

Variegated System of Mass Rapid Transit: An Innovation that Changes the “Familiar World” of Urban Transport

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Commercial initiative has yielded a revolution in service quality and cost in telecommunications and energy sectors. With such a heavy involvement of private suppliers of service in urban transport, it eludes many an expert, why it has failed so badly to meet the aspirations of customers, producers and market makers alike.

It also seems paradoxical that such disparity should exist in a sector which has such an obvious excess of demand over supply, and which has witnessed rapid advances in automobile and transportation technologies with more powerful engines and electronic and software control that are designed for super fast speeds as the vehicles exhibit in test conditions and on racing tracks. On the road though, the traffic speed in most urban areas has been dramatically similar to what existed at the times when horse and carriage was the fastest means of travel.

Urban transport falters on other counts as well. It is polluting, unsafe, costly, inaccessible and inequitable. Worse still, short term, localized improvements are often out of concert with a systemic approach towards a wider and sustainable development. Few would disagree that the need of the hour is a radical change in our deeper assumptions, beliefs and motivations that drive the current urban transport system, on the need to reinvent the wheel.

Across cities around the world the *familiar world* of urban transport presents a grim scenario. The frames may vary amongst cities, but the underlying assumptions that govern the failed *familiar world* are the same. See Box 1: The *Familiar World* of Urban Transport.

Box I: The *Familiar World* of Urban Transport

“The frames for Mumbai, for instance, bring images of cavalcade of motor vehicles caught in bumper-to-bumper traffic congestion. discomforted and vulnerable pedestrian, raging drivers, dug up roads, dusty roads, waterlogged roads; roads under perpetual repairs; roads encroached upon by vendors and slums; flyovers which are left incomplete for several years further eating up road space; overcrowded buses; long queues on bus stops along with empty seats on air conditioned cars, with rolled up windows and dented bodies. Closer still, images occur of street children knocking on the windows of the air-conditioned cars. The knocks have been getting harder on the ear together with honking cars to shoo them off and other vehicles to get off the road too. What meet the eyes (and enters the lungs) outside in the “familiar world” are vehicular fumes (dense due to poor fuel quality and localised in traffic jams).”

Pull down the frames of Mumbai and roll over London. The problem is not so severe, but bad enough to register in the minds of most Londoners – citizens and businesses – as first among the issues facing the future of the city.



“During the morning peak in Central London, Average traffic speeds (including time spent in queues) are around 16 kmph during the working day. The total number of cars and commercial vehicles (50,000 vehicles per hour) entering or crossing Central London is equivalent to that carried by 25 or more busy motorway lanes. In the rest of Inner London, traffic on main roads moves at around 19kmph during the morning and evening peak periods and at about 24kmph between these peak periods. Narrow lanes and turning roads are crammed to the brim with cars. To sit in gridlock at an intersection for ten minutes waiting for more than one change of lights before your turn comes, as many Londoners do, is indeed a harrowing experience.”

Move over to Baltimore, Detroit and Cleveland in the United States, for a country which is in the eye of a storm for its antics in the Middle East to suit its oil interests, the images are very different, but they are linked to problems elsewhere.

A recent editorial cartoon in the Baltimore Sun shows a shopper's eyes popping at the prospect of \$1.65-per-gallon gasoline, while he's lugging such groceries as \$9.87-a-gallon beer, \$48-a-gallon maple syrup, and \$4.52-a-gallon spring water. Urban sprawl, in the meanwhile, has been spreading, like some incredibly tenacious disease, paradoxically in cities that are losing population. Metropolitan Detroit lost 8 percent of its population and grew 35 percent in land area in the last twenty years. Cleveland lost 11 percent of its population and grew 38 percent in land area. There you have shrinkage and sprawl. Such unabated growth waste resources or land unnecessarily, or cause excessive traffic congestion.



Whetting a seemingly insatiable appetite for automobiles, Sport-utility vehicles (SUVs), and the category they occupy, light-duty trucks, have overtaken cars in the US marketplace. Huge eight-passenger SUVs are part of the morning commute, many with solo drivers."

Congestion is First in Our Minds, Next on the Roads

The "familiar world" negates the primary basis of a city. A city is marked by its ability to intensify good quality interaction. With such slow traffic as exist in most cities or with sprawl stretching commuting distances, they fail to serve intensive interaction. If left unchecked, the increasing constraints on existing urban transport systems could work against a city as the preferred location for companies.

Further, in a causal loop with frustration over traffic delays, stressed minds due to lack of rest and for social nurturing; road accidents and missed meetings; traffic congestion affects the quality of interaction as well as the quality of our lives. Air, water, land and noise pollution due to vehicular emission further affect us as they creekily creep into our body and mind through various channels. Direct and indirect, internal and external, individually and collectively, we continue to pay a heavy price of holding on to these assumptions.

One, such assumption is that *vehicles are owned and self-driven, as the most favored mode of transportation in a city*. Buses and trains do not match the comfort and convenience of door-to-door travel carried out in a private vehicle, even though in many cases private vehicles are slower and definitely lots more costly than public transport alternatives. Private vehicles are self-driven as many vehicle owners cannot afford a chauffeur even if they would prefer to. Many others do not wish to depend on a chauffeur. Yet, on a closer look, this assumption leads to a host of problems.

As traffic gets slower and the distances get longer (as people are forced to sprawl to suburbs also as downtowns get congested), the driving times are longer and frustratingly slow. Time for which, people are incapacitated to perform other tasks. Many people are not good drivers or do not like to drive at times, but have no option. The situation is not remotely as rosy as fancy advertisements pushed on to the customer through multiple channels - on the television, in newspapers and magazines that the customer and their peers read and subcutaneously through commercial cinema- showed. Unsuspected and without help, they are captive to their own assumptions.

Whither convenience?

Many of these assumptions are linked to each other. They become enmeshed in the inscrutable complexities of urban transport to become a belief. The *convenience accorded to owned vehicles* is one such belief. One aspect of this convenience is that *the vehicle owner can command the vehicle at their desired speed*, without stoppages of a transit service where the passenger has no control over the speed at which they travel.

The belief is true only so long as the number of vehicles owned is less than the carriage capacity of roads for an optimal traffic speed. Every extra vehicle causes inconvenience to everyone else including itself. Like in the parable of the boiling frog, congestion creeps up gradually for people to sit back and notice. When they do, drivers are conditioned to look at others as causing the congestion and view themselves as victims. Any vehicle that enters a radius around their vehicle is treated as an intrusion and a threat.

This further worsens traffic congestion. Raged drivers try frequent overtakes to reach their destination faster. As many others do the same, everyone moves slower than if they followed traffic discipline. This increases the probability of a collision, which, if it happens further aggravates congestion by blocking a lane, till the time it is towed away.

In these conditions, the convenience of owned vehicle becomes a myth. The reality is that every one would be much better off if the empty seats on all the vehicles were filled up and vehicles with a higher seating capacity to space occupied on the road prevailed. Thus, with fewer vehicles on the road carrying the same traveler population, everyone will be able to move at the optimal speed.

What and who safeguards them? What happens when we learn about them and change these mental models? Let us expose the invalidity of these models that severely affect our daily lives and endanger the future of our children.

In a scenario when one individual owns a vehicle, numerous questions arise over experiments to fill up empty seats such as carpooling. How do owner-drivers find people traveling the same route at common times? How do they get compensated? At what rate do passengers pay? How much do passengers pay for a fraction of the trip? What if a passenger is absent on day/days? What if the owner-driver changes their travel plan?

To break this gridlock of juxtaposed objectives, we need to apply new knowledge and technologies in areas of "on the road" psychology, transportation data collection methodologies, wireless technologies, in-vehicle electronics and software; GIS, GPS, large scale database management, faster processing times, etc.

Based on our knowledge of these enabling technologies, many of these problems begin to dissolve. A new assumption emerges which invalidates our previous assumption of *convenience accorded to owned vehicles*:

Most people in a city are better off if they access vehicles rather than own them. The undistorted economics of owning a car in a city at their full cost is closer to owning private jets, or private island resorts, than of buying a hamburger or a mobile phone.

What Urban Transport users really demand?

It is possible with the application of knowledge in these areas to reduce the number of vehicles on the road and at the same time significantly reduce waiting and stoppage time associated with buses and carpools. A deeper insight into the travel experience desired by most users yields the following constellation of features that urban transport users really want.

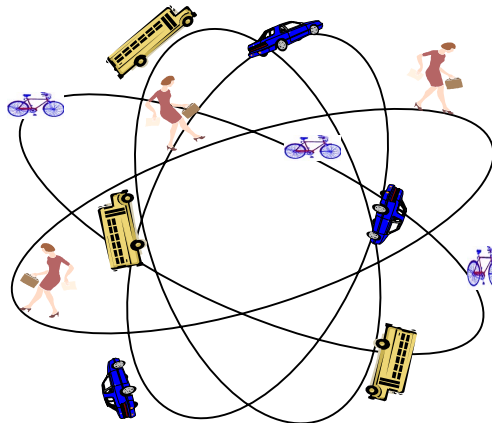
- They want:
 - Faster travel with a guaranteed door-to-door travel time;
 - Seating comfort and ambience – vehicle model, noise, leg space, air-conditioning etc.

- Choice to travel with a group of favorite co-passengers or single;
 - Choice to drive (with navigation support for the best route to your destination); or
 - Avail of hands free comfort and flexibility to make a phone call, connect to the internet, video conference/chat, listen to music or play video games;
 - Greater road safety with fewer vehicles driven by proficient drivers;
 - Choice from a variety of service plans that are designed to closely meet user demand.
- They do not want:
- The inconvenience of finding a parking place;
 - The trouble to take your vehicle to the fuelling station; for repair, maintenance and hire another when the private vehicle is not in service
 - The high cost of owning and running a vehicle

In the following section we describe a new system that is designed based on the real needs and expectations of urban transport users. Through clear and consistent communication, it navigates quite a few mindbends and crosses several other hurdles set up by entrenched practices and vested interests, in a journey to fulfill our dreams of healthy and sustainable urban transport for all.

VSMaRT – System Architecture

VSMaRT stands for Variegated System of Mass Rapid Transit. The key proposition of VSMaRT is that it provides the comfort and convenience that closely matches (and even betters on certain counts) that of private vehicles and at the same time matches the economy and efficiency of conventional mass rapid transit systems. It offers “variegated” value plans of price-level of service composites that are designed to closely match real user needs and expectations.



For instance, door-to door travel time with the VSMaRT service is significantly lower than what exists today. This is achieved by a combination of measures based on a keen understanding of user needs. Table 1 shows Service quality comparisons of VSMaRT with

the most popular preference in the existing system i.e. privately owned vehicle. Table 2 shows the overall positive effect of VSMaRT on the automobile manufacturing industry. The components of VSMaRT are as follows:

A. Classification of Road Network

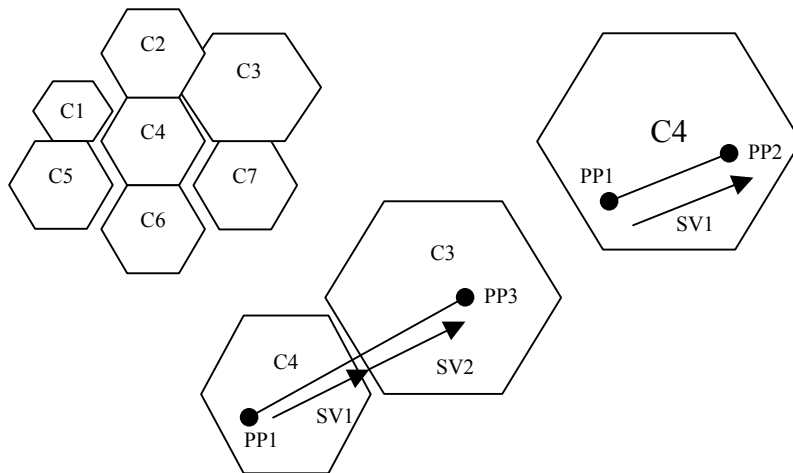
Footpath – Access to pedestrians only

Streets – Access to pedestrian, bicycles, semi-motorised rickshaws, electric/solar vehicles; Speed Limit – 15 kmph

Dual Roads – Access to motorised vehicles, bicycles, semi-motorised rickshaws, electric/solar vehicles, pedestrian crossings; Dual Roads are will be converted to ExpressRoads or to Streets in phases. Speed Limit – 35 kmph

Express Roads – Access to motorised vehicles only (except 2-wheelers), pedestrian crossover through Road Over Bridges; Elevator facility for people who are unable to climb stairs – physical/ health reasons, bicyclists; Construction of walls or fences will reduce problems with trespassers; Speed Limit - 70 kmph

The entire city region is divided into honeycomb cells. The area of the cell varies with density of residential and commercial establishments and is bounded by the road network.



B. Classification of Vehicles

Light Vehicles: 3-4-seater Electric/Solar/Gear and Pedaled/ vehicles, bicycle. These vehicles adhere to zero emission standards. Their other design feature is that they cause minimum discomfort to walking. LVs ply on Streets and Dual Roads.

Heavy Vehicles: HVs ply on the *ExpressRoads*. These are vehicles with seating capacities of 4 (2seats x 2 rows, 12 (3 seats x 4 rows and 40 (4 seats x 10 rows). These are low to zero polluting motorized vehicles (running on Fuel Cell, CNG or HSD), suited for long distance travel. Different classes of HVs correspond to various Value Plans.

Current bus design is not user friendly (particularly for anyone who has difficulty climbing stairs) and does not facilitate speedy entry and exit because of having a high floor body built on a truck chassis. They have single entry and exit points. These add to delays at bus stops.

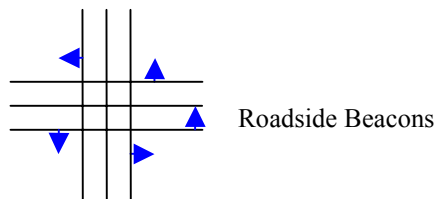
HVs are designed for ease of getting in and out of vehicle with multiple doors for entry and exit. In the LDT service, HVs have none or very few stops. They move from one Mobilitaire to another.

Unlike existing buses, these vehicles are lighter and have lower height as illustrated in the figure below. These vehicles have comfortable seats and leg space.

C. In-Vehicle Electronics and Software System

Components - Accelerometer, electronic compass, short range communication, GPS, long range communication, display panel that meet the following functional requirements:

Dynamic Traffic Routing: At the start of the journey, the In-Vehicle Unit receives a navigation applet for the entire trip. The display occurs on a dashboard monitor as the Lane position, Target Speed and the Direction that the vehicle should follow. The *Target Speed* is continuously recalculated to find a green signal at the approaching junction. *Roadside Beacons* are located at exit to all junctions (see figure below).



If the actual speed of the vehicle deviates from a Target Speed Range, it triggers a message to the *Area Traffic Control Station*.

In the event of an incident- vehicle breakdown, accident – the navigation applet is revised for all vehicles approaching the point of incidence.

Driver Proficiency Rating – Closer adherence to the navigation plan – lane, target speed and direction – is rewarded with higher a higher DPR. All deviations are recorded in the IVU and the log report is sent to the ATCS at the end of the trip.

D. Service Infrastructure

VSMaRT Information Center – Issue and service VSMaRT Membership Card; Facilitate Reservation through phone, internet, mobile, VSMaRT kiosks

Mobilitaire: Station for Heavy Vehicles, Fuel/Repair/Maintenance Service Center, Transit Warehouse. These are located at the edge or the junction of two or three cells.

Pick-up Point: Station for Light Vehicles, VSMaRT kiosk

Area Traffic Control Station: Central display of all vehicles, Driver Proficiency Rating data processing, navigation applet dispatch, traffic signal synchronization, incident management

E. Advanced Traveler Information System:

Users call up or send an SMS to a VSMaRT Call Center number. Or they log on to their webpage on the VSMaRT network through a PC or a public kiosk. Once connected, they specify their destination (Cell and LV Parking Point) and time of travel. They receive a message that confirms their booking and states the Mobilitaire/Vehicle/Seat that they are to board. Cancellations are charged.

Short trips (<3-4 kms) are within a cell or to adjoining cells. They are conducted by walk or by LVs.

Long Trips (>3-4 kms) happen between two Mobilitaires with no stops at a high Value Plan to very few stops for lower plans. LTs are thus broken up into a Short Trip from the origin point to the assigned Mobilitaire and to the destination point from the destination Mobilitaire.

F. Payment Options

Users subscribe to various Value Plans offered with VSMaRT Membership Cards– *Platinum, Gold, Silver, and Economy.*

Users have option to use a prepaid card or post-pay. A monthly bill is generated and dispatched to members. Options to pay by Cheque or electronic payment through VSMaRT Card are available. Visitors to the city use prepaid cards. The balance upon completion of their stay is refunded. Travel charges include Road User Charging. Fare varies with the nature of trips as follows.

1. Routine Trips are made at a specified time to a specified destination. e.g. Work/School trips. Season tickets are issued for these trips on a discount. On day/s when the user does not make this trip, they can claim refund if they inform the system in advance.

2. Non-routine, advance notification: User get a discount on the Fare, the earlier the system is notified. If the trip is not time dependant, the user can specify a time range for the trip to get the best deal.

3. Emergency Trips – trips which need to be undertaken immediately to the nearest (travel time) destination – e.g. medical emergency

Comparative Assessment of Alternative Mobility Options

Table 1: Quality of Service

Cost/Service Quality for Users	Private Vehicle	VSMaRT
Traffic Speed	√√	√√√√
Effective Cost of Ownership/ Access for User	xxxxx	x
Fuel cost	xxxxx	xx
Repair & Maintenance burden on Individual	xxxxx	xx
Insurance Cost	xxxxx	x
Accessibility	√√√√	√√√
Parking Cost	xxxxx	x
Traffic Speed	√√	√√√√
Driving Stress (Road Rage)	xxxxx	x

Hands Free Time	√	√√√√√
Suitability of Vehicle to Travel Need	√	√√√√√
Effect on Traffic Congestion	xxxxxx	x
Effect on Air Pollution Level	xxxxxx	x
Effect on Road Accidents	xxxxxx	x
Travel Options	√	√√√√√
Total Traveler Experience	√√√	√√√√√

Table 2: Supply Side Impact

Vehicle manufacturers sell ownership of vehicles through dealers to individual users. Vehicle manufacturers also collaborate with finance companies to finance the purchase of these vehicles by individual users.

In the VSMaRT model they choose to shift from their existing revenue model to earning revenue on every kilometer that the vehicle is accessed as a share of the farebox.

Vehicle Manufacturer	Existing Model	VSMaRT Model
Standardization	√	√√√√√
Recyclability	√	√√√√√
Replacement Rate	√	√√√√√
Product Design Error Cost	xxxxxx	x
New Technology Absorption	√√√	√√√√√
Distribution Cost	Very high	Low
Credit Cost	xxxxxx	x
Vehicle Sales Price	High	√√√√√
Volume of Cars sold	√√√√√	√√

Conclusion

VSMaRT – A Future of Urban Transport

At present travel choice is largely defined as the choice amongst alternative modes of travel such as private vehicle, public transport and intermediate public transport e.g. taxis.

VSMaRT redefines *choice* as amongst “variegated” value plans of price-level of service composites that are packaged to closely match or exceed customer expectations. Compared with the level of service available at current price levels, VSMaRT is bound to delight the users. The opportunity lies in all urban areas that are still steeped in the “familiar world”.

It challenges the familiar world of the automobile. It downplays the importance of the automobile as a prestigious possession to merely a means to a complete travel experience. It proposes that vehicle ownership to reflect their *full cost* at current and forecast demand levels. At the same time, it facilitates a smooth changeover of a large majority from being vehicle owners to VSMaRT users.

Equally important, the VSMaRT model is consciously designed to minimize externalities such as pollution - air, water, land and noise, congestion, accidents, visual intrusion and ecosystem fragmentation and to pay for irreducible externalities.