10

ORF SPECIAL REPORT

APRIL 2016

New-Age Urban Transportation and Disruptive Technologies

Nimisha Pal

Delhi-Faridabad skyway | Photo: Tahir Hashmi

ABSTRACT

Emerging technologies have the potential to reshape our world. These innovations, also called disruptive technologies, have started to seep into the area of finding solutions for mobility. Is existing infrastructure prepared for such technological advancements? These and related themes were discussed in a roundtable organised by Observer Research Foundation (ORF) on 8 February 2016. The roundtable, "Urban Transportation and Disruptive Technologies", was an opportunity to exchange ideas related to the underlying relationships, the dimensions, and impacts that may be mutually created between the imperatives of urban transportation and

the innovations created by disruptive technologies. These relationships span a wide range of planning, technology, policy, and safety perspectives. This special report builds on the opinions articulated in the roundtable, and reviews emerging technology innovations brewing in India and in other parts of the world.

INTRODUCTION

Cities are taken to be engines of growth. For cities to run, however, they depend on movement: of people, goods, and information. And although transport is a derived demand, transport planning and policy interventions adopted for an area carries the potential of either supporting, or hampering, sustainable development of its environs. The provision and management of urban transportation services, therefore, has always been and will remain a challenge in the governance of cities.

For Indian cities, studies of their transport characteristics have revealed a high dependence on non-motorised modes (walking, bicycles, cycle rickshaws) as the primary means of travel. As cities grow, the role of these non-motorised modes tends to decline, though still remaining important: They can, and do, serve as the more sustainable means of last-mile connectivity under an overall, integrated multi-modal public transport framework for all city sizes.

Despite moderate level of reliance on non-motorised transport, the trend witnessed in Indian cities is of their fast eroding patronage base for want of favourable infrastructure and services support. At the same time, a lack of required supply of public transport services leaves citizens with little choice but to aspire for owning, and depending on private motor vehicles. As a result of such demand for private cars, Indian cities are suffering the concomitant issues of worsening congestion and traffic delays, higher economic costs, and deteriorating pollution levels. Research have indicated that in India's metropolitan cities, the annual loss of productivity due to traffic congestion and inefficient transport systems, may be valued at billions of rupees.

The rapid urbanisation and motorisation levels fueled by economic development are inadequately supported by both the required land-use transport integration, and fast-paced and timely reforms, initiatives and regulations. Against this backdrop, private-sector players are proving themselves to be innovative and enterprising—ready to match dynamic mobility demand through user-friendly accessibility solutions. Yet despite their potential to transform people's lives, such emerging urban transport solutions generally face constraints of regulations, support infrastructure and policy, hindering their growth into a sizable and readily acceptable alternative.

Present institutional mechanisms and policies have either failed or have been slow in meeting the mobility aspirations of local populations and businesses. The origins of 'affordable cars' in the past, and 'E-rickshaws' in recent times, were driven precisely by the need for faster and more convenient travel (i.e., the use of car) and to fill the vacuum of affordable, last-mile connectivity (i.e., the use of E-rickshaw). Further, their emergence was driven by the private players who also pushed government regulators into formulating modifications in existing rules to accommodate them into the overall system. Even the introduction and spread of rail-based, cost-intensive mass transport systems took a long time to flourish and needed the support of various policy-level initiatives and regulations.

In the context of disruptive, emerging technologies (generally being pushed by private players) making inroads in transport services and operations, it will do well to have a clear understanding of the kind of support that is required to enable their deeper and faster outreach to various stakeholders.

URBAN TRANSPORT NEEDS AND INITIATIVES: STATUS & PROSPECTS

The need for transporting people and goods in an urban environment has historically manifested itself in the evolution of new and faster means of travel. The changes brought out in the urban transportation systems, owing to changing mobility needs, can at best be categorised as mixed—whereby accessibility levels have generally increased but, alongside it, the problems of rising costs (to both users and service providers) have also grown. Further, these issues have created a scenario where the elderly, women, children, differently abled and the poor, are excluded in the city's progress in mobility; they, in fact, face restrictions on their movement.

The demand for mobility is getting increasingly dynamic and heterogeneous, riding on a wave of the changing demographic and socio-economic profile of urbanites. As economic prosperity manifests in higher consumer power, the demand for accessible and reliable transport facilities is also getting pushed up.

Past studies conducted by the Ministry of Urban Development (MoUD), Government of India (GoI) on mobility characteristics across different types of cities have indicated growing transport demand levels and declining public transport and non-motorised transport shares in the total demand, especially for medium- to large-size cities (See Table 1). The supply for fast-paced growth in transport demand, assisted by growing motorisation levels and socio-economic developments, has been hampered by the absence of a corresponding transport network and systems capacity expansion in urban areas. It may be noted that the gaps in supply have been both quantitative and qualitative.

Table 1: Transport Modal Share and Utilisation Intensity of Vehicle (Km. Travelled in Indian Cities)

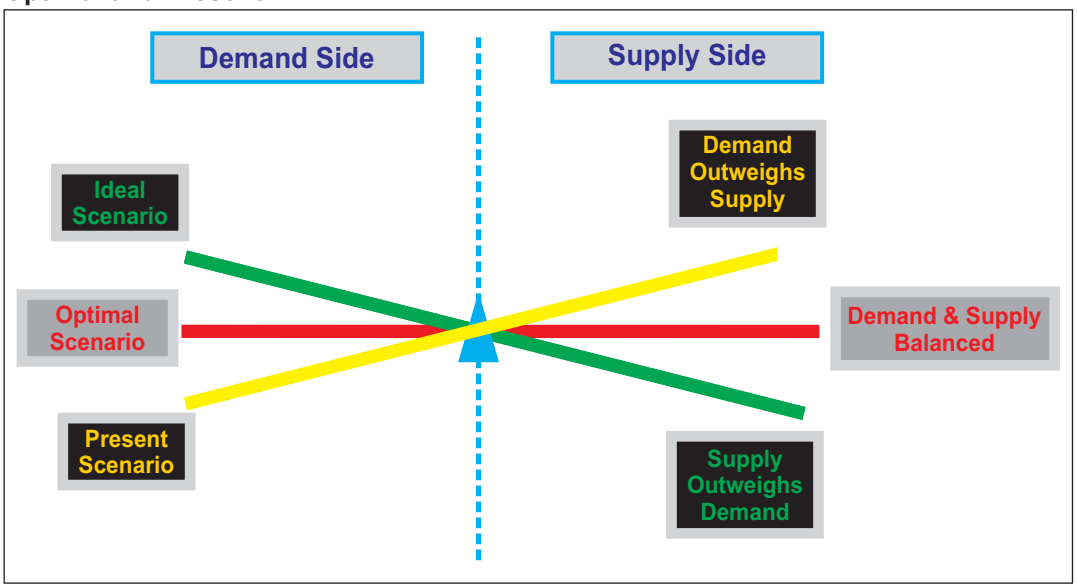
City	1994					2007				
	Public Transport Share (%)	Private Transport Share (%)	Non-Motorised Transport Share (%)	Daily Pax. Trips (Million)	Utilisation Intensity of Veh Km (Pax km/ Veh Km)	Public Transport Share (%)	Private Transport Share (%)	Non-Motorised Transport Share (%)	Daily Pax. Trips (Million)	Utilisation Intensity of Veh Km (Pax km/ Veh Km)
Delhi	65	25	10	7.57	3.6	61	24	15	19.95	3.4
Kolkata	93	2	5	12.23	16.8	72	15	14	17.23	5.5
Ahmedabad	36	40	24	2.91	2.2	28	54	18	6.64	2.1
Varanasi	18	34	48	0.93	2.3	20	58	22	1.89	2.2
Kanpur	24	35	41	1.77	2.1	22	51	26	2.14	2.0
Bhopal	39	53	8	1.49	2.1	24	53	23	1.56	1.7
Nagpur	7	49	44	1.84	1.7	18	48	35	2.63	1.8
Guwahati	53	32	15	0.46	3.6	25	48	27	0.80	2.5
Pune	38	46	16	2.94	2.1	24	62	14	4.55	2.0
Shimla	86	14	0	0.05	4.6	38	60	2	0.07	2.2

Source: Author's compilation sourced from MoUD reports.[1]

Other worrisome areas include sub-optimal utilisation of available resources in the form of transportation networks, transport vehicles and systems, and manpower. The **intensity of utilisation-per-Vehicle-Kilometer** travelled in urban areas can be gauged from Passenger Kilometer travelled per Vehicle Kilometer travelled in a city. The bigger the value of this utilisation ratio, the higher the economic, environmental and social sustainability, as more passenger kilometers are served per vehicle kilometer operated. Passenger kilometer served can be identified with mobility demand satisfied, while Vehicle kilometer travelled denotes transport service supply. A comparison of utilisation intensity of each vehicle kilometer travelled, indicates lowering levels over the period 1994-2007 for ten cities across India, where data could be collated (See Table 1).Consequently, the congestion levels have been on the rise, with average speeds coming down, resulting in longer delays and therefore, losses of productivity and higher fuel consumption.

Transport networks play an important role in overall logistics of meeting the transport demand and supply. The flaws of transport network performance affect efficient throughput and constrains the overall efficiency of logistics to meet perpetual gaps between demand and supply. Despite continuous process of transport sector advancements and public support, the demand and supply gaps for safer, economical and environmentally sustainable urban transport system still persist and an ideal system (even closer) remains elusive. The problem worsens due to the presence of multiple players and stakeholders (transport sector decisions generally have significant impacts, as transport industry is one of the major employment generator and contributor to Gross Domestic Product (GDP)) as well as due to long gestation period of cost intensive transport investments (See Figure 1).

Figure 1: Balancing Act of Transport Demand and Supply in Urban Areas: Ideal, Optimal and Present



Source: Figure developed and designed by the author.

Under these circumstances, the current policy focus—of how much faster we can move people and goods in urban areas—needs to be replaced with a new one: how *efficiently* these can be moved. The mantra therefore has to be: "Increase passenger/tonnage throughput per vehicle kilometer (km) operated" and if possible, simultaneously, "Reduce vehicle kms of travel". Transport Demand Management measures offer means of maximising the utilisation of transport

infrastructure and services and thereby improve efficiency. In order to reduce transport demand levels, land-use transport integration and technology interventions (such as E-commerce, internet banking, online shopping, and distance learning) will be necessary. Moreover, a number of inter-disciplinary integration in the above operations will be required in an effort to achieve objectives of better managed urban transport demand, which can ultimately lead to the containment of transport sector carbon footprints.

With the formulation of National Urban Transport Policy by GoI in 2006, the policy and planning focus had shifted towards increasing the attractiveness of public and non-motorised transport modes with the objective to move people out of personal motor vehicles. The underlying philosophy was to reduce vehicular traffic in the process of meeting ever increasing transport demand. Substantial investments have been made in the development of good public transport infrastructure. The efforts have seen fast rising patronage levels for comfortable and safe public transport systems systems such as the Delhi Metro. Similarly, the recent Delhi experiment in car usage restrictions on a particular day, depending upon Odd-Even registration number, was found surprisingly acceptable and did manage to reduce traffic congestion and vehicle km travelled—as people then used public transport, or else carpooled and managed their transport demand, during the implementation period. These initiatives show immense potential and system acceptability towards the need for good public transport as well as demand management-based initiatives in the urban transport sector.

With past experiences of abysmal security (be it public transport, contracted school or office transport services, hired taxi services, and even those offered by demand aggregators in recent times), safety and universal accessibility have become one of the major concerns of transport regulators and managers. The fear of security in transport systems has not deterred vulnerable users from participating in economic activities but it has certainly influenced travel choices to meet mobility needs. In most cases, such choices culminate in the use of a private car, which has become the epitome of personal mobility and safety in a city where public transport means are facing severe challenges.

The above issues need considerations in transport planning and solutions development, not only from the regional and national perspectives but also from that of global policy framework. Rapid urbanisation, changing demographic and socio-economic profile, the threats of climate change and fossil fuel extinction—are all driving next-generation global policy and strategy framework of urban transportation. Such a policy should encourage and direct for (1) enhancement of transport system performance, and (2) development of people-centric attitude. The policy framework will need to be inter-disciplinary, integrated, dynamic, flexible, and sustainable. The transport demand management and minimisation of vehicle km should be at the forefront of such policy. Further, such a transport system will need to be accessed from the remotest of locations and must prove economical for the poorest, considering the diversity and magnitude of users across Indian cities.

From the user perspective, the bigger the vehicle, the cheaper, sustainable and less accessible it is; and the smaller the vehicle, the costlier, less sustainable and more accessible it will be. Moreover, heavy dependence for high accessibility on smaller vehicles can worsen already congested transport network, alongside ever-rising demand for parking spaces, circulation areas, and depleting fossil fuel. A new

transportation system combining the utilities of bigger to smaller modes could be the key towards resolving seemingly intractable transportation problem of Indian cities.

The integration of bigger to smaller vehicle transport systems could be a potential model of a seamless, integrated and sustainable transport solution of urban mobility. The public transport services can be brought closer to convenience and comfort of private transport, and vice versa, where private modes can be utilised for public service (See Figure 2). A case of integration and sharing of modes across users or owners, makes sense to satisfy overall mobility needs and maximise utilisation of resources. This integration will have to be driven and guided by emerging technology advancements, among various other measures.

THE POTENTIAL OF DISRUPTIVE TECHNOLOGY

In recent times, web-based banking, commerce and shopping applications have gained tremendous popularity with the expansion of their user base, riding on the wave of internet and mobile-based technological revolution of the last decade. Taking cues from these, other technological interventions utilising smartphones, mobile networking, cloud computing, and GPS, have enabled user-centric application developments in the arena of urban mobility. These applications have predominantly focused on the online hiring of cab services, route guidance, travel guidance, real-time vehicle location and arrival prediction, incident management, and real-time traffic signal synchronisation. Riding on such technology wave, a number of transport demand aggregators have recently sprung up, whereby demand aggregation and its commoditisation is taken up which can then be ordered by the user and managed by the service provider. Such mobility services belong to the area of "Shared Mobility" originating from shifting worldwide focus towards "Shared Economy"[2] where the basic mantra is: Access not Ownership. This new philosophy and way of dealing with urban transportation may require grassroots-level changes in the way supply of transport services is presently planned.

Disruptive technologies are the root enabler of shared economy business, whereby the usual means of supply and consumption of transport commodity have slated to undergo changes. The "disruptive technologies" typically offer benefits for being simpler, more convenient, and less expensive products that appeal to new or less-demanding customers. Once the disruptive product gains a foothold in new or low-end markets, the improvement cycle begins. And because the pace of technological progress outstrips customers' abilities to use it, the previously not-good-enough technology eventually improves enough to intersect with the needs of more demanding customers. When that happens, the disruptive practices are on a path that will ultimately crush the incumbent practices.[3]

The prevalent vehicle-based mobility has been guided by automobile and oil and gas industries and is increasingly considered unsustainable for future urban mobility solutions.[4] This new mobility paradigm is being pushed by the real estate sector, along with IT and telecommunications and tourism industries on one hand, and climate change restraint goals and new fuel technology agents, on the other.

The impact of technology-driven, shared economy in transport sector has been the subject of extensive research in North America. These studies have shown a decline in car usage, purchase of cars, and increased usage of public transport and non-motorised transport modes.[5] The car sharing user surveys in North America

also reveal potential for monthly savings, and not only reduction of vehicle kilometers travelled but also a noticeable dip in GHG emissions.

There has also been space for the growth of different car-sharing models, varying from traditional to new-age models: P2P sharing (shared use of private vehicle typically managed by third party), and Fractional Ownership Car sharing (individuals sublease or subscribe to a vehicle owned by a third party). Recently, real-time bike-sharing and ride-sharing services have also come up as alternate means of shared mobility, shaping up the growth of the 'shared car' market. Behind the real-time ride-sharing or carpool service design, a set of grinding logistical and management procedures are laid out to maximise the feeling of convenience and safety during travel. Adding to above applications, the emergence of Autonomous, Fuel cell, Electric and Connected vehicles; tremendous opportunities and choices for urban mobility could be made available to a large section of society.

These evidence of emerging technology interventions on urban mobility choices and consumption, signify a growing market for demand responsive transport. Such demand responsive services, when integrated with public and mass transport services (road-and rail-based), could potentially fill in the current void of last-mile connectivity, while providing alternative travel choices for less accessible locations.

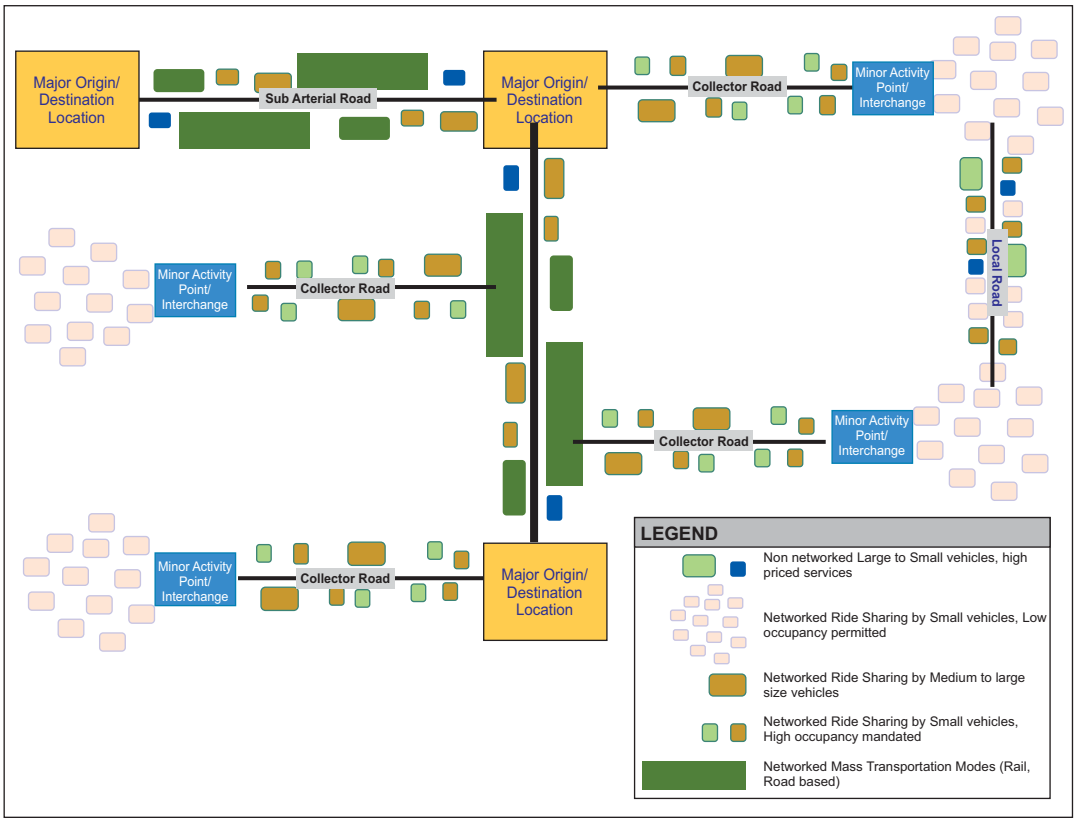
The landscape of urban transportation could get further transformed through the integration of shared mobility systems with various traffic operations based applications such as Real time traffic management, Travel planning and Guidance, Road user charging, Incentives/penalties, and Real time travel information, with Integrated fares and Multimodal transport solutions. This integration across different sub-systems of urban transportation will not only provide seamless and sustainable urban transport solutions but can also generate a wealth of knowledge base for planners, policymakers, managers and executives. The information, thus generated and systematically recorded over time, can assist in formulating daily (and even hourly) action plans under an overall transportation strategy, guided by the global, national and local policies.

The above will be a truly integrated and managed door-to-door transport service that can (1) satisfy demand for reliable, accessible, safe and flexible transport system for a user; (2) offer large operational efficiencies and opportunity for targeting products and services, to where they best add value and generate revenue for the service provider; and (3) enable efficient utilisation of resources with reduced emissions and improved safety.

India can potentially take up a large part of this shared economy business simply on account of numbers and an ongoing, fast penetration of e-literacy. The shared mobility is already experienced in India through various formal and informal ways such as contract carriage bus services (for school and office transport), hailing a taxi/auto rickshaw/cycle rickshaw; and fixed route and schedule bus services. However, these have yet to be supported by technology, and their full potential therefore has not been realised.

It may also be noted that many of the systemic and user centric applications have already entered the transport space of Indian cities. The online carpool market has recently seen startup ventures in metropolitan cities of India. For example, MeBuddie, RidingO, PoolCircle, and CarPoolAdda, have come up in this space. The entry of global players like Brazilian Tripda and French BlaBlaCar is also seen as a validation that the Indian market is ready for carpooling. Tripda is even looking at acquiring smaller carpooling companies to scale up their business in India.

Figure 2: Big to Small Vehicle Integration for High Accessibility and Intensity of Utilisation



Other innovative and localised mobility solutions of motorbike hiring and auto rickshaw hiring by Ola have been launched and user response has been encouraging. Uber, as a taxi aggregator service provider, is working on shaping up the Peer to Peer car sharing option to utilise existing car space availability in cities. This could potentially reduce growth in vehicle registration and vehicle mileage provided safety and security of both drivers and riders from untoward incidents are ensured.[6] Another innovative map-based application has been developed, named "Safetipin", for informing the users on the safety index of an unfamiliar route. "Bus aggregator" is one of the innovative mobility solutions being developed, under Smart Cities Mission of the GoI.

With advancements of emerging technology applications in designing urban mobility solutions, serious security concerns have been taken care of, albeit partly, whereby every rider can link a security profile, like LinkedIn or Facebook, with verifications using company employee IDs, for instance. Adding into the user friendliness attributes, Google Inc. now plans to integrate taxi or car aggregator services on Google maps to inform and guide the traveler for alternatives beyond car, bus and metro service operations.

Even with the above advancements—however significant and encouraging—nowhere has there been a systematic attempt to forge an integrated application of emerging technologies to fill and manage transport demand and supply gaps in India.[7] The absence of integration among technology-driven solutions into classified data platforms, could negatively affect reliability and dependability of information generated, and ultimately, their utilisation across stakeholders and knowledge seekers over time as each of the systems scale up. This is unfortunate, given that there is immense potential of developing a policy framework now supported by

technology given the awareness and acceptability of government, users, service providers, policymakers and regulators, on one hand, and this intersecting with a significant degree of readiness and maturity in the technology sector.

WAY FORWARD

The disruption to present mobility management scenario, through emerging technology interventions, is proposed by way of potential personalisation of public transport services. This new mobility scenario—one of seamless integration—cannot be successful unless these digital age transportation systems are "Massively networked, User centered, Integrated, Dynamically priced and Reliant on newer models of public-private partnership."[8]

A comprehensive and strong planning support is needed to understand how this interaction will develop and thereby control the process for (1) extracting their maximum potential, and (2) minimising the negative outcomes that may arise. As research is presently underway in the West along similar lines, there is an imperative to develop a clearer understanding based on India's peculiar experiences and local needs.

With GoI's ambitious plans of taking long strides in areas of renewable energy, universal electricity access, and internet penetration—alongside globally growing market of smartphones and connected vehicle technology, data mining capabilities, and other innovations—the impact of new technologies on urban transport could be substantive. However, it will be necessary to understand how this transformation can affect existing systems in India's context, as is also being researched globally. For example, research on car-sharing systems has indicated that sharing services are popular among the young, well educated, upwardly mobile, urbanites. Consequently, more understanding is envisioned to under stand how to scale shared mobility models to other populations and land use.

Some of the relevant research topics being studied globally and also relevant in the Indian context are the following:

- How disruptive can shared mobility be? (A scenario-based evaluation of shared mobility systems implemented at large scale)
- The impact of Information Communication Technology on transport decisionmaking (A qualitative study)
- Multimodal payments convergence to delivering seamless mobility
- Integrating car-sharing into a medium-sized city's housing project
- Innovative mobility master plan: Connecting multimodal systems with smart technologies
- Do autonomous vehicles need ethics?
- Disruptive effects of demand responsive transport systems on mobility
- Sharing is daring: Societal challenges of disruptive mobility
- Creeping toward a workable urban infrastructure for robo-cars
- Transit-oriented developments: Optimised, on-Demand, and networked
- Optimising shared on-demand passenger and goods mobility

More extensive research will lead to better understanding and enable a thorough assessment of the magnitude of new-age urban mobility scenario as driven by

disruptive or emerging technology innovations. The research will then support the development of strategies and measures to satisfy the same in a most sustainable manner. It may not take long before these technologies change the very way people think, order, and experience transportation as a user, provider, regulator and manager.

The Indian government's 'Smart Cities' mission has a number of smart mobility and accessibility initiatives adopted for various cities. The proposed multi-modal integration solution would ensure pulling smaller and bigger vehicles together to enable provisioning a privatised public transport service accessible to the poorest and remotest of locations of an urban area. Safety, Security, Regulation and Private sector participation will be important areas of integration in the service and product design of new-age mobility and digital transportation solutions. The regulation of transport service providers would need to focus on the nature of service provided, for example, to differentiate between asset generator and asset aggregator, while ensuring accountability and traceability for all. Mechanisms like carpooling, taxi sharing, as well as demand aggregator services, can prove to be sustainable options from both safety and mobility perspectives, provided adequate regulations are mandated.

A brainstorming and study of practices followed elsewhere in these respects (other sectors and geographies) should be taken up for India's urban areas. For example, the Department of Transport and Communications of the Government of the Philippines has created a new category of vehicles to accommodate app-based public utility vehicles under the name of Transportation Network Vehicle Services.[9] Under the new classification, a TNC is defined as an organisation that provides pre-arranged transportation services for compensation using an internet-based technology application or a digital platform technology to connect passengers with drivers using their personal vehicles. Eligibility standards for such Transport networked vehicles to have global positioning system (GPS) tracking and navigation devices for convenient and safer services. Only sedans, Asian Utility Vehicles (AUV), Sports Utility Vehicles (SUV), vans, or other similar vehicles will be allowed. A maximum age limit of seven years will be enforced.

Similarly, the physical infrastructure requirements to fit in the physical and operational integration facilitations, telecommunication and wireless network strengthening, charging and fueling facilitations, and other infrastructure needs will require inclusion into the city development plans. New designs and functionality of parking, cycling, walking, public transit, roads, stations and junctions, may be needed. A paradigm shift towards inclusion of not only road-based modes but of rail, water and air as well, in design and provision of such technology enabled services, has become imminent. A good understanding of these and practices followed elsewhere or being researched should be looked into, studied and suitably incorporated besides developing indigenous plans and designs of such infrastructure. The Smart Cities mission could form a launching pad for emerging technological advancements in urban mobility and accessibility. Pilot in few cities can prepare means of scaling this to other cities.

The question is: Should these tasks be taken up by the Government or should it be left to the private sector, where innovations, economy and efficiency will undoubtedly have better chance to flourish? The role of Government can ideally be that of policymaker, regulator and collaborator of inter-disciplinary sectors of economy (such as industry, infrastructure, social justice, finance, human resource

development, law and security). While bringing various sectors together, strengthening of local bodies at the urban levels to work out minute details with private sector players may be needed. Ideally, the private players and entrepreneurs will design, develop, operate and provide various mobility solutions, support government agency in logistically intensive operations and management of whole battery of infrastructure, operations and services. An emerging technology-based transport service provider will require support in the form of policy and governance to enable a more conducive environment within existing urban transportation systems. There is also the need for generating healthy competition among a number of private sector transport service providers to extract the best of available technology and entrepreneurship.

The present governance setup is inadequate to handle transformation to this new mobility and digital transportation paradigm. There will be need for capacity building, skills building, and reviewing existing legal and institutional framework, especially in light of expected socio-economic upswing and technological advancements. Required brainstorming and study of best practices needs to be done in this direction. A capable policy and regulatory institutional setup can catalyse proposed system integration and operations.

Under present context global as well as national climate change goals, the future of urban transportation will become more inter-disciplinary with urban planning, social and environmental sciences, engineering, technology, user behaviour and financing and economics play respective roles in preparing a framework of overall new-age urban transport system. The challenge for policymakers is to make sure they fully understand all sides of the technologies coming forward and make their own assessments based on hard evidence and structured analyses.

And whilst the focus of this understanding will be on the next 10 to 20 years, there is a need to identify immediate and short-term actions for putting in place the building blocks linked to clear policies, standards and a clear roadmap for delivery of new-age urban transportation. To initiate the process, transportation services and infrastructure associated with disruptive technologies must be given due consideration in the national, regional and city-level planning processes. ORF

ACKNOWLEDGEMENTS

This Special Report is an outcome of a roundtable discussion on 'Urban Transportation and Disruptive Technologies' organised on 8 February 2016 in New Delhi by the Observer Research Foundation with the support of UBER. The author acknowledges the contribution of distinguished speakers and participants: Ms. Kalpana Viswanath (Cofounder Safetipin); Mr. Rachit Ranjan (Public Policy and Government Relations, UBER); Dr. Sanjay Gupta (Professor and Head, Department of Urban Planning at School of Planning and Architecture); Mr. A.K. Jain (Former Commissioner-Planning, Delhi Development Authority); Mr. B.I. Singal (Former Director General, Institute of Urban Transport);and Dr. Pawan Kumar (Town and Country Planning Organisation).

ABOUT THE AUTHOR

Ms. Nimisha Pal is a freelance consultant in the area of Traffic and Transport Planning.

ENDNOTES:

1. Ministry of Urban Development, Government of India. Final Report of Study on "Traffic and Transportation Policies and Strategies in Urban Areas in India", 2008; Ministry of Urban Development, Government of India. Final Report of Study on "Traffic and Transportation Policies and Strategies in Urban Areas in India",1998.
2. Newly emerging dimensions of shared economy is expected to grow globally from $335 billion in revenues by 2025 from present $15 billion (only 5% of global revenues). This potential growth is expected on account of five new 'sharing economy' sectors viz., Peer-to-peer finance, Online staffing, Peer-to-peer accommodation, Car Sharing and Music and Video streaming. The rapid urbanisation, climate change, resource scarcity, demographic and social changes will drive the sharing economy growth in coming years as per Price Water house Cooper study (Source: http://www.pwc.co.uk/issues/megatrends/collisions/sharingeconomy/the-sharing-economy-sizing-the-revenue-opportunity.html).
3. The Innovator's Dilemma - When new technologies cause great firms to fall; by Clayton Christensen, Harward Business Review Press, 1997.
4. Zielinski, Susan. New Mobility: The Next Generation of Sustainable Urban Transportation. The Bridge, 36 (4), 2006.
5. Shaheen, Susan. Presentation on 'Disruption in Urban Mobility', Urban Transportation Research Centre, 2015. Available from: http://www.utrc2.org/publications/presentation-disruption-urban-mobility-dr-susan-shaheen.
6. Private players in Ridesharing business are continuously improving their background support systems works for (a) restricting public access to personal information of ride user, (b) selection of drivers and vehicles to be utilised in the pool, (c) mapping and selective sharing of rider's journey and (d) working in liaison with law enforcement agencies.
7. American Public Transit Authority (APTA) has recently carried out a research study on ridesharing where potential for integrating public transit with emerging ridesharing services has been studied. Available from:http://www.apta.com/resources/hottopics/Pages/Shared-Use-Mobility.aspx.
8. Deloitte. Report on Digital Age Transportation, Available from: http://www2.deloitte.com/tr/en/pages/public-sector/articles/digital-age-transportation-article.html.
9. Department of Transportation and Communications. DOTC creates new category to usher in App-based PUVs. Republic of the Philippines. Non dated. Available from: http://dotc.gov.ph/index.php/2014-09-02-05-01-41/2014-09-03-06-43-32/125-dotc-creates-new-category-to-usher-in-app-based-puvs.

ORF OBSERVER RESEARCH FOUNDATION
Ideas • Forums • Leadership • Impact

20, Rouse Avenue Institutional Area, New Delhi - 110 002, INDIA
Ph. : +91-11-43520020, 30220020. Fax : +91-11-43520003, 23210773
E-mail: contactus@orfonline.org
Website: www.orfonline.org