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Rethinking Mobility (Urban Transport Policy) in Pakistan

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EXECUTIVE SUMMARY

This document holistically examines the current state of urban transport in Pakistan, while simultaneously highlighting its inherent flaws, and offering innovative, cost-effective, viable solutions based on a critical appraisal of urban transport systems that are successfully developed and operating in developed cities of the world. In doing so, this document brings forth an in-depth yet brief overview of the following:

- Framework and components of an urban transportation system.
- Barriers to public mobility and urban growth in local environments.
- Mitigation of the aforementioned mobility barriers.

The conclusions, policy recommendations, and designations of responsibility to deliver individual system components offered in this document envision the urban transport system of Pakistan as follows:

- Urban transport system that provides equal mobility opportunity for all segments of society.
- Access to opportunities, jobs, and amenities needed for cities to serve as engines of growth.
- A Connected city with multiple mobility options; strictly discourage reliance on a single mode of transportation.
- Integrated transport with urban planning to increase system efficiency and optimize expenditures.
- Smart (technology-based) initiatives to lead decision-making of transport development processes.
- Explore potential revenue sources for city authorities to lessen their dependence on state/central government in building and operating efficient transportation systems.
- Improve environmental parameters significantly by regulating transport-related causes of climate change and global warming.

1. INTRODUCTION

In essence, a city is an urban labor market (see Bertaud, 2018). For a city to function efficiently as a labor market and also provide for the needs of its residents, universal design is critical. Successful cities represent opportunities that in turn draw talent to the labor pool. The inflow of jobseekers causes congestion, an effect that is manageable with effective mobility options. However, accessibility and mobility themselves are a product of how a city is laid out.

Road/street space also referred to as 'right of way' (ROW), is where most urban transportation activities take place and constitute the majority of public urban space. ROW generally contains 60-90% of a city's public spaces. Since cities in Pakistan rarely have other public spaces, such as parks or libraries, this value would be on the higher side for them at around 90%. Thus, transport planning in Pakistan's urban environment is critical from both a mobility perspective and the future shape of a city's public space.

Urban transport planning is experiencing a paradigm shift in how mobility problems and their solutions are defined and evaluated. This involves three types of analyses:

a) **traffic-based** which evaluates the transportation system based on motor vehicle speed and operating costs;

b) **mobility-oriented** which evaluates the system on speed and cost of people and freight;

c) **accessibility-based** which evaluates the system on the ability of both people and businesses to access the desired services and activities (Litman, 2020).

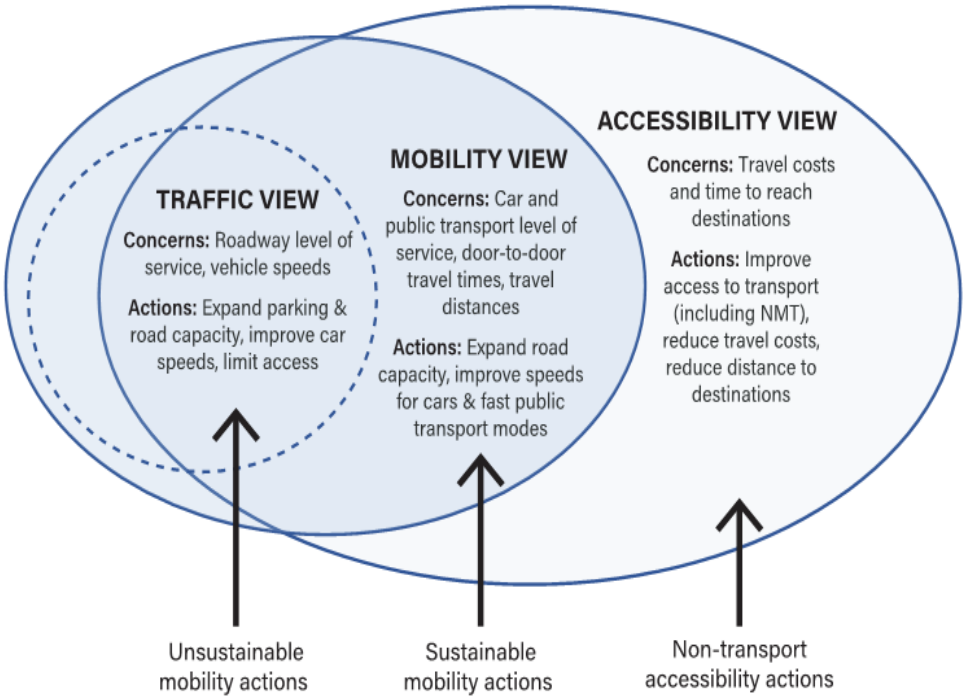


Figure 1: Transport Policy Progression (Venter, 2017)

1.1. Objectives Of Urban Transport Policy

The objective of an urban transport policy is to provide safe, affordable, reliable, comfortable, and sustainable accessibility options to city residents, especially the marginal segment, to access jobs, education, living, and other necessary services. The main objectives of transport policy are:

- Urban transport to be considered a system, and not as separate projects.
- Integrating urban and transport planning to shorten commuting distances
- Cities to have aggressive targets to switch from private vehicle-based transport to sustainable modes. This will also support climate control measures
- Budget spending on transport infrastructure to prioritize sustainable modes over inefficient modes
- Transport agencies to explore new revenue sources for funding and managing infrastructure
- Design of urban streets to be safe, with universal access that encourages multimodal options
- Increase contractor skills to deal with urban challenges and deliver quality projects in time
- Standardization of urban transport operations like licensing, vehicle fitness testing, automated violation monitoring, ITS, parking management, and congestion pricing, among several other operations.

1.2.Urban Transport Development Framework

Cities in Pakistan need to adopt a standard framework for sustainable urban transportation systems. Details for each element may vary for each city but missing elements from the

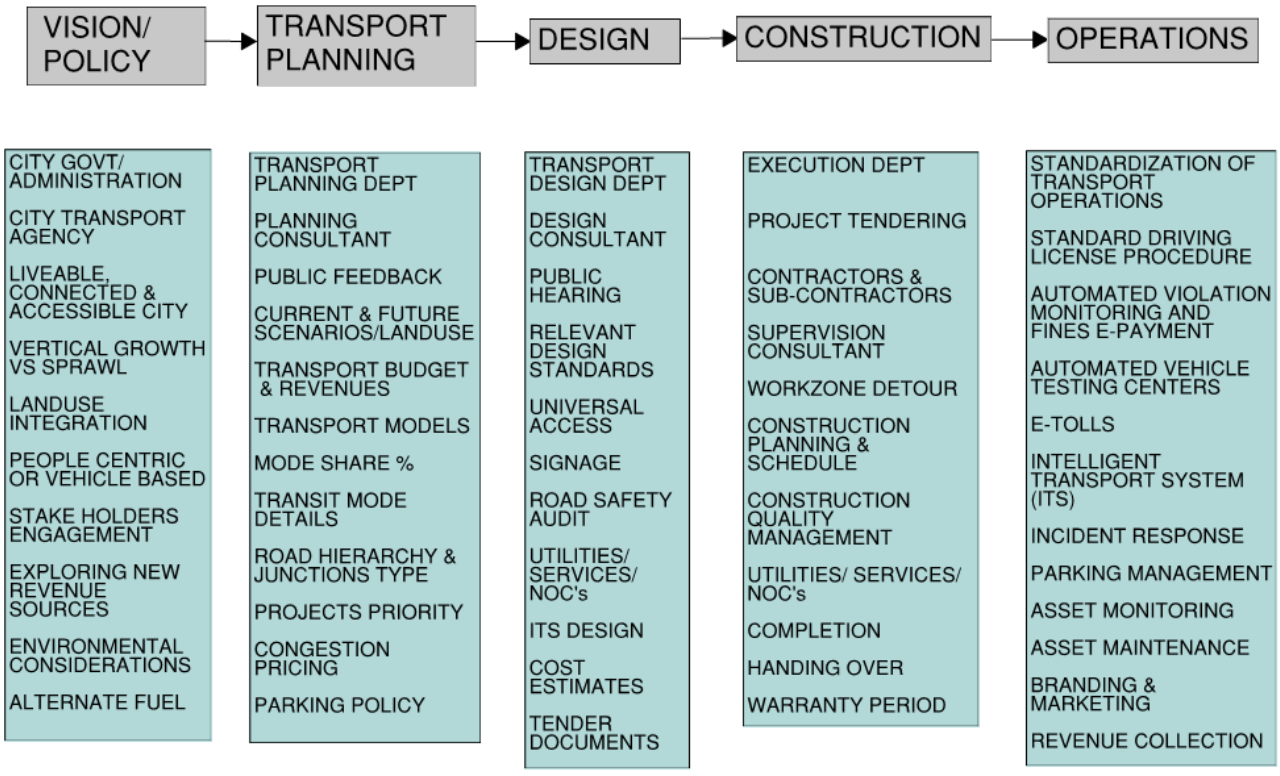


Figure 2: Urban transport development framework

framework mean the city is lacking in certain requirements to develop a sustainable urban transport system.

1.3.Global Practice In Urban Development

The latest global practice, when considering urban transport, is to focus on accessibility and connectivity with strong cross-sector collaboration, rather than looking at traffic flow or mobility in isolation. While transport planning has a critical role in good urban connectivity, it cannot deliver on its own and requires other sectors to play an active role (Rode, P., Heeckt, C., da Cruz, N.F., 2019).

Cities like Singapore, Hong Kong, Jakarta, Delhi, Bogota, Abu Dhabi, and Cairo have shown how to create jobs, support economic development, and deliver a good quality of life to their residents while minimizing their carbon footprint. A transformational approach for compact and connected urban growth is to increase livable density by creating mix-use land development where people can live, work, study, shop and have fun without excessive travel, and combine this with citywide public transport. Cities can benefit from integrated planning and a more efficient use of resources that allows for greater prosperity and social inclusion at lower costs. Cities like Ahmedabad, Addis Ababa, and Dar es Salaam, with large lower-income populations, have found ways to translate compact and transit-oriented growth effectively into their contexts (Rode, P., Heeckt, C., da Cruz, N.F., 2019).

1.4.Urban Development In Pakistan

The current preferred model of city planners in Pakistan is SPRAWL! With the start of economic development, migration to urban centers rose rapidly as expected. However, the urban planners continued to pursue a rural model, refusing to allow old city centers and neighborhoods to regenerate. The most important elements of their master plans were:

- An insistence on low-rise and single-family homes. This meant favoring suburbs and greenfield development over city and neighborhood regeneration.
- With sprawl, repeated road widening followed by the creation of more flyovers and underpasses to facilitate cars.

The result was the growth of housing for the affluent, as suburban single-family homes were usually beyond the reach of the lower middle class, let alone the poor.[1] The excluded populations had to huddle into tenements in the older parts of Pakistani cities that lacked many urban services. Moreover, the only choice of transport for them was a family motorcycle, if they could afford it. Despite this, space remained at a premium in these cities,

[1] It is worth researching why Karachi is an exception with a fair supply of flats. The rest of Pakistan is plagued with a limited supply of flats because of poor regulation.

and more and more people were forced sought shelter in informal settlements known as *katchi abadis*.

In Pakistan, city planners seem to be uninformed of the needs of the city and the research on urban development and its economics. Haque (2015), Haque (2017), and PIDE (2020) have identified continuing urban shortages of space for schooling, flats, retail, warehouses, offices, etc. Masterplans have consistently ignored these needs. Instead, the sole concern of masterplans has been the development of affluent suburban housing, as if the majority of the Pakistani population has a standard of living that equates to that of the American middle class.

2. MOBILITY OPTIONS FOR ALL IN CITIES

Streets or Right-of-Way (ROW) are public spaces that connect people to neighborhoods and facilities. They allow mobility and access to street vending, art, and other community services (shows, meetings, etc.). Common modes of urban transport include walking, cycling, paratransit[2], buses, trucks, cars, motorbikes, and urban railways. Most of Pakistan's urban transport budget, however, is used to improve roads and signal-free corridors (flyover and underpasses) that only facilitate cars and motorbikes, seldom focusing on other modes. City administrations rarely spend on buses, which are a basic mode of transport used to connect various neighborhoods in a city. The priority of transport modes in Figure. 3 shows the efficiency to cost ratio. Efficiency in urban transport systems is a priority so cities can be a place of opportunity for everyone.

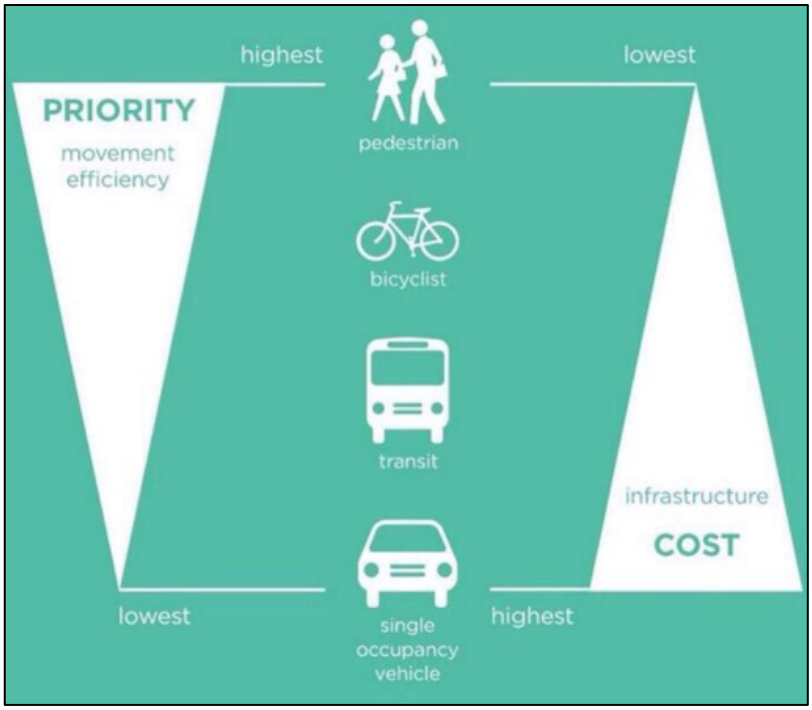


Figure 3: Transport Modes: Hierarchy vs Cost (ITDP, 2018)

[2] A transportation service that supplements larger public transit systems by providing individualised rides without fixed routes or timetables.

2.1.Walking

Walking is a core segment and the foundation of any public transport system. If a street design does not accommodate pedestrian use, it will promote car usage and will not benefit the majority of the population who do not have cars. Correspondingly, if a mass transit project (BRT or rail line) does not have pedestrian access to metro or bus stations from neighborhoods, the project cannot be termed successful. Universal "access for people with special needs" is mandatory in all projects – whether they are private buildings or street infrastructure – and in all civilized cities. As such, universal access is the minimum standard of convenience that Pakistan's cities will have to achieve to become connected and accessible for all citizens.

Benefits of promoting walking in cities:

- Universal access/equal opportunity
- Walking is free
- Environmentally friendly
- Lowest infrastructure cost
- Economic benefits (due to increased interaction with local area businesses)
- Healthy lifestyle
- The safest mode of transport, if properly segregated from traffic
- Accessibility range (0~1500m, preferable < 500m) keeping weather conditions in mind

Helpful measures to enhance pedestrian access in cities:

- Sufficient width of walkways (min. 5m for boulevards/avenues and 3m for local streets)
- Pedestrian ramps for continuity of pedestrian paths (at junctions or at building access point)
- Raised pedestrian crossings (to give priority to pedestrians)
- Pedestrian safety during street design
- Shaded walkways (encourage walking in cities with hot climate)
- Priority for pedestrians at traffic signals (push button)
- Universal access provision required for the approval of a transport project at any stage
- Elevators mandatory with pedestrian bridges as a universal access requirement

Figure 4: Walking continuity along a commercial area

Figure 5: Walking barrier or continuity at a building's access point

Figure 6: Pedestrian crossing (with ramps) and pedestrian discipline

Figure 7: Raised pedestrian crossing for pedestrian comfort

Figure 8: Pedestrian bridge with an elevator to encourage walking

2.2.Cycling, E-Bikes & E-Scooters

Cycling is one of the key elements of a clean and sustainable urban transport system. Considering the socio-economic background of the majority of the population of Pakistani cities, cycling should be our most popular transport mode as it is free to operate, unlike motorized vehicles. However, our transport system shows a complete disconnect from this reality as our cities rely heavily on motorbikes instead of bicycles. While motorbikes may provide low-income segments with a realistic alternative to cars, we never hear city administrators or planners evaluating cycling as an alternative to motorbikes.

Although cycling has its limitations, such as trip lengths and weather, it is worth noting that cities with weather similar to Pakistan, like Abu Dhabi and Dubai for example (with summer temperatures of 45 C°), are building bicycle tracks within city limits to encourage this mode of transport. Abu Dhabi is putting in a 300km track with Dubai already having built around 100km of it. Globally, a significant number of people are using bicycles and shared e-bikes to commute. Since Pakistan shares climate and demographics with the U.A.E., we would benefit from adopting their best practices concerning improving urban mobility.

The experiences of cities around the world show that bicycles have a huge potential in Pakistan's urban environment. If explored properly by city authorities and people, this mode of transport can result in improved accessibility within cities, new opportunities for millions of people, and overall less spending on motorized infrastructure and fuel. Some benefits of cycling are:

- No operating cost
- Environmentally friendly

- Minimum infrastructure cost
- Economic benefits due to fuel savings and less spending on road projects
- Healthy lifestyle
- Safe mode, if properly segregated from traffic
- Accessibility range (200m~5km; speed 10~20kph; can vary due to weather)

To encourage cycling in our cities, the following measures can be effective:

- Properly designed and safe bicycle tracks
- Safe cycle crossings at traffic signals and streets
- Availability of high quality and fairly priced bicycles
- Bicycle parking racks at major facilities and bus stops
- Bicycle racks within office and educational buildings
- Creation of recreational cycling facilities

Figure 9: Cycling in an urban environment

An E-bike is a bicycle with an electric motor to assist the rider. E-bikes allow city residents to commute longer distances compared to manual cycles. In 2019, the global E-bike market was worth $18.6 billion, a clear indication that this mode of transportation is in demand and growing.

E-scooters – which also have an electric motor to assist the user, but have no seats or pedals. They are useful for commuting short distances while E-bikes – with a seat and pedals – are more appropriate for commuting longer distances. Several cities in Europe and the Middle East are planning to build cycle highways to optimize spending on motorized vehicle infrastructure and reduce fuel consumption with the premise that people can use e-bikes to travel between 5 and 20km. While cycling highways may take time to appear in Pakistan's urban environment, e-bikes have great potential in our cities as an alternative to motorbikes. Thus, a small step toward adopting e-bikes or e-scooters may quickly change the shape of urban transport in Pakistan.

Figure 10: E-Bike Sharing and cycle highways

2.3. Buses

Buses are arguably the most basic component of any public/mass transit facility in a city. In Pakistan's urban environment, buses are the most neglected mode of transportation. In recent years, administrations of various cities have spent billions of rupees to upgrade transport infrastructure, such as roads, highways, and the like, but have repeatedly ignored the need for a citywide bus service. Building a metro line for a mid-sized city without a connecting bus system is like enrolling in a master's degree program without passing high school. No Pakistani city currently provides standard bus coverage that extends across the city.

Figure 11: Existing buses in Karachi

Whether as a result of government, administrative, organizational, or system failures, Pakistani cities have failed to understand that an urban mass transit system cannot exist without standard bus coverage across the city. While Karachi previously had a decent bus system, its buses are now almost 40 years old. The number of minibuses there has decreased from 22,000 to 9,000 in the past 10 years. According to the 2018 World Bank Report, Karachi currently has 8,000 fewer buses than are required to meet demand. This shows the demand and supply gap in the mass transit system, which is currently filled by substandard transport like rickshaws and motorbikes. Worse still, other cities in Pakistan do not have a significant old or new bus fleet, and thus face an even larger public transport shortage than Karachi. Here are some key features of standard buses that can be easily implemented with existing infrastructure:

- Can offer mobility for all
- Carry 40-180 people in a vehicle
- Cheapest motorized mobility option
- Need less urban space
- Less energy consumption (per person)
- Pollute less (per person vs car)
- Safer than private vehicles
- Improve accessibility to jobs
- Reduce traffic congestion
- Increase productivity of consumers (by freeing up time spent driving)
- Create new employment opportunities for bus drivers, and maintenance staff

Figure 12: Articulated bus and a double-decker bus on normal streets

To promote bus usage in cities:

- Offer direct routes between major destinations
- Observe published timetable strictly
- Ensure passenger safety (on and off vehicles)
- Offer attractive fares by generating additional revenue from other sources
- Build accessible bus stops
- Integrate with other modes of transportation
- Create better pedestrian infrastructure to and from bus stops
- Include on-demand service/arrival information sharing

2.4.Urban Rail Based Transport System

Rail-based transport is the most effective way to build sustainable urban transport systems, especially for densely populated cities. Due to its high capacity, an urban rail network increases the efficiency of a transport system through a major modal shift from other modes to rail capacity. Rail-based urban transport is considered the safest, most reliable, environmentally friendly, and urban-growth-supportive mode of transportation. It helps to reduce congestion in cities, and lower fuel consumption and emissions through a reduction in private vehicle trips. A rail-based transport system creates more jobs than road-based transport systems and ensures human resource supply for business centers. The neighborhoods benefit as real estate value in the area increases several-fold after the implementation of such projects. Therefore, a feasibility study for rail-based transport must capture the real estate benefits to counter the initial high capital investments that are required. A modern urban railway needs specialized skills for its planning, design, and execution, including that of its structures (viaducts or tunnels), track, rolling stock, rail signaling, and operating system. The following are popular urban railway systems:

Tram	**Light Rail (LRT)**	**Heavy/Metro (MRT)**
- Runs at grade - Occupies ground space	- Stays elevated - Doesn't consume ground space	- Elevated or underground - Doesn't consume ground space
- No structure cost - Track, train, and rail system * Some cities run trams with rubber tires on asphalt streets - Interface with traffic and pedestrian through signals	- Cost of elevated structure - Track, train, and rail system	- Cost of elevated or underground structure - Track, train, and rail system
- Train (2-5 car units)	- Train (2-5 car units)	- Train (2-5 car units)
- Capacity: 12,000 pphd	- Capacity: 22,000 pphd	- Capacity: 48,000 pphd
- Cost $20-25m per km	- Cost $30-50m per km	-Cost $50-70m per km (Elevated) -Cost $150-200m (Underground)
- 2-3 years of construction	- 3-4 years of construction	- 4-5 years of construction
		

Table 1: Urban rail options comparison

Revenue sources for mass transit investment

Mass transit projects are not viable on a fare-only basis; major revenue sources for mass transit are:

- Real estate value capture (cost share from private developers)
- Rental income from retail facilities located inside stations
- Payment from private developers to pay for stations serving their developments
- Advertising revenue from space leased out on trains, in stations, and related structures
- Media (special bookings by entertainment industry)

Figure 13: Real estate, commercial, and marketing revenues from mass transit project

2.5.Bus Based Rapid Transit (BRT): Expectations and Limitations

BRT is already operating in a few Pakistani cities with more cities adding it soon. However, the million-dollar question is whether we have evaluated other alternatives and picked the best solution. Spending Rs.30 billion on a locally-funded BRT line serving 5-10% of a city's population is not an effective use of resources, if instead, 2,000 normal buses can operate in the same amount, in Karachi or Lahore for example.

There are many types of BRT, such as trams, light rail, and metros. They cater to different requirements in a city. How can we be certain that we need BRT with dedicated corridors for our cities? If we are not certain, why are we willing to spend such immense amounts on a single project that requires more funding than a city's entire transport budget? Although BRT systems indeed tend to increase real estate prices around their routes, the question remains, will they be able to solve an entire city's mobility or accessibility issues. Are we even heading in the right direction if we are entirely ignoring foot traffic and conventional buses? Any professional assessment would answer both these questions in the negative.

BRT may work for mid-sized cities like Islamabad/Rawalpindi or Peshawar, but will not be effective without a connecting basic bus service. It is difficult to fathom how we opted to dedicate Rs. 30 billion for a BRT line in a city like Multan, where a basic bus service would have served the same purpose.

BRT has a limited capacity and consequently cannot be the ultimate solution to provide adequate transit facilities for the majority of the population for cities like Karachi and Lahore. Indeed, BRT is successful in very few cities with populations greater than 10 million. It has failed to serve effectively in a city like Delhi, which has an estimated population of 18.6 million. The experiences of these populous cities have demonstrated that the limited benefits of BRT are outweighed by its immense costs.

Points to consider before BRT installation in Pakistani cities:

- BRT has a limited capacity compared to urban railway systems. Even in major metro rail stations, such as those in Tokyo, Manila, or Dubai, with a training capacity of 1,000 passengers, people often have to wait for a train with space to accommodate them because of a large number of passengers. Thus, BRT with 7-10k pphd capacity in the major corridors of Karachi and Lahore cannot work for these cities in the long-term; it may require further projects and investment or replacement by urban rail eventually.
- BRT may have economic benefits to some extent, but will not relieve traffic congestion in peak hours, as the major mode of transportation will still be private vehicles, which are a hindrance to further development of cities.
- Cities should have standard bus coverage before building a BRT system.
- Cities should facilitate walking and cycling.
- Traffic management in cities must be automated to ensure the maximum performance of existing infrastructure before investing heavily in mass transit.
- If BRT is still necessary, all potential revenue sources, such as real estate rental for commercial activity, and advertising space leasing, must be fully explored to determine BRT feasibility.
- Level-1 BRT – including dedicated bus lanes without separation, roadside bus stops with shelters and benches, real-time passenger information, and bus priority at traffic signals – should be evaluated first. This will cost less than current expenditure and will serve as a realistic transition if a future rail corridor is needed.

2.6. Paratransit (Private Services)

Paratransit services supplement the larger public transit system by privately providing individual rides. Taxis, limo services, and private vans all fall in this category. Due to a lack of a comprehensive public transit in Pakistan, paratransit is filling some of the gap between supply and demand in cities. This is ineffective at the macro level because of affordability and limited supply. While the addition of app-based ride services, such as Careem, has improved the situation, a large proportion of the population does not use these alternatives due to an educational background that does not facilitate the use of the cellular internet.

As standard paratransit is a component of a city's urban transport system, its easy availability is important in limiting private vehicle usage. However, a policy ensure that fares of

paratransit are high enough to make usage of public transport preferable due to it being more economical. Thus, for a paratransit system to be successful, it must adhere to a regulatory regime. Indeed, one reason why taxis have never flourished in Pakistani cities is that no regulatory authority monitored their operation. The existence of empirical studies analyzing the public sector regulation of paratransit systems in African cities, as well as in Delhi, could prove to be a useful tool for the creation of a regulatory regime in Pakistan.

2.7. Private Vehicles

In cities that have no public transport or mixed-land-use, people are forced to use private vehicles. Sprawls, such as those in Pakistan, require cars, motorbikes, and other modes of private transportation. Furthermore, when road use is free and subsidized through regular road-widening, underpasses, and flyovers, demand for such vehicles increases.

Vehicle Registration Data (Pakistan)			
Mode	2018 (m)	2017 (m)	Increase
Total	26.57	23.87	11.3%
Motor Bike	19.74 (74%)	17.49 (73.3%)	12.9%
Cars	3.46 (13%)	3.19 (13.4%)	5.2%
Rickshaw	0.85	0.76	10.9%
Bus	0.242	0.239	1.2%
Trucks	0.28	0.27	2.4%

Table 2: Vehicle registration data (PBS-2018)

Cars

- Almost 13% of total vehicles (3.5m) in Pakistan are private cars
- Most road infrastructure caters to cars
- Worst fuel consumption and environmental impact per person among all modes of transportation
- major congestion contributor
- Spending to improve car flow is short term and encourages more cars in the system
- Cities like Riyadh, where cars are the only mode of transportation and all city arteries are signal-free, face massive congestion
- Karachi has seven signal-free corridors, all congested at rush hour, and recently commissioned flyovers congested within a few weeks of opening
- Limit car usage through congestion pricing, restriction time, and parking management
- City authorities must also consider switching completely from manual to automatic cars in order to improve traffic flow at traffic light junctions

Figure 14: Cars are biggest source of congestion and emissions

In Pakistan, only two methods of transportation exist for commuting: private cars, and motorbikes. City planners seem to have forgotten about the rest of our population. The table below shows that only about 8% of households own cars if we assume that there are no multiple-car-owning families. Similarly, 50% of all households own motorbikes if we assume that there is no more than one motorbike per family. This means that around 40% of all households are without an adequate method of transportation, specifically because cities are arranged as sprawls for cars.

MOTORBIKES

- 74% of total vehicle share (20m total bikes)
- Affordable/popular mode for low income population
- Unsafe mode: major contributor in fatal accidents and the leading vehicle in most traffic violations
- Inconvenient for long distances
- Not a standard transport mode in design guides
- Must be considered a part of Pakistan's environment while designing street parking
- Major policy change needed to replace short distance trips with trips using healthy NMT transport modes
- Improved public transport needed to replace long distance bike trips
- Research and effort required to limit motorbike usage on streets
- E-bikes can be an effective means of reducing motorbike usage

Figure 16: Motor bikes are 74% of total vehicles in Pakistan

SUBSTANDARD VEHICLES CANNOT OPERATE IN CITY ENVIRONMENT

There is no concept of substandard vehicles, like rickshaws or Chingqis, in sustainable urban transport due to their poor operating speed (10-30km/h) and unsafe riding conditions. Low-speed vehicles compromise overall system efficiency by slowing down public buses and private vehicles, as well as increase the overall travel time for commuters. Yet, rickshaw use in Pakistan is increasing at an alarming rate of 10% yearly.

Substandard vehicles are unsafe. To ensure public safety, other modes of transport must replace them. Eliminating such informal transport will be a tough task for authorities as thousands of people rely on it for employment, and use it on a daily basis for their transportation needs. This transition should be carefully studied and a strategy to replace these substandard vehicles should be properly planned considering ground realities, with viable alternatives for both users and drivers.

Figure 15: Unsafe and substandard transport

2.8.Freight Transport

The needs of a city and its people grow with time accompanied by changing logistical needs. Efficient movement of goods – through freight transport – is essential to meet a city's need for growth, as is the right of residents to access jobs and services via urban transport. Cities require professional management to ensure that both these needs are met

simultaneously, without conflicting with each other. Often these industrial areas become part of a city's dynamic growth and expansion. Managing the growth proactively ensures that industrial growth does not negatively affect the commercial and residential profile of a city.

Karachi, a city with one of South Asia's busiest seaports, still fails to manage heavy vehicles without impacting urban movement. Mega construction projects mean many construction vehicles in cities like Karachi, a factor not accounted for in urban transport planning. For example, hundreds of big trailers simultaneously enter Karachi via a single entry point after 10 PM, creating chaos, heavily impacting city traffic, and restricting residents' mobility. Such occurrences create serious environmental and traffic safety issues in urban areas. Some key elements of managing freight transport in urban areas are:

- Assess current and future freight needs through surveys, data collection, and engagement with real stakeholders
- Introduce logistic spaces to serve urban growth
- Integrate freight movement with transport and land-use planning
- Strictly implement limited operation timings for heavy vehicles
- Upgrade to green vehicles for environmental benefits and reduced fuel consumption

Figure 17: Poor freight operation impacts urban life and the public's right of access

3. URBAN TRANSPORT PLANNING

The planning process should begin with an understanding of the socio-demographic, land-use, and economic contexts within which a transport system operates. Urban transport planning is a process of transforming a vision into reality by identifying the future needs of a city through data collection and technical analysis, with an eye on financial constraints, before creating a plan that projects a city's needs over time. Pakistan's urban population is expected to double by 2050 (PC 2014, PBS 2017). City governments need to have a realistic plan to fulfill future mobility needs so that cities can be both livable, as well as engines of growth. For that, cities need to create their novel resources and tap potential revenue sources in line with global best practices.

In Pakistan, urban transport has been in crisis for the past two decades. An increase in the number of private vehicles, mainly due to easily accessible leasing facilities paired with population growth, is dominating the usage of public space as there has been no significant improvement in a mass transit system. The owners of a few existing public transport companies lack interest due to low returns. Recently, political leadership discovered a very expensive option – the metro bus. This differs from basic public transport in that it uses elevated concrete platforms and dedicated lanes to leave room for private cars on the ground.

3.1.Transport And Land Use

Transport planning must be an integral part of urban planning rather than being a consequential requirement. Integrated planning is needed to minimize urban travel distances. Trip characteristics by the urban population are a function of land use. Urban planning must encourage short distance trips which can be served by healthy and sustainable modes like walking and cycling. All trips within a neighborhood can't be served

locally and a need for some long-distance trip would be there which would be relatively manageable by public transport if they are limited in numbers. This needed to be dealt with from the early planning stage.

The land use pattern of the city has a major role in the travel distances of commuters. A resident of North Nazimabad Karachi (major residential center) has to travel 20km to reach FTC, Shara-e-Faisal (major business center), or 25km to reach I.I Chandigarh Road (major business center). The main reason of increasing trip length is the confinement of work-related activities in downtown or CBD due to building regulations as new developments in Suburb lacks the business and workspaces.

Our current sprawl system to build huge residential plot schemes 20-40 km away from the city center with no significant other work, business, health, education, and other urban spaces is depending on car-based transport which is in-effective, unsustainable and causing a huge burden on public expenditures as either expensive metros or further car expressways to connect these suburb developments with the city center, while city center has no space to accommodate the additional cars.

Transport alone can not viably manage the encouraging long trips and it adds huge expenditure to the transport development budget. Urban planning is required to support a sustainable transport system at both pre-development and post-development stages. To achieve that goal, Land use regulations for cities in Pakistan need to be extensively reviewed and updated to meet the need of liveable cities;

At the **Pre-development** stage, the urban planning to target Integrated communities or sustainable districts, So maximum trips happening in developments are served within developments and limit the impact on urban transport infrastructure.

At the **Post-development** stage, (For existing urban areas and downtown) urban planning process to continue evaluating the land use pattern and identify shortages in specific facilities causing the significant number of long-distance trips. Mitigate the shortage of specific urban land use by adding the required urban facilities and revision in regulations where needed.

3.2.Switch From Congestion Responsive Actions To Demand Forecasting

Urban authorities in Pakistan upgrade road infrastructure wherever they see congestion. This is not urban transport planning but a reaction to car-based congestion. Urban transport planning and investments should not be made on guesswork and personal preferences but through a macro planning process commonly known as '4-stage Travel Demand Forecast' modeling. Planning tools help identify current and future transport needs and provide a quantitative analysis of current and alternate future scenarios. No city in Pakistan is actively using macro models for transport planning.

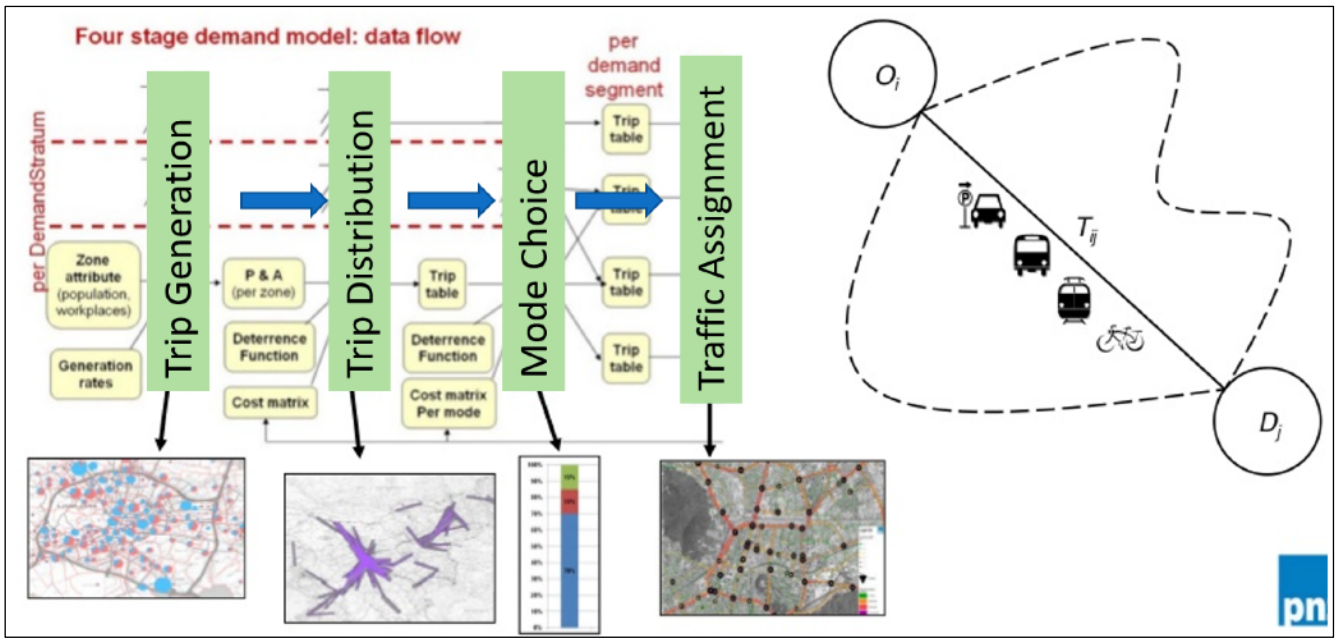


Figure 18: Four-stage 'Travel Demand forecast modeling'

3.3.Public Transport Share in Big Cities

Globally, densely populated cities rely heavily on multiple public transport modes, which include walking, cycling, and buses. As a country with limited resources, we should not depend on the luxury of a private-vehicle-dominated transport system. After building expressways that cover most of the city, Riyadh and Dubai have realized that this approach is neither effective nor sustainable. They are now investing heavily in urban rail, as they are unable to manage mobility and traffic congestion issues with vehicular growth and luxurious expressways. This should serve as an example to Pakistan. Although Pakistan cannot spend $10bn in one city to develop a rail network system like Cairo or Delhi have, spending Rs.30-70 billion on a single BRT line which will barely serve 5% of a city's population is not smart planning.

It is obvious from the above table that in all densely populated and developed cities globally, sustainable mode trips are a major contributor to commuting. Similar mode

City	(Public Transport/ Walking/Cycle) Share	Population (millions)
Hong Kong	90%	7.5
Tokyo	89%	37
Mumbai	85%	28
Dehli	81%	26.5
Shanghai	80%	34
Paris	80%	12.5
Istanbul	80%	15
Beijing	79%	24
Singapore	67%	6
London	63%	14
New York	55%	24
Dubai	25%	4
Riyadh	10%	7.5
Karachi	30%	24

Table 3: Modes distribution % (Global values)
Source: citymayors.com & www.wikipedia.org/wiki/modelshare

share targets are needed in Pakistan to achieve a high share of sustainable mode trips (walking, cycling, and public transport). If our cities do not implement a target of 70-80% sustainable mode share, the transport planning and investment decision-making process is flawed, and not working towards sustainable development.

3.4.Environment and Transport

Transport, as a sector, is the largest and fastest-growing emitter of greenhouse gases (GHG). While the exact figure of the factor contribution of transport to total emissions is unavailable for Pakistan, transport globally accounts for 20-30% of GHG for developed countries; this figure may be higher for third world countries because of older vehicles. Thus, the transport sector must take a proactive approach to mitigating and adapting to climate change. Some Pakistani cities have set an interim target of reducing emissions by 50% in 10 years, reaching net-zero carbon dioxide emissions in 20-30 years.

During the recent COVID-19 lockdown, the usage of motorized vehicles was on the lower side in cities, resulting in improved air quality and a reduction in emissions that were obvious even to the naked eye. The air quality index showed a significant reduction in emissions for all major cities, including Karachi, Lahore, and Islamabad. This highlights how the excessive

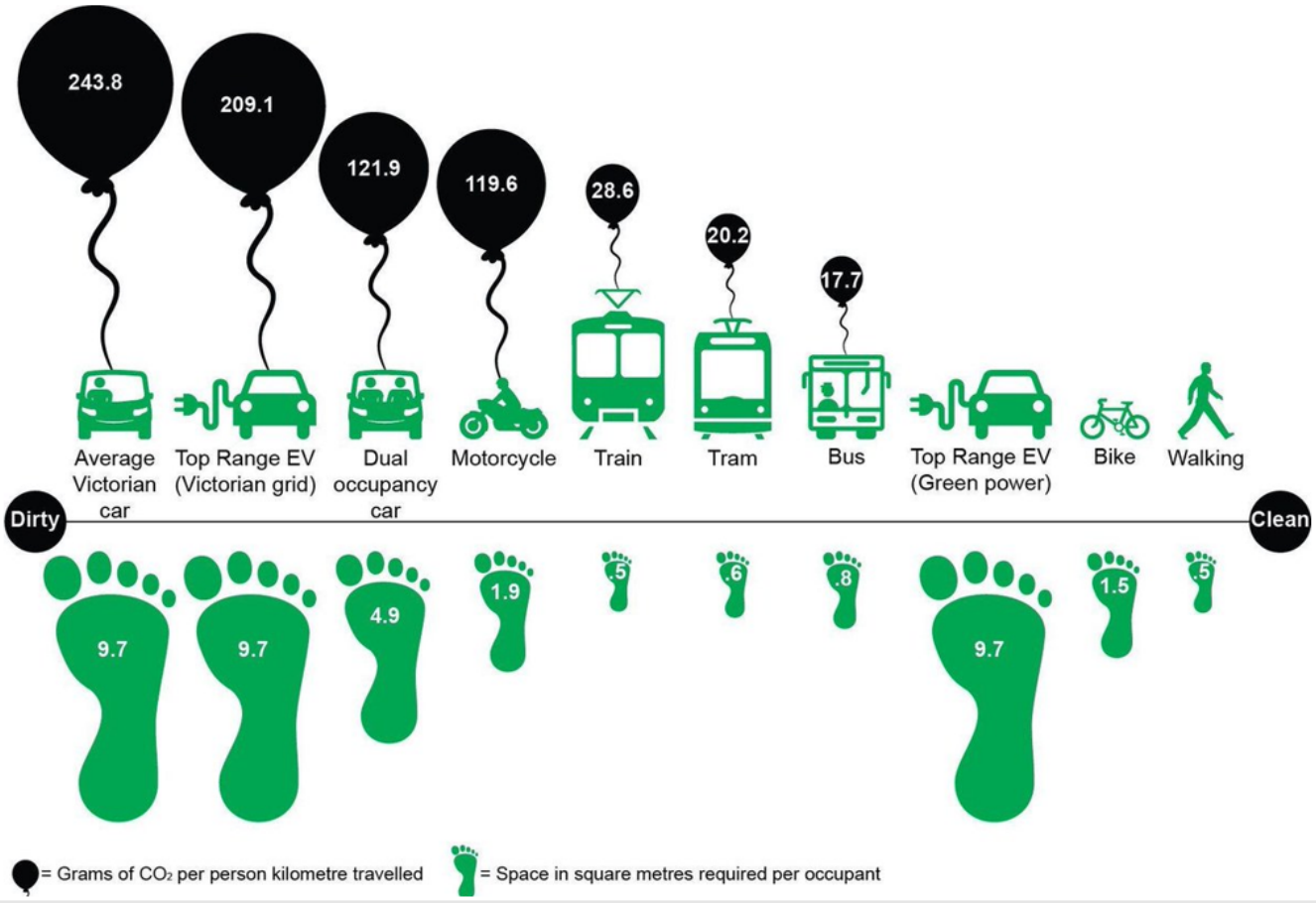


Figure 19: GHG emissions of individual mode and space footprint (ITDP, 2018)

use of private vehicles adversely affects the environment, and urgent action is needed to stop further contributions to global warming and climate change.

Shifting to electric vehicles is a major strategy for reducing GHG emissions, but will prove to be ineffective if electricity itself is generated from fossil fuels. Thus, action is required from the transport and energy industries both. The transport sector's actions to minimize its environmental impact involves a reduction in private vehicle usage and a switch to non-motorized modes, as well as a reduction in trip lengths through improved access to services and public connectivity. Figure 20 shows the environmental and economic benefits if bicycle trips increase on a global scale, from 7% to 23% by 2050.

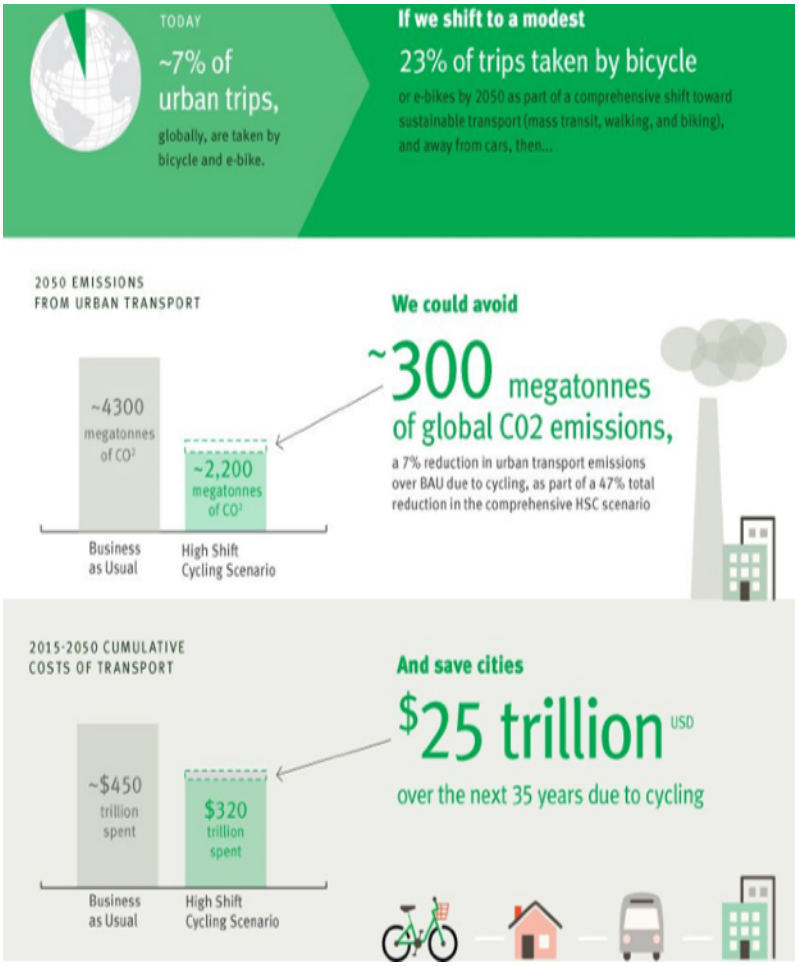


Figure 20: Environmental cost benefits of walking, cycling, and buses (ITDP, 2018)

3.5.Limit Private Vehicle (Car) Usage in Cities

As established previously, private vehicles (cars) are the most inefficient mode of transport and a major contributor to congestion and emissions within cities. Many cities have adopted different ways to limit car usage, including better public transport, time-restricted usage of some streets (full time or certain timing), congestion charging, parking pricing, and others. Here is how we can apply two of these techniques effectively in Pakistan's urban environment:

Congestion pricing / E-toll

Land is the most valuable commodity in an urban context. Private vehicles that occupy precious public space and use up billions in infrastructure for personal use must pay a surcharge. The results of imposing a surcharge on private vehicles to enter congested areas/ routes are as follows:

- Congestion decreased to a manageable level
- Alternate routes are used if available, reducing congestion

- Encourages people to explore alternate sustainable modes such as mass transit, if provided
- Generates revenue for infrastructure maintenance

The congestion charge in London is £11.50/day for driving a vehicle within the restricted zone between 07:00 and 18:00, Monday to Friday. Dubai charges AED4 for crossing a charged point once; there are five toll points along Sheikh Zayed Road alone.

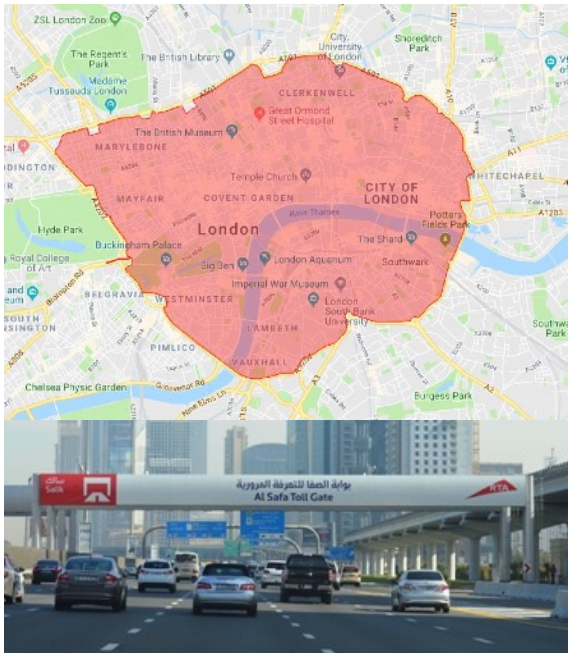


Figure 21: Congestion charging or e-toll in cities

Paid Parking

Parking pricing and management is essential to ensure effective urban space usage in cities. To achieve this, many cities are reducing the minimum parking space requirement within buildings and providing alternate healthy transportation options to discourage car usage. Furthermore, commercial users, such as container food outlets or kiosks, pay to occupy expensive urban land generating revenue for infrastructure maintenance. It is quite surprising then that the Blue Area in Islamabad has free on-street parking in such a congested and expensive area. The following parking regulations must be adopted to improve parking management and to increase revenue from parking:

- No free parking in cities/downtowns
- Parking in urbanized area ***only at designated*** points; no parking on main thoroughfares
- Hourly charging, rather than full-day, to be encouraged to maximize parking revenueand discourage long term parking in commercial areas
- Parking fee to be equivalent to adjacent property rental value

Figure 22: Parking pricing in urban areas

- Parking fee collection to be automated by either parking meter or by SMS/online applications
- Violators of parking rules to be strictly fined.

3.6.Transit Oriented Development (TOD)

Pakistan's cities have built some mass transit facilities, but city agencies have not yet explored TOD. TOD is mix-use vertical growth within a 400-500m radius of public transport stations. It follows the vision of creating compact, connected, and accessible cities in which most facilities are within the proximity of a public transport station. TOD also provides residents with the opportunity to live a car-free and lower-stress urban life. By using integrated urban planning, it brings people, activities, residences, and public spaces closer. It does so while giving the highest priority to walking and cycling, as well as providing a transit facility nearby for residents to connect with the rest of the city.

TOD encourages healthy commuting, public transport usage, and supports sustainable urban growth. TOD is a leading alternative to 'sprawl' to mitigate growing environmental challenges and energy consumption that occur due to excessive car usage. With current and upcoming mass transit facilities in Karachi, Lahore, Islamabad, Peshawar and Multan, this is a great opportunity for city agencies to shift from suburban sprawl growth to TOD and fully

Figure 23: TOD around bus stations and bus stops (ITDP, 2017)

capitalize on the potential of expensive mass transit facilities. For example, Agha Shahi 9th Avenue in Islamabad is a perfect location with seven BRT stations, for TOD. TOD is not exclusive to metro rail or BRT stations. A reliable high-frequency bus service between neighborhoods can also be a starting point for TOD.

3.7.Challenges In Local Urban Transport Planning

To address urban transport issues, understanding the problems of the local system is necessary. Our cities face many barriers to improving urban transport standards:

- Nonexistent or ineffective local government system. Provincial government departments, CM, or commissioner offices do not have the technical expertise to address urban issues. Qualified professionals are required to address complex planning issues and provide solutions
- Even with local governments (2002-2009), cities only managed to upgrade the road network, but no significant work was done to improve livability or transport system development
- Lack of transport professionals with global experience in the public sector. Urban and transport planning needs committed professionals with diverse experience in urban affairs to create the needed plans. Unfortunately, the public service structure does not allow professionals to enter public sector service to become a part of the decision making process. Additionally, local governments have budgetary constraints and cannot hire experts with internationally acknowledged experience
- Lack of available data to help with making plans
- Lack of interest from the private sector as there is no incentive to get involved in professional transport planning

3.8.Transport Planning Process

Actions to achieve an efficient and sustainable transport system:

- Independent and professional decision-making process at the city level fully supported by all government tiers
- Qualifications of public sector team leading the development process must match credentials of consultants on the project to understand and monitor the progress of ongoing projects
- Legal cover for the city transport agency to generate possible revenues. Financial reliance on central government negatively affects city management and services.
- A central organization under the city umbrella to manage all components of urban transport, for example, planning, design, execution, and operations.
- Mandatory integration of urban planning with transport planning and public hearings during the planning stage with feedback from public/other stakeholders

- Performance evaluation measures to be clear, simplified, and available to the public. A timely update on progress to be shared with the public, such as:
    - No. of bus routes or buses added in the city
    - No. of major streets transformed for pedestrian traffic
    - % of people switching from cars to public transport
    - Emission levels reduction as per targets or % of previous value

4. URBAN TRANSPORT DESIGN AND CONSTRUCTION

Transport design translates urban transportation plans into detailed engineering deliverables that can be read in terms of drawings by a contractor uses to execute the project.

4.1.Transport Design - Learning from Global Experience

Transport design is a specialized field that uses vision, policy, and planning together to configure the specifics of a project's details. Good design can help projects successfully achieve overall goals; similarly, bad design can ruin all the efforts made at policy or planning stages. Transport design captures the existing physical conditions and expected system users. To be effective, transport design must follow engineering standards and propose a design configuration that meets the project scope, is safe, sustainable, environmentally friendly, economically feasible, realistic, and resilient.

Transport design must be a holistic process that considers all modes of transportation. If urban transport design ignores critical elements, like walkability, bus stops, or cycling tracks, and instead exclusively follows the highway design strategy of free-flowing cars at high speeds, it will create a flawed system that does not meet the needs of every segment of a city's population. Design should cover complete ROW; considering only vehicular movement and ignoring the fulfillment of remaining street facilities by leaving them to contractors, or budget availability at the end of construction, is a mistake. However, this method is in common use in our urban environment.

A balanced design will consider full ROW and allocate appropriate space to each mode of transportation as per the urban transport master plan. Good design distinguishes vehicular space, pedestrian or cycling space, transit space, and parking space, if any, without ambiguity. Bad design does not demarcate space for each function clearly, causing confusion and overlap of usage.

Transport projects plan roadways that have specific functions. For example, urban roadways are normally classified into four types:

- Expressway or freeway (controlled access, complete free flow, long-distance motorized vehicles)
- Arteries or Boulevards (partial controlled access, signalized, mid-distance multi-modal)
- Collectors or Avenue (limited access control, signalized, short distance, multi-modal)
- Local streets (building/plot access, uncontrolled, multi-modal)

Details for the design of each category may vary based on the context, such as suburban, urban, or urban core.

Below are the standard sections for each type of street. Note that these sections are referenced from the Abu Dhabi Urban Street Design Manual, which accounts for vehicles that are much larger than those in Pakistan. Therefore, slight adjustments may be required for each category, as per the local context. Abu Dhabi's urban street design standards are most relevant to Pakistan's urban environment, as they support narrow lane widths and tight turning radiuses, which are precisely what Pakistan needs to discourage cars and encourage pedestrians and cycling on streets.

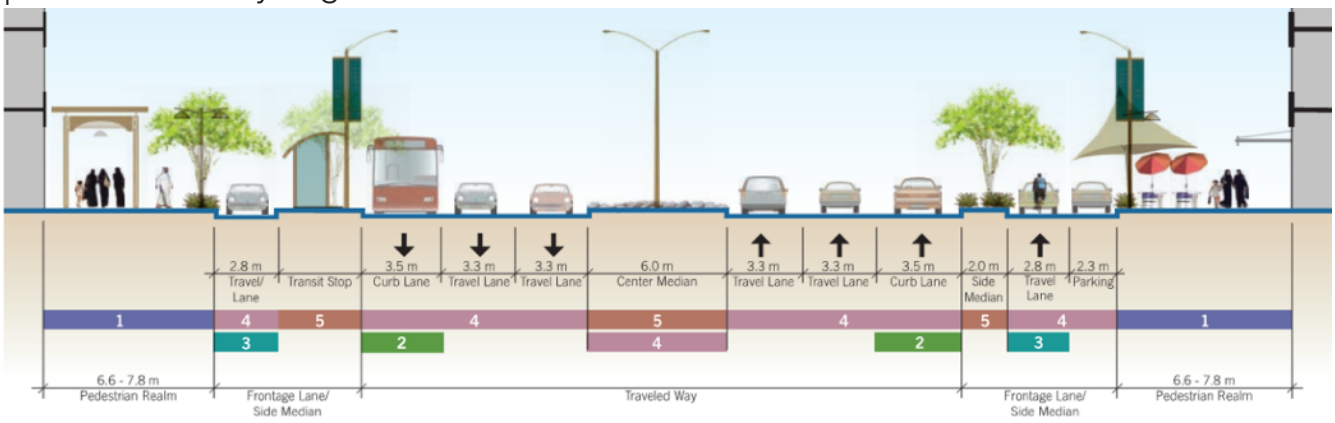


Figure 24: Typical Urban Boulevard Section

(Note: Travel lane can be reduced to 3m for smaller cars and service road may be increased for maneuvering. Also, the pedestrian realm can be split into a cycle track and a walkway.)

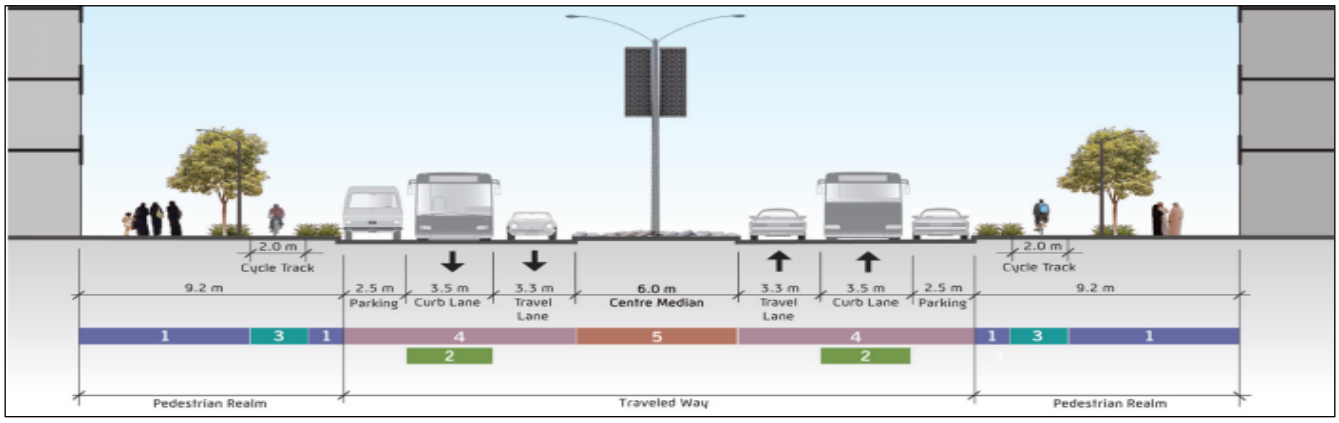


Figure 25: Typical Urban Avenue Section

(Note: Travel lane can be reduced to 3m for smaller cars. Also, the cycle track can be 3m wide)

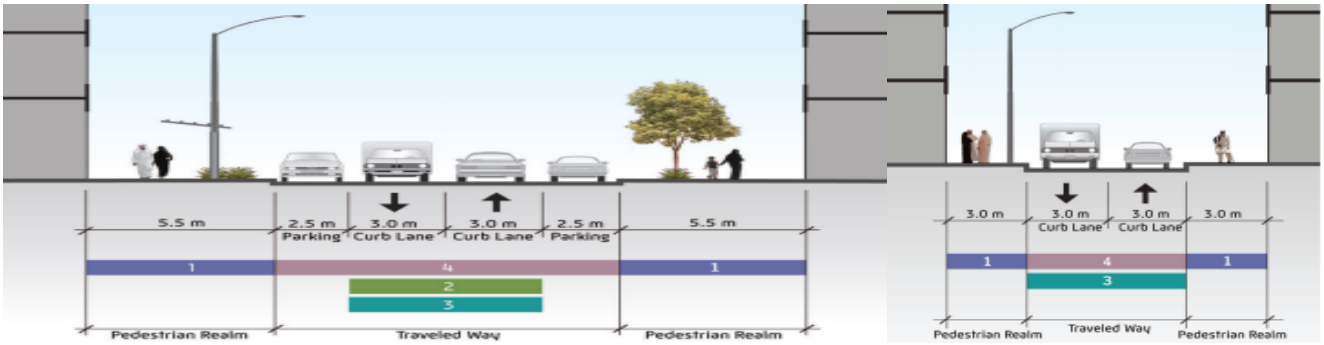


Figure 26: Typical Urban Street or Access Street

(Note: Travel lane can be reduced to 2.8m for smaller cars and two-way streets)

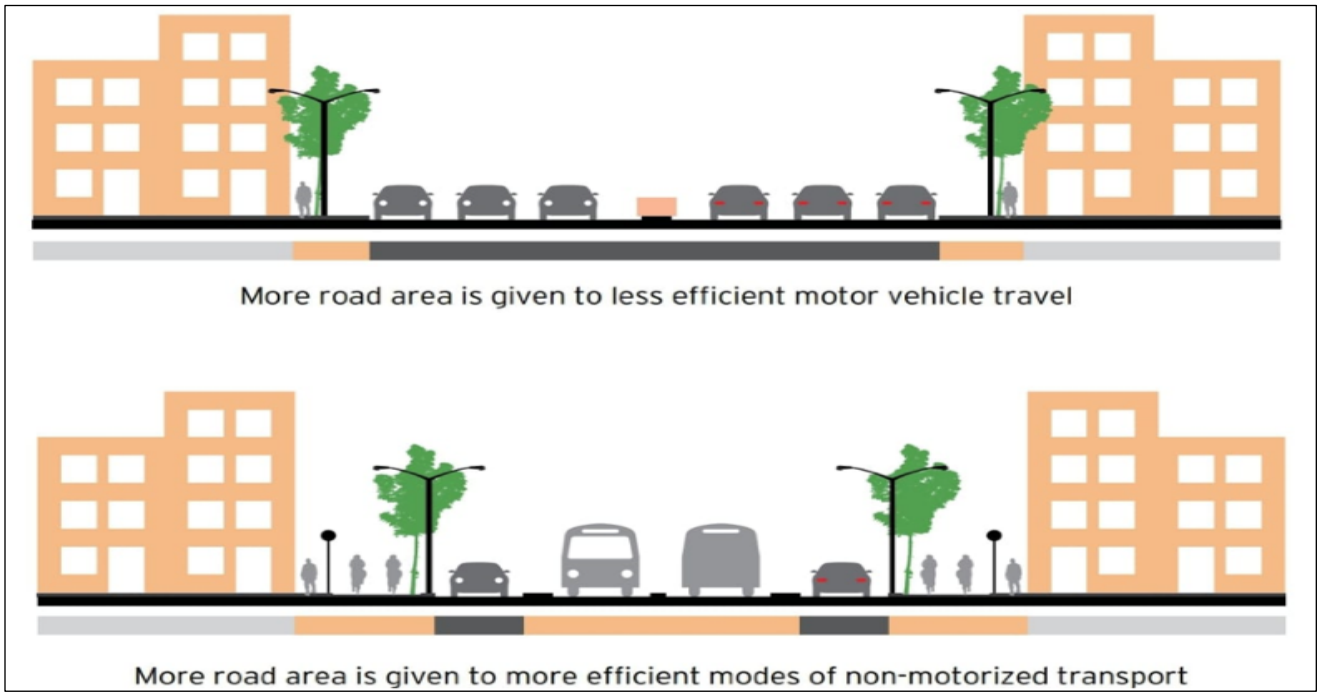


Figure 27: Balanced (Multi-modal) street design vs car-oriented design

4.2.Signalised Junctions are not a Curse for Urban Streets

A junction is a point where multiple streets merge or cross each other, with traffic moving in many directions. Junction design is arguably the most critical element in urban street design. Most junctions in urban areas are equipped with traffic signals to meter traffic for safety. A city without safe and efficiently signaled junctions cannot have sustainable urban transport management.

In the past 15 years, Karachi has built seven signal-free corridors, with Lahore, Multan, and Peshawar following suit. The preference of decision makers/designers to remove traffic signals from junctions purports to eliminate congestion at junctions and make it easier for cars to travel freely. In reality, the removal of traffic lights from junctions comes at the cost of

killing pedestrian movement and handicapping public transport operations. This is a mistake in all aspects of urban transport planning (vision, policy, and design).

Figure 28: Signalized junctions in Pakistani cities vs standard junction in Dubai

In principle, grade separation should be strictly discouraged in the urban context to curb car growth. The limited resources should be spent on sustainable transport modes, like buses, walking, and cycling. The performance of signalized junctions can be optimized by implementing demand-responsive timing, green wave progression, and automated violation monitoring. These measures are simple and effectively used globally but not utilized in Pakistan.

Figure 29: Grade separation does not mean neglecting junction and pedestrian requirements

4.3.Utilities in Transport Design and Construction

Urban areas need utilities such as electricity, telecom, water, sewerage, drainage, gas, and irrigation. These are generally installed under the streets. As such, any roadworks usually affect these services and require the transport management agency to coordinate construction activity with utility agencies to manage the project without affecting the functioning of these services.

There are many examples in Pakistani cities where projects are delayed for significant periods because of a lack of coordination between utility providers and transport construction project planners. Since these projects were executed without consideration of their impact on utility services, they later had to be put on hold until alternative planning was put in place. This causes time delays, cost overruns, and induces variation in the scope of projects leading to contractual issues between the parties involved.

Utility agencies must collaborate closely with urban planners and city governments to share information and updates related to their existing and plans. This is necessary to avoid delays in transport infrastructure projects.

4.4.Construction in Urban Transport

A well-planned and designed project cannot become a reality if it is not executed as per design. The biggest barrier in the construction of urban transport infrastructures is the competency of the contractors available in Pakistan.

The difference between urban and rural construction is their interface with urban life. Cities like Singapore, Dubai, or Kuala Lumpur have frequent large construction projects ongoing regularly, but these do not affect the lives of their residents adversely. Pakistani city governments and urban contractors must quickly adopt such best practices to ensure the safety, health, and accessibility of the neighborhoods impacted by their construction activities. These requirements must be clearly stated in a project's contract documents.

The urban transport construction sector is not very specialized in Pakistan and still practices obsolete construction methodologies and techniques. One can forecast that if strict pre-qualification criteria are adopted for construction projects, many bidders will not qualify, leading to a dearth of qualified contractors. Lack of work in the market, procurement transparency issues, and uncertainty in construction projects also discourage contractors from upgrading or acquiring the skills and resources necessary to deliver key projects in time.

4.5.Collaboration with Global Design and Construction Firms

When one acknowledges that our agencies, designers, and contractors do not have the skills to deliver growth-oriented urban infrastructure, the natural approach for addressing this issue

is to collaborate with global firms that have expertise in planning and delivering urban infrastructure in well-planned cities.

We have done a few projects/studies with funding from international lending agencies, including Japanese and Chinese funded projects. The results can be reviewed to analyze the effects of collaboration with global firms. All these projects involve international design and contracting firms in some capacity although the firms are not among global top tier companies. Unfortunately, well-known firms like Bechtel, AECOM, Jacobs, Parsons, ACS, Hochtief, Samsung, and many others, are strangers to the local infrastructure fraternity. Some Chinese conglomerates have entered the local market through CPEC projects; their impact on both the market and skill enhancement of professionals and firms working with them will be clear with time.

Out of 20 leading global infrastructure firms, only two have offices in Pakistan on a minor scale. In contrast, all major infrastructure giants have established offices in India, where they are working on key local projects while also working on international projects remotely. This allows young local professionals to gain international experience within their own country, and thus acts as a major contributor to the local industry's quality and capacity development. Thus, collaboration with global construction firms will not only improve the urban infrastructure in Pakistan but will also have a positive effect on the economic development of cities.

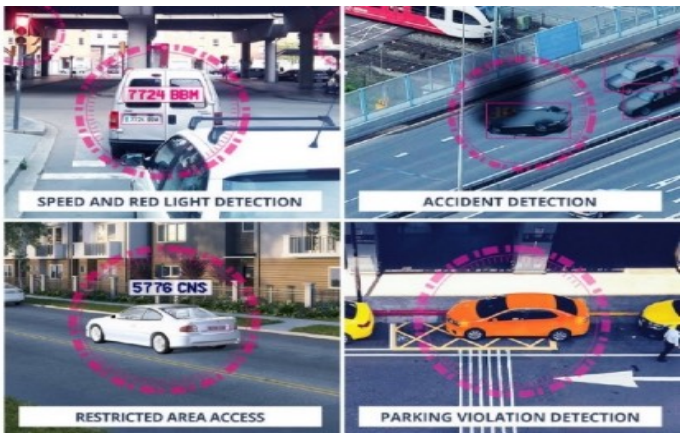
5. URBAN TRANSPORT OPERATIONS

Successful urban transport operation is the key to the success of an accessible and growth-oriented city. Transport operation is critical to ensure the maximum performance of investments in infrastructure. Operations in transport vary from data collection, information processing, surveillance, communication systems, monitoring, controlling, and several other activities.

Lack of successful operations will lead a city to failure and destabilization. Transport operations are generalized as traffic management. However, traffic management is a part of the whole transport operations department. The following are some elements of transport operations and management. Automated traffic violation monitoring

5.1.Traffic Monitoring and Violations Tracking

- Surveillance and monitoring on streets and junctions
- Automated violation monitoring by smart cameras, information processed by the system and directed to the offender
- Traffic violation fines set very high as a deterrent to offenders. The red light violation fine in the UAE is AED2,000 and the vehicle is impounded for a month. The offender can pay an additional AED3,000 for the immediate release of the vehicle.
- Demerit points on violations, with cancellation of driving license on reaching a predetermined cutoff demerit point level.
- Automated traffic police system to implement and manage the system professionally



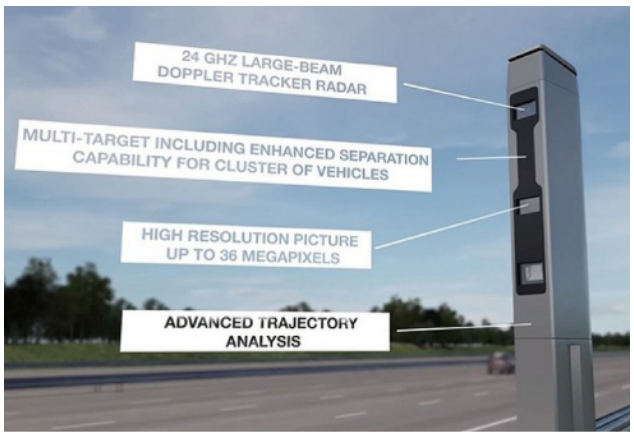


Figure 30: Automated traffic violation monitoring

5.2.Driving License Procedure

- A written and physical driving test must be passed before the issuance of a driving license. This must be strictly implemented without nepotism and favors. For example, in Dubai, a new driving license applicant pays AED10,000 and waits from 6 to 12 months for a driving test after the initial application.
- The above is even more critical for public transport and freight drivers

Unfortunately, a significant number of drivers do not hold a valid license, with even license holders unaware of driving rules and laws.

Figure 31: Driving license procedure

5.3.Vehicle Fitness Testing and Certification

- All vehicles (including bikes, buses, trucks, and paratransit) on streets must pass an annual fitness test
- Annual testing must be mandatory for vehicles older than 3 years. Testing to be fully automated with no human intervention in evaluation
- Smart cameras will be able to detect expired registration from the number plate and assign fines

These regulations will result in safer vehicles and better traffic, especially involving heavy vehicles.

Figure 32: Mandatory vehicle testing

5.4.Intelligent Transportation System (ITS)

Intelligent Transportation System (ITS) is an application that aims to provide innovative services relating to different modes of transport and traffic management. It enables users to be better informed and to make safer, more coordinated, and 'smart' use of transport networks. ITS focuses on the following:

- Enhanced public travel safety
- Enhanced operational capacity of the roadway network
- Monitor, control and mitigate traffic congestion
- Inter-agency coordination
- Roadway Weather Information Systems (RWIS)
- Provides current traveler information at critical decision points
- Provides alternate route information during dynamic rerouting
- Capable of acting as guide signage for events
- Designed for innovation
- Tiered Open architecture
- Modular approach
- Intuitive, robust and configurable
- Advanced tools for decision support

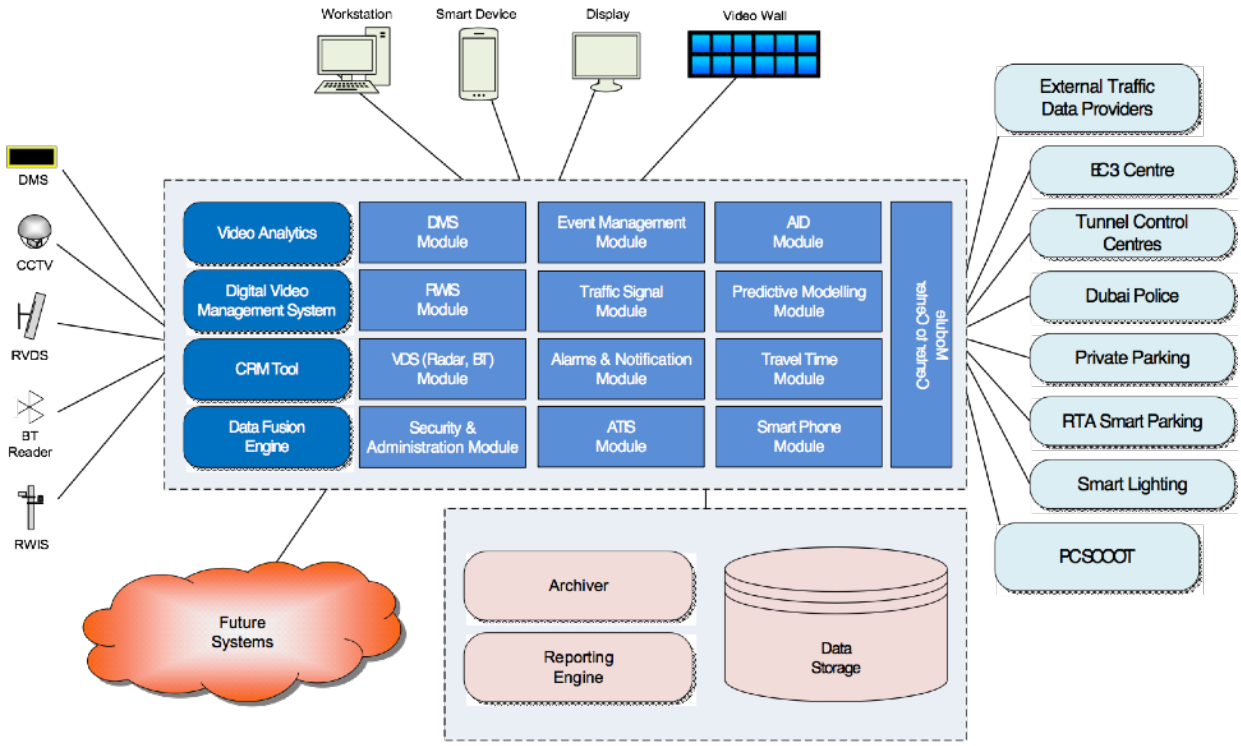


Figure 33: Intelligent transport system (ITS 2020, Dubai)

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