Introduction To Multimodal Urban Transportation System
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Lecture - 42
Urban Transport & Sustainability: Push Measures Cases

Welcome back friends. In the previous lecture, we introduced you to the concept of travel demand management and looked at two sets of classifications of travel demand management. One is push measures and one is pull measures. In this class, we will now look give you an in depth understanding of once one of those sets of measures which are called the push measures, which are the push measures.

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So we will look at four specific types of push measures, which are congestion pricing, parking pricing, vehicular restrictions and traffic calming. We will give you an idea of what those are and also give you the theory behind how these policies, how these measures can reduce congestion.

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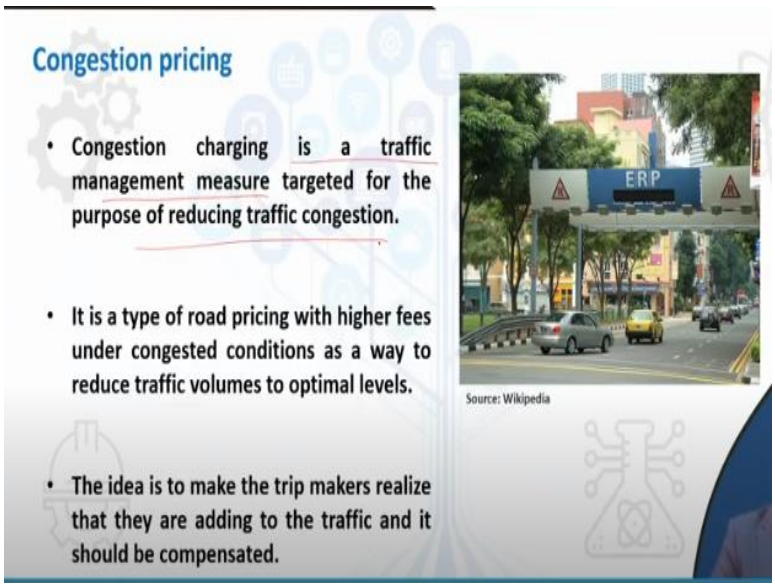

So what is congestion pricing? Congestion pricing is a traffic management measure targeted to for propose of reducing traffic congestion. So what it does is it has been used in various cities across the world. Singapore was one of the cities that have that had implemented congestion pricing in the late 70s, I believe.

So they what it essentially tells tells you is that, if you are to travel on a on a stretch of road during the peak period, you have to pay toll to use that facility. The essential part is that it tells you that the road is already congested and you are still choosing to use that road. So look at it in that in this point of view that if a glass is already full with water and you are trying to add some more water to it, it is bound to overflow.

So what it is the same effect a new car will have to a system where if it is trying to enter a system that is already congested. So by pricing what by adding a price to that what we are trying to achieve is that this price will act as a deterrent for this car and say that okay, now that this road is already congested, and I have to pay this much amount of money, I will no longer use my car to travel on this stretch of road.

People usually if there is a good transport network, then people try to use different roads, but usually the other roads are also made their utilities are their disutility is increased, so that people do not divert using their private cars to other state networks, but rather they either shift their travel time to a different time period or they shift their mode to a different sustainable transportation mode, okay.

So this again, there are different forms of congestion pricing, the best form is that this price should be dynamic in nature. So as congestion increases, the congestion cost also increases. Some of the cities the easiest form is to just have a flat price on on congestion. So whenever you enter the CBD in the peak period, you have to pay a flat price. So it can be a flat pricing, if you use a facility to access the CBD.

And that facility is getting congested dynamically, the price also might change. So there are different ways of adopting congestion pricing, but the basic theory behind it is that you as a car driver, if you are entering a facility which is already congested, then you have to pay this additional fee, which is the congestion price and that congestion price should act as a deterrent for you to not use that facility. So that is essentially what congestion pricing means.

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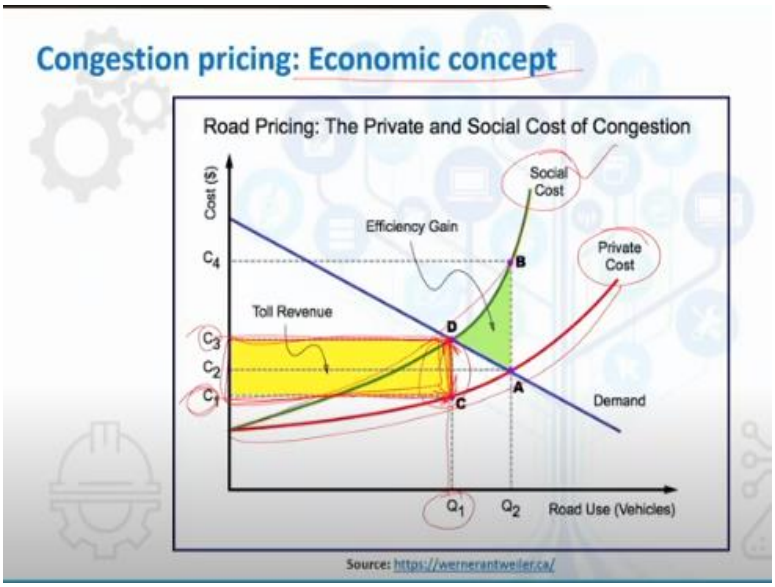

If you look at it from the economic concept, you would see that if you know the supply and demand curves, you would see that uh if if this the red is the supply curve, what essentially you are saying is that at any level of road use and so if there are this much volume of vehicles on the road, everybody seems to be paying this much amount of price for using that road.

It is not told yet so what is the price that you are paying for using the road? It is maybe just the out of pocket cost of your petrol price right. So as road as road usage increases that price increases, because it is getting congested, so your fuel efficiency

is going down. So you are burning more and more fuel to use the same facility, right. So that is what usually happens.

However, there is another curve, which is not just your cost, but it is a social cost right. So if you are driving you are not you think that you are paying that trip is costing you this much amount of money, but to the society, it is costing you this much amount, it is costing the society as a whole that much amount of money. So what is this cost to the society? Maybe you are polluting on the road right.

So environmental cost is a cost to the society. Maybe you are getting into accidents that is a cost to society right. So these are all social costs of your travel on a facility. So what congestion pricing does is it this difference in the cost is what it charges as a toll. So this is the toll revenue this in yellow is essentially the toll revenue that you can generate, if you price if you take this much amount of toll from the people who are using the road.

So this is essentially what in economic terms congestion pricing means through the supply and demand strategy or through the supply and demand curves, you can think of it in this term. So you can visualize this in these terms. So this is the toll that agencies usually charge for using that facility which is the difference between the costs that you incur as a private person while driving the car versus the cost that society incurs while you drive as a private vehicle.

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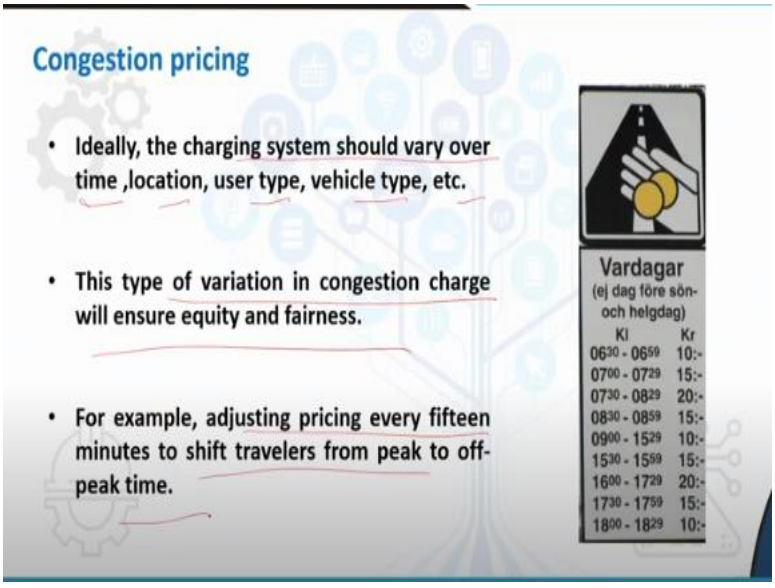

Ideally, charging systems should vary over time, location, user type, vehicle type, etc., right. You should not be charging congestion pricing to a bus for example, right. That is that is not your intent. Because your intent is to attract people to the bus, so that the space, road space gets cleared up. So vehicles also, different vehicle categories can have different congestion pricing.

If you are a person who is using your private vehicle, but you have two other people sitting with you in your private vehicle. So essentially what you are doing is you are carpooling now. So in the case of carpooling then, your congestion pricing may be different, maybe also zero. So you may be able to use that facility, but you do not pay a charge right now. You are still using your vehicle but because you are carpooling, you have two people, two more people sitting with you.

So you do not pay any charge. Maybe if you are a motorcycle user, then the congestion pricing charged for you would be less because motorcycle uses lesser space on the road as compared to a four wheeler, right. So ideally, this is how congestion pricing should be implemented. Usually what people or what agencies do is because it is very difficult to monitor how many people are within a car.

Now you have to have sophisticated ITS systems in order to implement these. So what usually agencies start out doing is just having a flat rate for any type of private vehicle. So you say that, if you use your car or two wheeler that has a license registration plate which is private, then you would be charged a flat amount of money for say maybe a kilometer or 10 rupees per kilometer could be a flat congestion pricing charge.

So people start out or agency start out with such flat prices, then they start experimenting with it getting more sophisticated instruments, devices and then the dynamic pricing starts okay. So congestion, type of variation in congestion charge will ensure equity and fairness. So you are not charging everybody the same amount of money. Adjusting pricing every 15 minutes, so that is called dynamic pricing like we said.

Congestion may be the peak hour may be from 8am to 10am, where you are charging a congestion price. But between 8:30 and 8:45, maybe the peak within the peak, right. So that is the time maybe when your congestion pricing is the highest. So any people anybody who wants to enter into the system at 8:45 am would pay the highest price, as opposed to anybody who has already entered the system at 8am.

Because at that time congestion has just started and he or she has already used the system so they will be using it at a lower cost, right. So as opposed to anybody who is traveling at 7am, he does not incur a congestion pricing cost because there is no congestion on the street. So it has to be dynamic in that sense that when there is no congestion, when there is free flow on your roads, you do not you do not charge anybody, even the private vehicle owner is not charged.

Whereas when congestion starts building up, that is when you start charging. So that could be the dynamic pricing. Sometimes agencies who are firm believers of TDM, they no matter no matter which time of which time of the day, they would always charge some amount of money for private vehicle use along certain facilities, for example.

Even during uncongested hours, although the price will be very less, but they would still charge it so that they try to bring about a behavioral change saying that any time of the day, you want to get out using your private vehicle, you have to pay this charge. There is a huge debate, of course, that we are already paying taxes on our petrol.

So why do we have to pay this additional cess which is essential and additional tax as congestion pricing, but the entire idea of this price is to not penalize you, but change your behavior by bringing in this bringing in this charge or this cess, okay..

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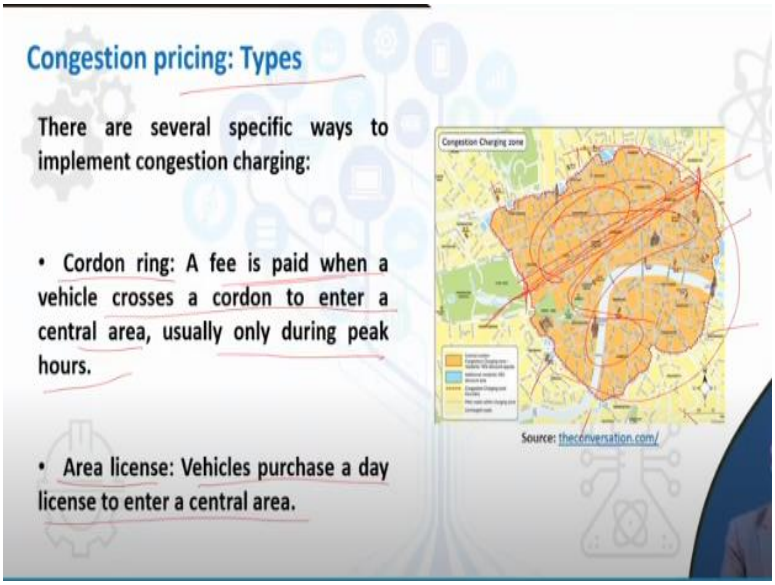

Then there are different types and ways in which you can set up your congestion pricing. There could be a cordon ring method, where you say that a fee is paid when a vehicle crosses a cordon to enter a central area, usually only during peak hours. So you can have a cordon like this. And if there are four or five streets that enter into this cordon that any vehicle that is entering that cordon, pays a fee.

So that is kind of a CBD area, if you may think of it, and any vehicle entering would pay the fee. So that is a cordon ring method of congestion pricing. Then there are area licenses that can be issued. Vehicles purchase a day license to enter a central area. So it does not matter how long you enter into that area, you just pay a day pass. So you get, you pay this fee, you enter into this area, and then you are traveling around as much as you as you can throughout the day.

And then you come out, you do not have to pay any more. In cordon ring what happens is that you are charged for, a fee is paid when a vehicle crosses the cordon, right. So you are crossing it here, and again you are crossing it there. So you are crossing the cordon at two different times. And based on what is the difference in this time, you are charged. So if you are there for a long period of time, you will there will be a longer charge, a higher charge.

If you are there for a shorter period of time there will be a shorter charge. So that is the difference between a cordon and an area type area license congestion charge, which is just a flat rate.

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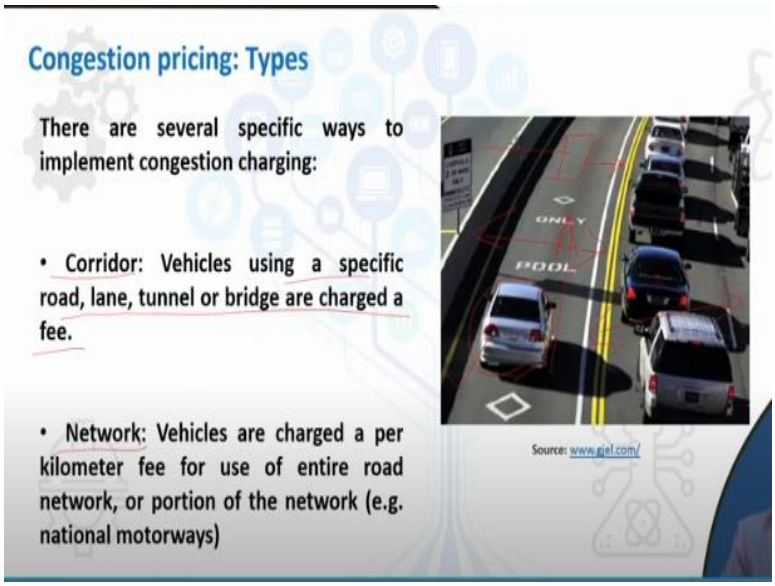

It could be a corridor level charge, right. Vehicles using a specific road, lane, tunnel, bridge are charged a fee. So you would see that many, many of the toll roads in India for example, are are charged or you pay a fee for using that facility, right? They are being built in a PPP method where it is no longer free to use. For example, all of the other the older national highways and the state highways, if you could imagine we would have never paid a fee to use it.

But nowadays, all the roads you are paying. So the road is a facility, for its use, you are paying a fee. Then there could be other means that are used in different cities in the US, which says that even in the urban area, there could be only one lane that is that is a congestion charged lane. These other lanes could be could be free lanes. So what usually is the intent is that if you want to use this lane, you have to pay a fee.

There are usually lot of ITS devices that are put overhead that check for how many who which are the cars that are using this. If it is a private vehicle for example, you see this is a private vehicle that is using this lane. That means there has to be at least two or three people inside that inside that car. That means they are carpooling and hence if they are carpooling, they can use this lane for free.

Otherwise, if this it was a private vehicle, with only one person who is using that lane, they have to be charged heavily. So people are many agencies use these differently. They either set up a lane based or corridor based tolling system. They either set up a

cordon based tolling system, area type tolling system, you can you can do whichever way you want in your in your urban area. You can even have a network wide tolling system, if you would like that.

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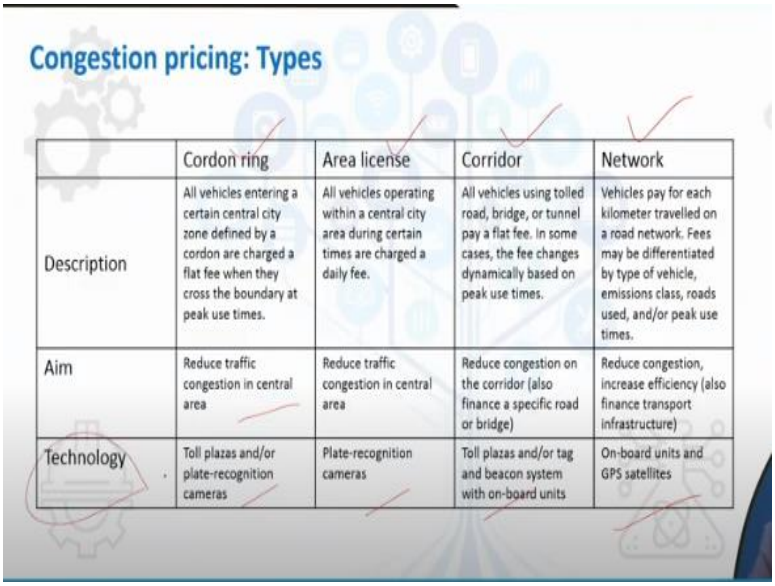

So you can compare all these. This is a nice table that has been developed to compare these different types of congestion pricing schemes. What are their aims and what technologies have to be put in place, right? Now you cannot, you have to enforce these things. Unless you enforce it, people are going to violate it and then nobody, the benefits are not going to be met.

So enforcing means, you can either have manual enforcing by having a lot of police along that corridor or in that stretch, but also having a lot of technology, taking the use of technology, taking the help of technology to monitor. So this gives you an idea of what are the different technologies that are involved.

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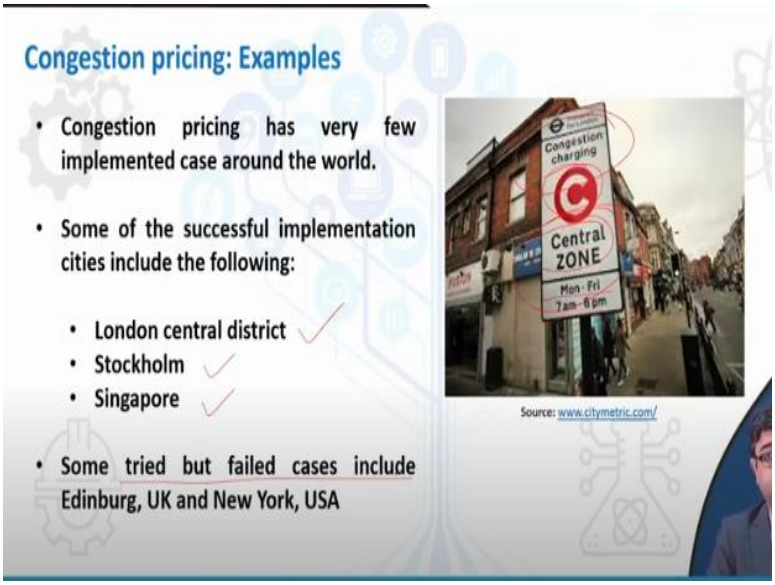

This is an example of the London's central district or Stockholm or Singapore, which has implemented a successful congestion pricing in their central zones for example. So you see there will be boards like that, which tells you that if anytime, from Monday to Friday between 7am to 6pm if you enter what is called a central zone, which is indicated by this circle C, then you have to be paying a price.

And this price is automatically charged using this transponders that are on your cars and now that we are getting those fast tag fast tags in our cars. So imagine that everybody has that fast tag and there is a transponder, overhead transponder receiver that catches the signal from this transponder in your vehicle. So that the toll automatically gets deducted.

So that is the type of system that is being followed in some of the cities successfully. But at the same time, there are some cities that have failed in implementing congestion pricing in their in their areas due to several reasons, most prominent of which is public opposition to this especially where a lot of people use private vehicles and are habituated now to using their private vehicles in such areas to bring about this behavioral change is very, very tough.

So unless again you have to have a very good public transportation network. You have to have people who are ready to or willing to change their behavior and move to public transportation system. That is when congestion pricing is going to be successful in your area.

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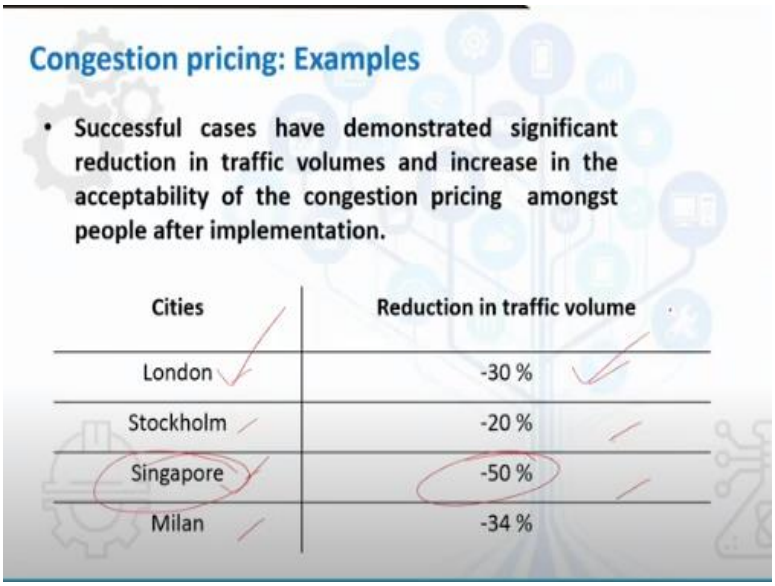

But wherever there it has been successful, it has actually seen reduction in traffic volumes. So for example, here you would see Singapore is because they have had this in place for the longest time in the world, any of the cities in the world, among any of the cities in the world, it has seen a lot of almost 50% reduction in traffic volume on those streets, right. So there is a valid good reasons good benefits in applying congestion pricing.

You cannot say that congestion pricing is an extra tax on us, extra burden on us and it deters our free will of using our private vehicle, right. Many people look at it in that way saying that our free will is being is being choked by these congestion prices. It is not it is not that at all. When you think about Singapore, people are thriving, their businesses are thriving.

It is not like anybody has been pushed towards this corner by congestion pricing or anything like that. London is of course one of the wealthiest cities in the country in the world. So even they have implemented congestion pricing and seen benefits out of it.

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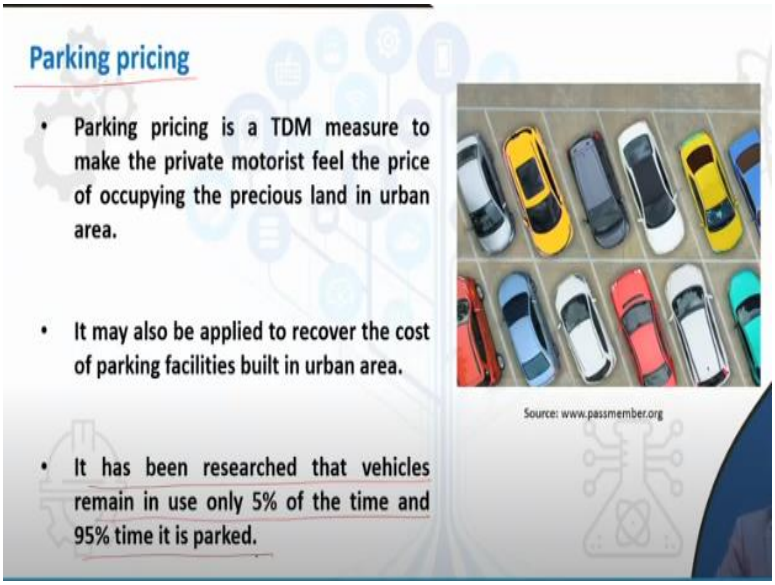

So but however, it is a behavioral change, it takes time. The other means of bringing about travel demand management is parking pricing. Similar to congestion pricing, which is which may be a larger area wide measure, congestion parking pricing is not providing free parking. This is currently in the urban areas providing free parking to four wheelers is one of the biggest crimes if you may, if you may think about in that in that sense.

Because price of land is very high in the central business districts and if that piece of land is given for free for a vehicle to just park it is it is almost criminal offense. So people are beginning to not give any free parking. They may subsidize the parking and put the charge in something else, hide it in some other charge, which usually is not encouraged either. Because then public does not pay out of pocket.

Unless public pays out of pocket, they do not realize the effect that the use of private vehicle is having. So if you if you mask it under some other charge, and say that parking is free, okay I will not charge you for parking. But if you come to my movie theater, the ticket cost for the movie is going to go up by 15 rupees.

So that is kind of masking your price of parking, which people then do not realize is realize it as much as if you just say that okay, if you come in to my movie theater and want to come in your four wheeler and park it here, you have to pay 50 rupees for parking or something like that. So people are no longer or agencies are no longer willing to provide free parking.

And by increasing and by increasing the pricing of parking, they are deterring people from using private vehicles. It has been researched that vehicles remain in use only 5% of the time and 95% of time it is parked, right. 95% of the time it is parked. It is either parked at your home, it is either parked in the office. So most of the time during the day it is parked and if this parking is free, especially when it is out of your home, then it does not deter you from using your vehicle.

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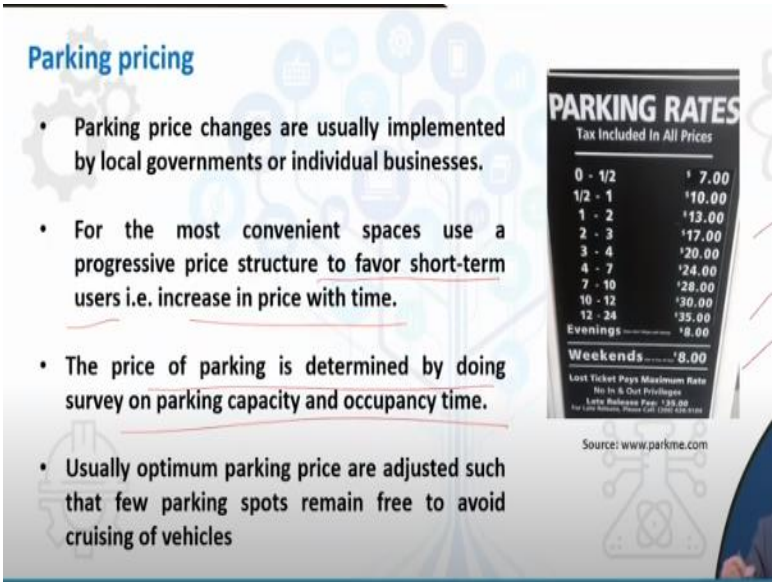

So parking pricing are usually implemented various ways. It could be the structure should be in favor, could be in favor of short term users increasing price with time. So it could be it need not be a flat rate. It could be you could say that if you park here for the first 15 minutes, we will give you free. But suddenly if you keep on keep you add your if you keep your vehicle here for any more than 15 minutes, 15 to 30 minutes we will charge you this much.

30 to 1 hour we will charge this much. So it could be time incremental parking pricing. It could be that you could say that if you come here and park early in the morning at 7am. So that means you are avoiding the rush hour and you are coming before the rush hour, then I will charge you a lower parking price parking price. Whereas if you come here and park during the rush hour, then your parking charge would go up

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So there are different ways of determining what the price of parking should be. The price of parking is determined by doing surveys of parking capacity and occupancy time. Occupancy time meaning how much time a car occupies a space. And not only a car, but any number of cars that occupies that space.

So it could be based on that. And you typically see such parking charts or parking boards or parking costs that are implemented or that are shown outside a parking garage, for example..

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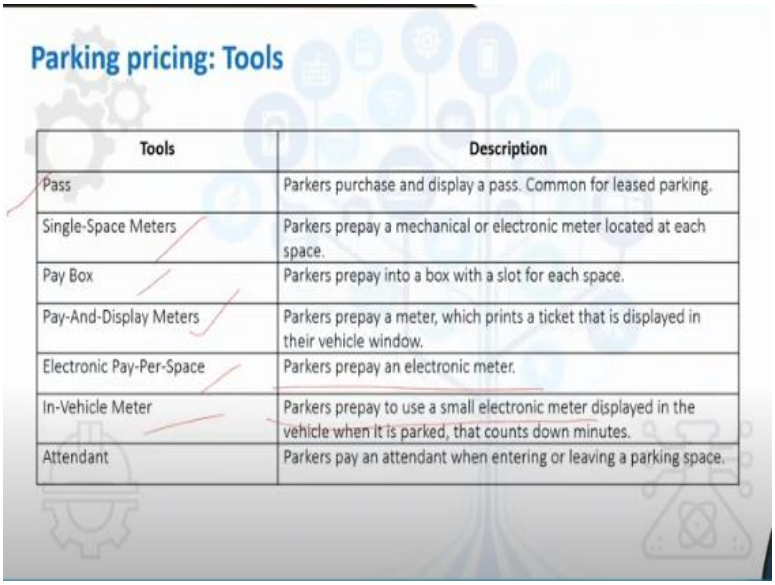

Different tools could be used. You could buy a pass. You could pay for parking for a monthly parking charge for example, that is a pass. You could have single metered parking right. On street parking is something that is usually metered nowadays in most of the Western countries or cities in the Western countries, where you there is a there is a meter. You put in some coins, and it shows you that this much amount of time you can park at that spot, which is on the street.

And this is obviously has to be monitored. So there are different police personnel who keep on constantly monitoring this. Pay-And-Display meters. They are all similar to these things. Electronic paper space. Again, in-vehicle meter. Some of them, some parkers prepay to a small electronic meter displayed in the vehicle when it is parked that count down the minutes.

So there could be different now there are different apps that have come out that show you where available parking spots are and what are their prices. So you can pick and choose maybe another street or two streets down the line down the road from your office space the parking price is less so maybe you go down two streets and and walk down to your office from there.

So you could do many of those things. Obviously the manual way to have is to have an attendant take parking from you.

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These are some pictures. So these are the meters that I have been talking about. And these are the in-vehicle meters that could be put in your vehicle, which will tell you give you a countdown of when your parking time is up. Usually these they have for such types of parking meters, they have slots to put in coins here.

And for this vehicle that is parked along it, along with it, when the driver gets off and puts the coins in this meter, he or she knows that okay, I can park here for 30 minutes, and I have put in only 30, I have put in only two rupees or four rupees or whatever it is.

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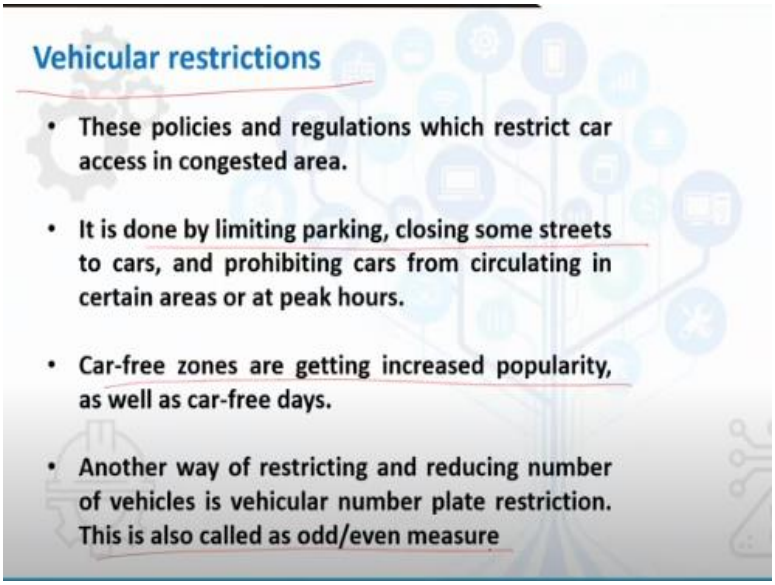

So that is what these meters allow you to do. The other type of push strategy that you can have is vehicular restrictions. You can completely restrict certain types of vehicles from certain areas during certain times of the day. For example, you could some of the cities have tried to restrict motorized vehicles during weekends from 4pm to 6pm, for example.

Or 4pm to 8pm on a Saturday evening for example in order to open up that area for completely for non-motorized traffic. All the streets and cafes in those central business districts are open, they thrive, there is no pollution. So people can walk around and use their bicycle and so on and so forth.

So that is those are those are also some strategies that again, by doing that what is happening is you are bringing in trying to bring in a behavioral change. Remember, in the back of your mind that TDM strategies in a sense, are first trying to bring in the fundamental change in your travel behavior. So there could be car free zones, which are becoming some of the cities are increasingly promoting these, right.

It is done by limiting parking, right. Sometimes you just say that no parking is available or do not provide any parking. So you will see that even metro stations in central business districts will not have any parking available at the metro stations. So it avoids vehicular parking altogether.

Even we in India have tried this in Delhi, where we have tried to restrict vehicles by having the odd and even rule saying that only odd numbered license plate vehicles can get out on one day and even numbered can get out on another day. So those are also vehicular restrictions in a sense, right. Some of them may have restrictions to entry of heavy vehicles in certain areas or during certain periods of time, right.

For example, Kolkata does not allow heavy trucks to enter during the evening peak or morning peak hours from outside the city limits. So any trucks that are trying to enter into Kolkata have to wait for evening peak or morning peak to be over before they are let inside. So they are mostly let inside during the nighttime

So you would see many of the highways choked with trucks that are waiting to enter Kolkata during the evening, late evening and night times, because heavy vehicles are restricted. So those are again vehicular restrictions or type of vehicular restrictions that you can put in, right?

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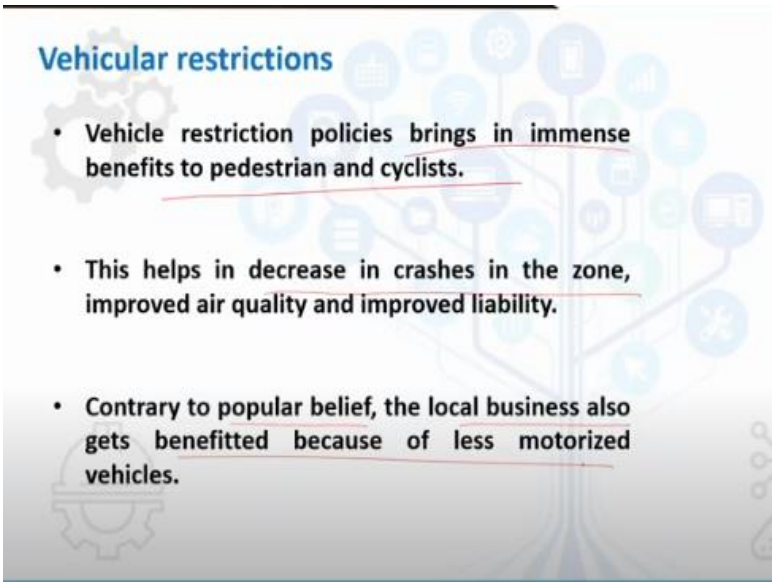

This bring in immense benefits to pedestrian and cyclists. For example, like I said, on weekends, if you close it down to vehicles, you can go in there using your different NMT modes. It helps decrease in the crashes in that zone. So suddenly you make vehicle, an area vehicle free. Then there are no more vehicular accidents that take place. And it helps improving, it helps in the improvement of safety.

It brings about safer environment. And contrary to popular belief, the local businesses also get benefited. So people first were apprehensive that if you do not allow cars and private vehicles to come, what happens to the local business there. Who will come and use our business. But when you saw that, when it was seen that this was well implemented if it was implemented properly and implemented regularly, you saw that people did come.

It maybe it was different type of people but they did come there and the businesses were not affected. People came there, they bought whatever they had to buy. They purchased whatever they had to purchase. They ate whatever they had to eat. So there was no impact, financial impact on the businesses for closing down vehicular traffic during the weekends.

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Like I said, for example, New York City that famous downtown Manhattan area Time Square was experimented has experimented with having car free days. They have had tremendous success as well.

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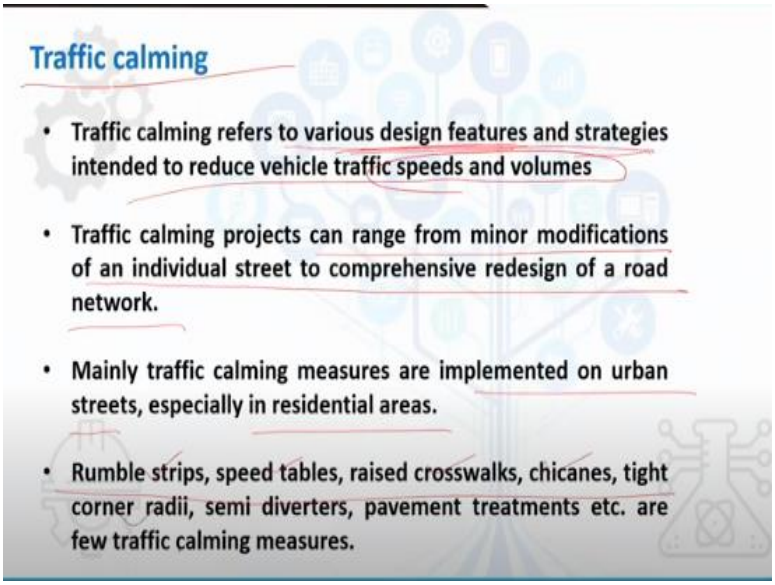

And the last means of achieving a TDM strategy which is a very localized way of doing it is what is called traffic calming. So this is a more engineering oriented method of bringing about reduction in the number of vehicles or especially in the speed of vehicles. So the philosophy the theory behind it is if you make it difficult for vehicles to travel on a certain street by adopting certain traffic calming measures, then this the motorized vehicles will not have the benefit of going fast, going fast.

And if they do not have that benefit of moving fast, then they would think that well, if I, if I cannot go fast using my motorized vehicle, what is the use. Let me just go in a public in a public transport which is going to take the same amount of time maybe or maybe just let me use my bicycle which is going to take same amount of time. So that is the entire philosophy behind traffic calming.

So what it does essentially is various design features and strategies intended to reduce traffic volume, traffic speeds and volumes, right. By reducing traffic speeds, they are trying to bring about a change or reduction in the traffic volume. So these are some design features. So there are some engineering features that are involved. And also obviously, some strategies.

They can range from minor modifications of an individual street or comprehensive redesign of the road network. You could do it at any scale you want to do it. If you want to do it only for your neighborhood you can do it for that or if you want to do it

for the entire network of streets in your area you can do that as well. Implemented are primarily implemented on urban streets especially in residential areas.

Some of the some of the design elements that are included are rumble strips, speed tables, raised crosswalks, chicanes, tight corner radii, semi diameters, pavement treatments, etc. So you will see how what we are talking about.

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So suddenly if you have, say this is a neighborhood street, which are which is now paved by paver blocks or say bricks, some type of bricks rather than your asphalt or concrete. So what happens is now, that gives you the ride of the vehicle is not that smooth, it gives you a bumpy ride. And in addition to it now you put your rumble strips here.

So rumble strips are nothing but speed hump is usually one at a time and the rumble strips are multiple strips at a time, they have been seen to achieve greater reduction in speed than a single speed bump. So these rumble strips also allow the speed of the vehicle to reduce in in addition to some pavement treatments, like either you treat the pavement in this fashion or use different materials for small residential streets, right.

So this is a residential area, it is not a heavy traffic volume area. So in order to discourage people from using their motorized two wheelers for every purpose within the residential area, this type of traffic calming devices are used. Here also you see this road otherwise was a very straight road where vehicles could have gone very fast.

But by having what are called chicanes, what they have been done, what they have done to the street is that they have made the street a little bit windy now. So the street is a little bit windy now. Once it becomes windy in that way, you cannot drive fast, right. You cannot drive fast, your traffic is calmed or your traffic is slowed down. And maybe by slowing down the traffic the benefit that motorized vehicles usually have of going fast is reduced.

And then they start to think that well if it is the same amount of time that is going to take me by driving versus it is going to take me by bicycling, then why do not I just bicycle because that is a cheaper way of going. So people bring about a, there is a change in the mode from a unsustainable to a sustainable mode. So that again is a TDM strategy of of bringing about behavioral change and a shift in modes.

This is another one making the radius tight. So increasing, the corner radius so that cars cannot just whiz past or take a sharp right turn or left turn, but now they have to negotiate this turn very slowly. And hence that brings about a reduction in speed at intersections. Especially at intersections this is very, very important.

Now this is also extending the curb, so people who are pedestrians who are trying to cross this road can come all the way out to this portion and wait for the traffic. So even when people vehicle see that pedestrians are waiting here, they also tend to slow down the speed of their vehicles.

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So that brings us to the end of this lecture series. I hope you have now got a good idea of what are some of the push measures that can be implemented in achieving in order to achieve travel demand management. Again, the textbooks and the references are the same as before. So please read through them.

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In conclusion, what we have seen in this lecture is that congestion pricing and different types of congestion pricing, especially the push measures, what is parking pricing? How do we how do we achieve TDM through parking pricing. How do we achieve TDM through vehicular restrictions and finally, the concept of traffic calming and how that can bring about a reduction in the volume of motorized vehicles, Thank you for your attention.