-by-design would be another crucial element for an effective cybersecurity strategy. In practical terms, this means increasing the focus on security aspects during the design process of a product, giving them the required priority and ensuring compliance with relevant regulations and standards at an early stage.

Following further across UNIFE’s new vision, as the ongoing changes in land transport systems enter the next phase in their evolution, few emerging technologies offer as many opportunities for the future of rail transport as Artificial Intelligence (AI) promises to do. In this context, UNIFE believes that rail should become a priority area for strategic
investments in Artificial Intelligence. Arguably, given that rail is the most efficient mode of land transport – providing low-carbon mobility combined with high levels of energy efficiency, safety and capacity – we consider that rail transport offers unrivalled potential for realising the societal benefits of Artificial Intelligence. As a matter of fact, AI-related applications can be employed in a number of different segments of rail transport systems. European rail suppliers and manufacturers identify, in particular, enormous potential for AI-based technology to be applied in the areas of train operations & autonomous driving and mechanisation & robotisation.

The implementation of AI solutions in the area of autonomous driving is of particular importance for the European rail supply industry. Autonomous trams, metros and trains (passenger and freight transport) can indeed contribute to significantly increasing the capacity of rail networks. Assessable and certified AI-based technologies for safety-critical applications will be necessary to unlock the potential for autonomous driving – notably, this step would be carried out through new standardised certification processes and the possible creation of extensive open benchmark data sets. Furthermore, the European rail supply industry sees a significant scope for further mechanisation and robotisation in the building and maintenance of rail infrastructure. In this regard, AI-based technologies, fostered through machine-learning, could be used during maintenance execution and eventually become an essential element in multi-purpose equipment.

Nevertheless, UNIFE is fully aware of the regulatory complexity linked to the deployment of AI applications – even beyond our sector – which may ramp down the commercial use of AI-based products in the market. Accordingly, the relevant standards and regulations should be carefully reviewed and revised as necessary, taking the emerging role of AI-based technologies into account whilst also ensuring the highest-possible levels of safety. The importance of rolling out AI-based solutions in a responsible and fully transparent manner must be highlighted, to help advance their usefulness vis-à-vis society and consumers (overcoming the ‘trust’ issue) while at the same time promoting their uptake.

Another part that UNIFE’s new Vision Paper tackles is the emerging mobility market in which transport services are offered in an integrated way, beyond the ‘one single-mode’ solution, covering many regions and countries simultaneously – for a fully seamless mobility experience. New mobility services, which are particularly visible in cities and urban/regional areas, are fostered by digital technologies. In this regard, the increased availability of data on users’ travel patterns will allow transport authorities and service providers, across all modes, to better predict the demand and also understand their customers’ behaviour – driving targeted commercial and operational actions.

As digital technologies pave the way for new tools and services that can provide a seamless door-to-door mobility chain, based on integrated multimodal transport systems, the role of rail assumes a particular significance. Rail transport solutions, including metro tramways, tram-trains and suburban trains, already offer a number of assets in terms of capacity, CO2 emissions, land use and safety. Through the combination of these traditional assets, together with the opportunities brought in by digital mobility trends, including the effective collection and management of the data available that we mentioned earlier, rail will be able to provide innovative, multimodal and tailor-made tools for customers based on flexibility, high performance and minimum environmental impact.

Finally, the traditional freight and logistics business is another area which is being deeply transformed by digital applications. Indeed, digitalisation would enable logistics actors to maximise benefits from a digitised logistics process with intelligent services – e.g. end-to-end logistics planning & visibility with efficient sharing of information within the supply chain. The European rail supply industry is keen for rail freight to be seen as part of a
global digital logistics ecosystem, through the swift deployment of advanced technologies. In this regard, UNIFE and its members have developed the European Rail Industry Freight Agenda (ERIFA), highlighting the most important current and emerging technologies which could contribute to driving change in the rail freight and logistics business.

The Role of Research and Innovation

No vision on digitalisation would ever be complete without stressing the fundamental role of Research and Innovation (R&I) in driving ahead the digital transformation in rail transport. In its 'Rail 2050 Vision', the European Rail Research Advisory Council (ERRAC) outlines how transformative scientific advancements have the possibility to change technology dramatically. Digitalisation is at the core of this vision, notably targeting the automation of the railway system and intelligent assets lifecycle management.

The five focus areas explored by UNIFE in our new Vision Paper are also at the core of the work carried out by the Shift2Rail (S2R) Joint Undertaking which – by supporting numerous R&I projects – is enabling Europe’s railway sector to develop various value-adding products and services. Notably, it is worth mentioning Shift2Rail’s Innovation Programme (IP) 4 ‘IT Solutions for Attractive Railway Services’, and Innovation Programme (IP) 5 ‘Technologies for Sustainable & Attractive European Rail Freight’. The objective of S2R IP4 is to build a digital mobility ecosystem combining different travel segments, offering intermodal transport journeys customised to users’ preferences – with seamless access to all relevant services related to their journeys. The activities within S2R IP5 aim at the optimisation of the overall rail freight transport time, for example by stepping up the average speed for rail freight operations whilst ensuring that rail freight is able to better operate in conjunction with passenger traffic, in order to maximise the utilisation of existing networks.

Building on the success of Shift2Rail, a refocusing of collaborative rail-related research activities is needed for the post-2020 programming period. In particular, the increasing need for shared mobility, customer-focused, digital and intermodal transport tools – as well as the roll-out of new technologies – should be guiding principles for an extension of the Shift2Rail JU (or a ‘Shift2Rail 2’). This is why UNIFE strongly advocates an extension of the Shift2Rail Joint Undertaking within the forthcoming Horizon Europe Framework programme (2021–2027), ‘Shift2Rail 2’ should become the hub of the breakthrough innovation streams of the rail sector in the future.

Co-operation as the Pivotal Factor for successful Digital Transformation

UNIFE is convinced that co-operation among all rail stakeholders is the one overarching element playing a pivotal role in ensuring that our sector successfully embraces the digital transformation and masters the latest trends and services. A co-ordinated approach towards digital and technological development within the rail sector is therefore necessary. In this regard, rail suppliers and manufacturers are keen to engage in the European Commission’s recently established ‘Digital Roundtable’ gathering the key players in rail transport.

First and foremost, close co-operation between suppliers, operators – including public transport operators – and infrastructure managers will be vital in order to eradicate barriers to data sharing in the rail ecosystem. Following this further, exchanging knowledge and strengthening synergies with other concerned businesses on cybersecurity will help rail stakeholders to develop and implement effective measures to protect their systems and services against cyber threats. Co-operation and collaborative research are also at the heart of the Shift2Rail JU model, bringing together the whole of rail innovation. Finally, as
much as in the case of cybersecurity, we understand that close and transparent co-
operation between suppliers, railway undertakings and infrastructure managers will be
needed in order to maximise the contribution of AI-based technologies to the rail sector.

With its new Vision Paper, UNIFE commits to a twofold purpose: To bring the European
rail supply industry’s views and objectives into the centre of the Digital Debate, and to
effectively engage in a fruitful dialogue with decision-makers and other key stakeholders –
in the rail sector and more widely. Always acknowledging that all products and services
making use of digital technologies must be developed for the benefit of our customers,
economy and society.

Infrabel demonstrates digital
Innovations at Digital Days Exhibition;
Belgium

Jun. 5, 2019
Written by Kevin Smith

BELGIAN Infrastructure Manager (IM) Infrabel held two days of live demonstrations of a
range of digital technologies and solutions at its Schaerbeek workshop in Brussels this
week.

In a temporary building, 18 separate exhibits demonstrated innovations including Building
Information Modelling (BIM) for project development, mapping drone images to support
infrastructure monitoring, and Lidar detection for lineside vegetation management.

Outside, visitors were invited to board two of Infrabel’s inspection vehicles, EM130 and
EM201. Developers showed off the latest catenary and signalling infrastructure inspection
technology using high-definition cameras and shock detecting equipment as well as track
and switch condition monitoring equipment, all of which foresee future Artificial
Intelligence (AI) applications. And at the workshop itself, a virtual reality presentation
offered insight into a glimpse of centralised spare part supply using automated
technologies and logistics techniques pioneered by companies such as Amazon.
Each of the technologies on show are at different stages of development, from initial proof of concept and prototyping to some solutions which have or are being rolled out into live operation.

Infrabel began the process of digitalising its infrastructure in 2014 under the Smart Railway Project. In the beginning this involved the painstaking process of digitising much of the infrastructure and assets. Paper records have been replaced with online databases, which offer a history of a specific asset and are accessible at the trackside using a tablet computer.

This data – the fuel of the fourth industrial revolution – is also supporting the development of new innovations. In general these are divided into three categories: protecting people and safety; mobile inspection; and train management of the future.

The technologies, that Infrabel has or is on the verge of introducing, were on display at Schaerbeek, and among them were:
• Drones: Infrabel is already using 10 drones to monitor the condition of infrastructure such as GSM-R masts, catenary and bridges as well as to observe construction sites and areas where incidents have occurred. Seven Infrabel staff members are trained as pilots while the Schaerbeek site will soon benefit from an automated drone system to monitor potentially vulnerable assets such as copper cabling. The use of drones is also supporting “drone to map” applications, including three-dimensional modelling of assets and infrastructure, helping to inform maintenance planning processes.

• Automatic Train Warning system for use by track maintenance staff: developed by Zöllner, Germany, this mobile system manually controls signalling in a localised area and informs track workers of an approaching train so they can leave their worksite safely. The operator uses an RFID tag to inform the system that workers have left the area, enabling the train to proceed without disruption and ensuring that track workers are safe.

• Building Information Modelling: Infrabel is using BIM to support the development of new projects so developers and users have an accurate picture of how a new piece of infrastructure will operate and be used before it is built. These techniques are helping to prevent costly errors and to optimise construction techniques.

Other concepts which are in the early stages of development and may be of use in their current or an evolved form include augmented reality applications for maintenance personnel. In these applications, specially designed headsets can offer the status of specific components and instructions for maintenance tasks, leaving the technician’s hands free to work. Work is also underway to develop a smart traffic management solution. The solution on show utilises a digital twin to model potential disruptions to operation while harnessing Artificial Intelligence, AI to make the best traffic planning decision depending on the location and type of incident.

For Mr Carel Jockheere, smart railway programme director at Infrabel, the objective of the overall programme is to improve the efficiency and effectiveness of the IM’s working processes.

With Belgium boasting one of Europe’s busiest railway networks – 6500km of main line track currently serves 4000 trains every day – Infrabel is under pressure to deliver highly reliable infrastructure which meets the needs and expectations of increasingly-demanding
customers. This means replacing manual inspections requiring track possessions with automated processes which minimise line closures. It also means shifting from interval-based to predictive maintenance.

“The maintenance procedures that we carry out, replacing track and repairing infrastructure, will remain largely the same,” Jockheere says. “What we can do differently is to use this time more effectively and make more informed decisions of what needs to be replaced at a specific time.”

Inevitably this presents challenges: maintaining up-to-date databases; reacting to new technologies as they become available, notably 5G, automatic train operation and automated road vehicles; and effectively processing the huge volumes of data retrieved – a single inspection vehicle shift of six to eight hours can produce 2.5-3 terabytes of data. It is therefore a major challenge to use this data in a manner that improves rather than overwhelms the decision making process.

Critically though it requires the cooperation of staff, both to innovate and support the objectives of the programme, and to accept and adopt the new ways of working.

“The biggest challenge we face is to channel the enthusiasm and innovative spirit of Infrabel staff to deliver usable solutions,” Jockheere says. “This has been central to our progress and success so far, and will remain so in our future work.”

A detailed breakdown of the innovations on show at Digital Days will appear in an upcoming edition of IRJ.

Categories: EuropeInfrastructureNewsTechnology
Tags: BelgiumInfrabel

The Future of Urban Mobility, SMART METRO - Communication Based Train Control, CBTC, World Congress 2019, Madrid, Spain
The SmartMetro and CBTC World Congress returns for its 10th year in Madrid and is the meeting place for senior metro, tram, and light rail technology experts from all global regions to discuss the major challenges cities are facing such as digitalisation, congestion, automation and shared mobility. Delegates attending the show this year will be able to:

- Have the choice of three focused streams covering signalling systems, assets and digitalisation and operational excellence and smart mobility.
- Attend a site visit organised by local operator, Metro de Madrid.
- Listen to C-level global speakers from operators across all regions.
- New roundtable format where delegates can participate in multiple roundtables with topics covering CBTC, automation, data analytics and more.
- As a reader of Railway Gazette we can offer you a 15% discount off the delegate pass. Please quote RG15 when registering.

The congress will discuss topics such as:

- Communications-Based Train Control, CBTC.
- Asset Management and Predictive Maintenance.
- Constant Connectivity Including the 5G Roll-Out.
- Smart Cities, Autonomous Vehicles and Mobility-as-a-Service (MaaS).
- Security Management and Data Analytics.
- Onboard Monitoring Systems and Standardised Reporting.
- Enhancing the Passenger Experience.
- Information Technology.
- Sustainability within Transport.
Mosaic Transit Group (MTG) has awarded Thales a contract for a SelTrac™ Communications Based Train Control (CBTC) Signaling Technology for the new Finch West LRT in northwest Toronto. MTG’s contract is a DBFM (design, build, finance, maintain) project awarded by Metrolinx, with the Toronto Transit Commission (TTC) as operator. The project is slated for completion and revenue service in 2023, and includes a 30-year maintenance service contract that will be performed by MTG.

The 11-km (6.8-mile) Finch West line, with 18 stops between Humber College and the Finch West subway station, will provide new transit access to the historically underserviced northwest area of Toronto. It will connect to the TTC Line 1 Yonge-University subway, “making commuting to work and school much faster and easier for northwest Toronto residents, and have the added advantages of providing an economic boost and social benefit to the area,” MTG noted. “The Greater Toronto Area has a growing population and is facing significant traffic and transit congestion. The Finch West LRT is how Metrolinx and the Province of Ontario are expanding the public transit system to address these problems to make life faster, better and safer for GTHA (Greater Toronto and Hamilton Area) residents and their families.”

“The Finch West LRT project allows Thales to be a big part of a world class city’s expansion for the better,” said Dominique Gaiardo, Vice President and Managing Director for Thales’ Urban Rail Signaling business. “We are putting to work our local, made-in-Ontario SelTrac™ CBTC technology as a key part of this project, which will bring long-awaited transit service to northwest Toronto.”
Thales is also the signaling supplier on the new Ottawa LRT Confederation Line. The company says its “experience and proven track record of success with LRT means that there is a much lower integration risk when these systems are installed and put into service and operation.”

Thales’ Toronto office has more than 1,200 employees, including more than 900 engineers and 30,000 square feet of simulation lab space for software testing. Its “made-in-Ontario” SelTrac™ technology was the first CBTC system in the world and was implemented in the 1980s on Toronto’s Scarborough Rapid Transit and Vancouver’s SkyTrain fully automated (driverless) systems.


ION Light Rail Transit launched in Ontario; Canada

- June 21, 2019
- Commuter/Regional, Intercity, Passenger, Rapid Transit/Light Rail

Written by Bill Wilson, Editor-in-Chief
The ION Light-Rail Transit will serve Waterloo, Ontario, Canada.

The first of the two phases of the ION Light Rail Transit (LRT), the region of Waterloo’s new rapid transit system in Ontario, Canada, was launched June 21 at Kitchener’s Fairway station. The modern system will serve the residents and visitors of Kitchener, Waterloo and Cambridge, as well as surrounding rural municipalities. As part of the GrandLinq Consortium, Keolis Grand River, Keolis’ local subsidiary, is responsible for the 16-km light-rail line operations for the next 10 years and maintenance for the next 30 years. The contract, which was awarded in May 2014, is under a public-private partnership (PPP). This is Keolis’ first light-rail operation in North America.

The ION LRT is transformative for the region of Waterloo, which is the fourth largest community in Ontario with an existing population of over half a million. The network is funded by all three levels of government and fully integrated within the region of Waterloo’s existing public transport service, Grand River Transit (GRT). The transport options, for which just one fare applies, will be flexible and inclusive as the population grows.

This light rail is core to the region’s ambitious master plan for sustainable mobility to create a one urban area, from the three cities, and to increase the attractiveness of the Technological Triangle of Canada.

The trams will run on a dedicated rapid route along tracks isolated from regular traffic, except at intersections and road crossings. The project is divided into two phases. Phase 2 studies are underway.

ION light rail TRANSIT system at a glance:

- 16-km network with 19 stations (25,000 passengers per day expected).
- 14 accessible, low-floor, comfortable, electric and silent light rail vehicles (LRVs) made by Bombardier (Ontario) operating every eight minutes during peak hours with off-peak schedule of 15 minutes frequency.
- 200 passengers capacity per vehicle.
- ION Light Rail will be fully integrated within the existing GRT network – ION and GRT will be one system with one fare.
- 40 LRV operators participated in an extensive training program (120+ hours).
- The Control Room will feature 15 employees supervising train operations, power management and coordinating incident response 24/7 all year round.
30 technicians and engineers will monitor and maintain the LRVs and the infrastructure.

Categories: Commuter/Regional, Intercity, Passenger, Rapid Transit/Light Rail
Tags: ION light rail transit, light rail transit

Ontario ION Light Rail Transit, LRT, comes to Fruition; Canada

Written by Andrew Corselli, Managing Editor

June 24, 2019

Contract operator Keolis North America on June 21 launched the long-awaited ION Light Rail Transit (LRT) at Kitchener's Fairway Station.

ION, the Waterloo Region's new light rail transit system in Ontario, Canada, aims to serve the residents and visitors of Kitchener, Waterloo and Cambridge, as well as surrounding rural municipalities.

As part of the Grand Linq Consortium, Keolis Grand River—Keolis' local subsidiary—is responsible for the 16 kilometers of light rail line operations for the next 10 years, and maintenance for the next 30 years. The contract, which was awarded in May 2014, is under a Public-Private Partnership (PPP). This is Keolis' first light rail operation in North America.

The network is funded by all three levels of government and fully integrated within the Region of Waterloo’s existing public transport service, Grand River Transit (GRT), Keolis noted.

Keolis, which currently operates 25 LRT networks around the world, said the system’s light rail vehicles (LRVs) will run on a dedicated route along right-of-way isolated from regular traffic.
traffic, except at intersections and road crossings. The project is divided into two phases, with Phase 2 studies under way.

The ION LRT project includes: 16-km network with 19 stations (25,000 passengers per day expected); 14 accessible, 100% low-floor electric Flexity LRVs made by Bombardier in Ontario and operating every eight minutes during peak hours with an off-peak schedule of 15-minute frequency; 200-passenger capacity per vehicle; full integration within the existing GRT network—ION and GRT will be one system with one fare; 40 LRV operators who participated in an extensive training program (120-plus hours); a control room with 15 employees supervising train operations, power management and coordinating incident response 24/7 year-round; and 30 technicians and engineers monitoring and maintaining the LRVs and the infrastructure.

“We are delighted to start operating the light rail for Region of Waterloo,” said Bernard Tabary, CEO International of Keolis Group. “We began testing and commissioning the trams and control center in July 2017. Now, with responsibility for operating and maintaining the ION LRT for Region of Waterloo, we’re looking forward to enhancing quality of life in the region for many years to come. Supporting cities and regions in developing sustainable, accessible and comfortable mobility solutions is in our DNA. We’re proud to accompany Region of Waterloo authorities and residents in shaping the region’s public transport with this new network, which is our first light rail operation in North America.”
Lanzhou opens first Metro Line; China

Jun. 24, 2019
Written by Keith Barrow

THE first Lanzhou Metro Line to cross China’s Yellow River was inaugurated on June 23 with the start of trial operation on the first phase of Lanzhou Line 1.

The line, which is the first metro line in Lanzhou, the capital of Gansu province, runs underground for its entire 25.9km length and connects Donggang in the east with Chenguanying in the west.
The 20-station line is served by a fleet of six-car type A trains supplied by CRRC Changchun Railway Vehicles.

For detailed data on metro projects around the globe, subscribe to IRJ Pro.

Categories: AsiaMetrosNews

Funds sought to build next Stage of Lausanne Metro; Switzerland

19 Jun. 2019

Rubber tired Lausanne Automatic Funicular Metro Train M2 on steep Gradient; it replaced a former Pinion Funicular
SWITZERLAND: Plans to increase capacity on the Line m2 automated metro and to build the 4 km Line m3 took a step forward on June 13 when the government of Vaud canton sought approval from the cantonal parliament for credits worth SFr153.7m to cover the next stage of work and for detailed alignment studies.

The canton said that it would shortly be seeking approval from the Federal Office for Transport for construction of a new double-track alignment for Line m2 between Grancy, Lausanne-Gare and Flon and for construction of the Line m3 station at Flon. Capacity of Line m2 is currently constrained by a single-track section between Grancy and Lausanne-Gare.

Operator Transports Lausannois has experienced rapid growth in ridership in the last few years, and the new m2 alignment will double capacity between Lausanne-Gare and Flon, where Line m3 will diverge to serve stations at Chauderon, Beaulieu, Casernes, Plaines-du-Loup and Blécherette to the north of the city. Line m2 will operate at intervals of less than 2 min and will be augmented by departures every 3 min on Line m3, which will use the same technology.

The metro expansion scheme will dovetail with a SFr1.3bn project to rebuild the main railway station as part of the Léman 2030 programme to increase capacity on the Genève – Lausanne corridor. Three new pedestrian subways will be built to connect the main line platforms with the metro. The development plan for Lines m2 and m3 will guarantee that Lausanne station will function smoothly, said Nuria Gorrite, President of the Vaud government and Head of the Infrastructure Department.

Reconstruction of Line m2 between Grancy and Flon is costed at SFr228m and construction of Line m3 will absorb SFr582m. The Line m2 works are due to be completed in 2025, with Line m3 fully open a year later.
Contracts for civil engineering, rolling stock and signalling for Lines m2 and m3 were awarded in May 2017.

**Erzurum Tramway Project receives Government Approval; Turkey**

20 Jun. 2019

**TURKEY: The Ministry of Transport & Infrastructure** has approved the construction of a tram line in Erzurum. Planning has been underway since 2015, and the government has allocated TL890m for the project.

Due to be built in five years, the 15·5 km first phase would link the city’s railway station with Yeşil Yakutiye in the southwest. The second phase would extend the line northwest by 5·7 km.

The line has a design capacity of 10 026 passengers/h per direction, and the 14 stops would have 11·8 m long platforms.

- The Ministry of Transport & Infrastructure has also approved a tramway project in Erzincan.

**Testing starts on next Antalya Light Rail Line; Turkey**
The 11 km first phase has been built in 1½ years at a cost of TL700m. It will run from Varsak in the north to Otogar in the west, where interchange will be provided with the existing east-west Antray light rail line.

Work is underway on the second phase. This would take the route further south from Otogar to Müze, which is currently the western terminus of the heritage tramway. This route is to be upgraded to light rail standards and double-tracked to become part of the new light rail line, with through running between Varsak and Zerdalilik in the city centre. This would create a 23 km route serving 39 stops.

Antalya Municipality plans to purchase a total of 47 light rail vehicles to operate the route. Of these, 20 would be required for the first phase. The rapid depreciation of the lira caused the initial tender to be cancelled, and the rolling stock for the first phase has since been retendered.

As a result of this delay, testing on the line is taking place using four LRVs borrowed from the east-west route. These were supplied by the Eurotem joint venture of Hyundai Rotem and Tüvasaş in 2016 as part of an order of 18 for the opening of the eastern extension to Expo 2016 and the airport.

La Rochelle orders APTIS electric Buses; France
FRANCE: Greater La Rochelle has ordered four Alstom Aptis electric Buses for use on the Illico 4 Bus Rapid Transit route from early 2020.

The vehicles will be 12 m long with three doors, and La Rochelle has opted for them to be equipped for overnight slow charging in the depot.

The order has been placed through the CATP central procurement office for public transport, which provides member authorities with a fast and simple way to order Aptis buses.

Announcing the order on June 25, Alstom said Aptis was designed to have lower maintenance and operating costs and a longer service life than diesel buses, giving an equivalent overall cost of ownership.

Related news

- 30 May 2019 - RATP picks three manufacturers to supply up to 800 electric buses
- 11 Mar 2019 - Strasbourg becomes launch customer for Aptis
- 10 Mar 2017 - Alstom and NTL launch Aptis electric bus prototype