Introduction To Multimodal Urban Transportation System
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Lecture - 41
Urban Transport & Sustainability: Travel Demand Management (TDM) Overview

Welcome back friends. Now from today onwards, we are going to begin our last module for this class. And we will now look at the module called sustainability and transportation, so urban transport and sustainability. Now that we have given you an idea of each of the different sustainable modes, such as pedestrian, bicycle and public transportation, how to design them, how to plan for them, how to determine their efficiency, how to measure their performance.

So we have given you an idea about each of these modes. And from today onwards, we were going to put all of this together and see how they create an environment or how they create a sustainable urban transport.

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Beginning today in the first lecture, we are going to give you the concept and understanding of travel demand management which is very central to the idea of transport or urban transport sustainability. We will give approaches how to deal with traffic congestion under TDM policies. We will see the different classifications of

TDM measures. And we will look at some benefits and challenges of the supply side as well as the demand side approach.

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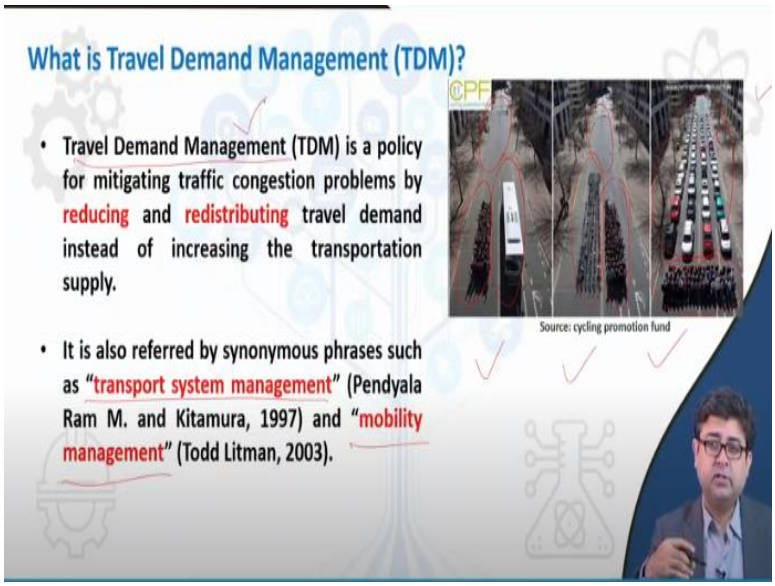

So what is travel demand management? There are no standard definitions as such, but you can pick up the key words in various definitions that are available to you. Overall, you can say that TDM or travel demand management is a policy for mitigating traffic congestion problems by reducing and redistributing travel demand instead of increasing the transportation supply.

So what essentially it says that, if one of your roads or one of your corridors are congested, just do not think only about widening that road and adding another lane will solve the congestion problem. You have to look at working with the existing road space itself and see how you can reduce and redistribute the traffic on that road. Maybe you can redistribute it temporarily.

So you can reduce the peak hours, you can distribute the peak hours. Maybe you can redistribute it according to modes. Maybe there are too many people who are using who are using private modes. Maybe you can redistribute them into public transportation mode.

So this is a very famous picture that you might have definitely seen earlier, where it shows that the amount of space that is needed to move different vehicles versus the amount of space that is needed to move the people that are in the vehicles. In the

extreme right most case, you would see that for the same amount of people, so for example, say there are 40 people there, they need 40 cars to move.

So if you are everybody is using one car to move, so that much amount of space, road space is needed. Whereas if those 40, same 40 people are now moving in bicycles, so you see that they would need only that much amount of space. Versus if you now see that those same 40 people are moving in one bus, then the amount of space that is required by the bus is that much.

So if you are everybody is using one car to move, so that much amount of space, road space is needed. Whereas if those 40, same 40 people are now moving in bicycles, so you see that they would need only that much amount of space. Versus if you now see that those same 40 people are moving in one bus, then the amount of space that is required by the bus is that much.

Let us look at the demand side. Let us look at trying to reduce the demand or redistribute the demand and in that manner, try to solve the congestion issue. So that is the entire concept of travel demand management. It sometimes is also called transportation system management or mobility management. So there are different phrases that is used. But a TDM is the most popular phrase or concept or that is used for to explain this phenomenon.

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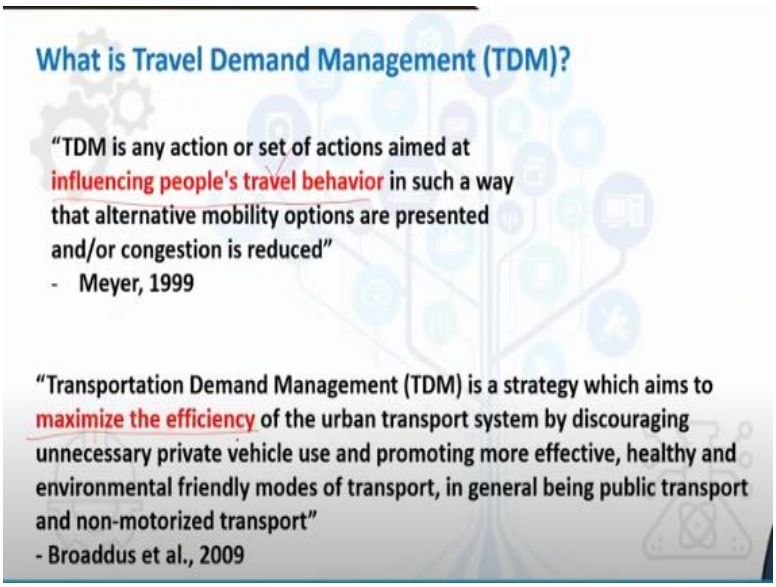

So again, what TDM does is influences people's travel behavior. So since it is a very behavioral, it looks at influencing people's behavior, and you would understand that somebody's behavior is not very easy to change. So it takes time. So essentially, what ends up happening is people do not see the immediate impact of a TDM measure. Hence they sometimes tend to be agitated saying that well, we are not seeing any impact of this measure that we have implemented.

So let us go ahead and widen the road anyways. So then they go back quickly to providing more supply or providing more capacity or providing more supply essentially. And that usually again does not solve the problem in the long run. And we will see why that does not or why it happens. So since travel behavior, we are dealing with people's behavior TDM measures do take some time to bear results.

Also it tries to maximize the efficiency of the system. So it says that we already have a system or network in place, let us try to manage it or use it more efficiently rather than provide more space or more network rather than increasing the network. Increase the network is only one solution. And that may be a solution that is needed. But that should not be the first solution that should be tried.

That is the entire policy or entire mindset that policymakers, urban transport policymakers are going through or using. They are saying that yes, widening of a road is one of the tools to reduce congestion, but it is not the first tool. It may be the last tool that we would use if any of these demand side measures do not work out. So that is the entire philosophy.

So you see these I have highlighted the phrase the most important phrases in red, most important terms or key phrases in red. So that all of those things give you an idea about what exactly travel demand management is trying to achieve.

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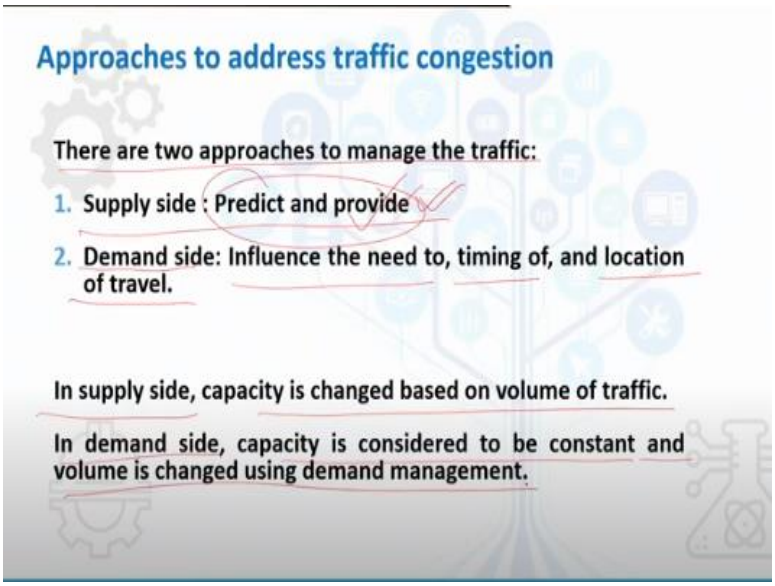

Usually, like we said, there are two approaches to managing traffic. The most common and the historically most used is the supply side approach, which is to predict how many uh vehicles would be using a facility and then provide that facility. So we do a forecasting. We do travel demand forecasting and says that and say that this road will carry n amount of vehicles in the year 2025.

And immediately, we think in terms of vehicles meaning private vehicles. So we say that okay, so accommodate to accommodate so many private vehicles, we would need to provide a two lane road or a three lane road and we go ahead and provide that. However, what demand side says is that it has to influence the need to travel. It influences the timing of travel and it influences the location of travel.

If we try to tackle these three aspects of travel, then we may not be able to we would most likely be not needing to provide for newer roads, we would be making more efficient use of existing roads, okay. So in a nutshell, the supply side capacity is changed based on the volume of traffic, whereas when we are looking at the demand side solutions, capacity is considered to be constant.

We are not changing capacity, road capacity remains the same and the volume is changed due to demand management. And we will give you some examples of how this can be achieved.

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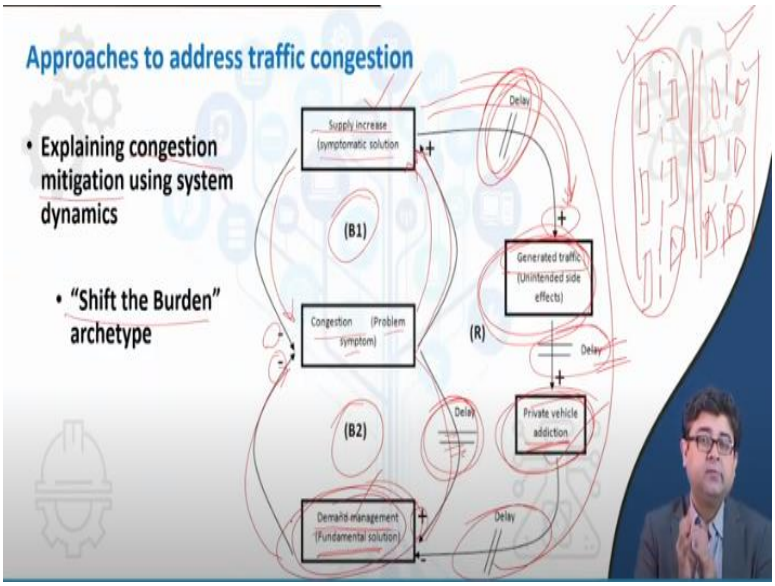

So if you look at the congestion and mitigation dynamics. So what you can see how supply side works and how demand side works, and why essentially people go towards the supply side and not go towards demand side, but demand side may be the more fundamental solution right. So what we do is we call this shifting the burden.

So what we say is immediately when we see that there is congestion happening on on a road, so that is the problem symptom. We see that oh well it is getting problematic, now we have congestion. However, we in our mind know that there may be two solutions to it, B1 or B2. The first solution may be increasing supply and the second solution may be look at demand management.

We know in our mind and both of those we know are going to reduce condition right. So negative sign meaning it will reduce condition, we know both of that. But in our mind, we also know that demand management strategies will have a delay. That means it will take some time to show the results. It will take some time to show the results. There will be positive results, but it will take some time to show the results.

So there will be some delay. So what we essentially tend to do is, we essentially go towards the supplies, increasing supply side solution, which is a symptomatic solution. So that gives you instant results. So suddenly, you have a two lane road, one up one down. And you make it a four lane road. Suddenly you see wow, there is the traffic has reduced. Everybody is applauding.

Well, that was a very good measure. But what happens is that over a period of time right, again, there is some delay to this phenomenon. Over a period of time, what happens is, after you increase the supply, there is what is called generated traffic or induced traffic. What induced traffic usually means is that, if you look at a road and think of it in terms of spaces right, maybe there was only this side of the road that was available.

So it was a two lane road. And these are all the roads, all the vehicles that were moving on the road. Now suddenly you have a median and you have built another two lanes. So this has become one way two lane. And this has become suddenly a another lane, right? So what you your intention was what? Your intention was to reduce this congestion. And you were thinking that these six vehicles would now get redistributed in these four lanes, right?

But what essentially starts happening is it is not just these six vehicles that get redistributed. There are other vehicles now that think that well now there is so much space available, so much capacity available, why don't I also utilize this space? So in other words, you as a user, you as a potential traveler, who was maybe using public transportation when this was the case, right?

I was using public transportation, you now suddenly see that the road has widened up. And there is and you can easily go, easily access your destination by using your car because there is so much space that has opened up. Now what you think is, why should I go in a congested bus? Where I do not get a seat, every day I have to stand. Whereas here are all these people who are using their private cars.

And they can now use this road which is new and widened. And they can just whizz past me. So why do I not do the same. So what happens is it induces new traffic. Now you are not only so this is not induced traffic, this is shift of traffic from our modal shift, from one mode to the other. So now you will be shifting from public transportation to private transportation.

But in addition to that induced traffic is what happens is when a person because of congestion earlier, would not have taken up a trip that he or she wanted to. So he

would have been thinking that well, the road is so congested. So in the morning rush hour, I will not use the road now to go to the doctors. I will take an appointment in the off peak time, maybe at 12pm, I will take the appointment.

At that time the roads will be emptier. So that is what he or she was thinking. But now that this road has widen, widened and opened up, he or she is now suddenly thinking well, now I can even go at 9am for a non-work trip. And let me just take my private vehicle and go. So a new trip has now been induced because of this widening of the road.

So what researchers and in practical cases everybody has noticed in the field of urban transportation is that when you give a supply increase when you do or when you have an increase in supply over a period of time, this road also fills up. So then you have congestion all over again. So the very problem that you were trying to solve is no longer solved.

And you have you are back to square one with the congestion issue. In addition to that, what happens is after another certain amount of time, you now have an addiction to private vehicle. Now you are already, your behavior has changed. That is why right there is a delay. So over a period of time you build behavior, right. Now you have all this time to build this behavior of moving towards private transportation.

After this, now you are addicted to private transportation. So these are all psychological aspects that are studied in human behavior or user behavior and travel behavior, right? You are talking about behavior now. So a little bit different from pure engineering or pure planning. Now we are talking about behavior. So what happens is you get addicted to the, to the private vehicle.

And that causes a delay in usually implementing demand management strategies which we have already seen, tries to influence your travel behavior. So these are trying to influence your travel behavior. Now your travel behavior has completely changed and it has been addicted to private vehicles and to bring to change your behavior back to a public transportation use or other sustainable transportation use becomes even more difficult.

So this is the entire shift of burden archetype that people use when they are talking about travel demand management and say that if you do not implement travel demand management, although it will give you some, take some time to show results, but that is the more fundamental solution.

If you take the symptomatic solution, then you will be in a loop where you will not solve the symptom and even it will become difficult for you to implement the fundamental solutions because now your behavior has completely changed, you are addicted to it. So this is the entire concept of why we should not always look at just the supply side. We have to study the demand side from now onwards.

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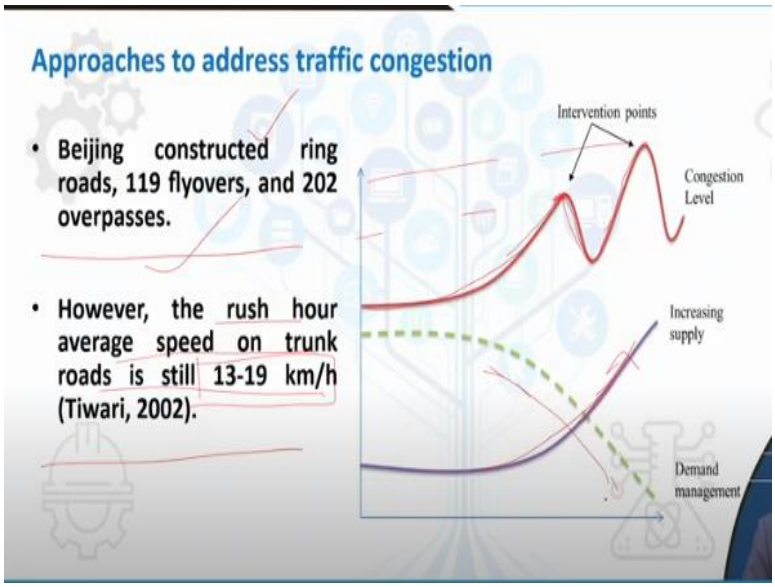

There are lots of practical examples that have been noticed. So Beijing in China, they started constructing ring roads, flyovers, and lots of overpasses and you will see these are the common supply side increases in urban areas, right. If the if you see a problem in an intersection, what you are suddenly thinking of is to build a flyover right.

If you see that there are lot of through traffic that is going through your city, what you suddenly think of is a ring road around your city, so that people try to go through, they cannot take this ring road and avoid the city. So all of these are capacity increases. But despite of doing all that, the rush hour average speed on the trunk roads is still 13 to 19 kilometers per hour.

So congestion has not eased, travel speed has not increased, travel time has not decreased. In spite of so many capacity, so much of capacity increase. So what essentially happens is if you keep on increasing the supply side, say this is your uh volume of traffic that is increasing and you have seen that at this point there is too much congestion happening and you add some more capacity to it.

What happens is suddenly your congestion reduces because that is the symptomatic solution. You will get immediate results. So your congestion release decreases and you are happy. But over a period of time the new capacity also starts getting filled up and what actually happens is a new congestion level is created which is higher than this congestion level right.

Now you have higher peak, because now you have not not only have a two lane congested road now you have suddenly have a four lane congested road. So the congestion is now peaking, if you only keep on increasing supply. Whereas you have to look at demand management measures, which will help you reduce the demand of travel. So that is what essentially a purely supply side solution makes you do.

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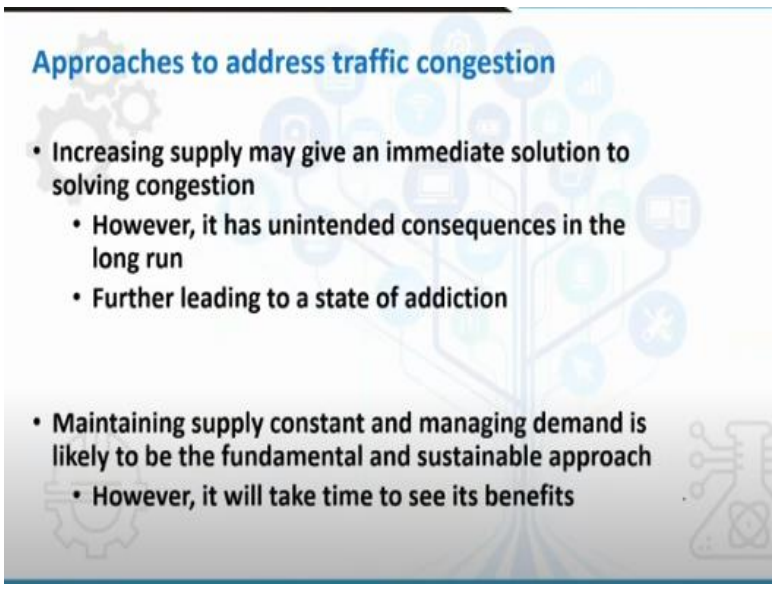

This is what we have just talked about.

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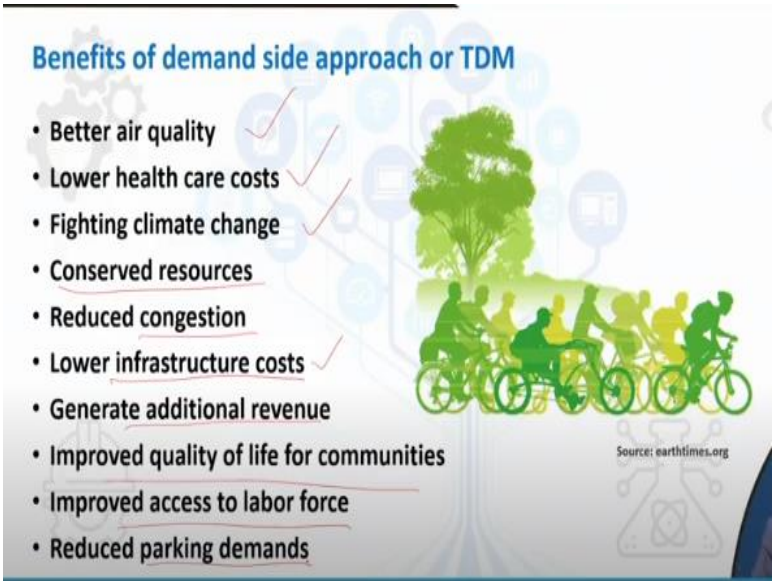

So people have then went ahead and measured the impacts of having such demand side approaches. What they have seen is that demand side approaches do end up in having in providing better air quality. They have seen that there are lower health cost associated with people once they shift towards more sustainable modes of transportation, which is the demand side approach.

Now that we are in in a soup with the climate change, and transportation modes like you know are one of the worst offenders in terms of increasing the temperature of the surface. So if you shift from your motorized modes to non-motorized or public transportation that reduces the energy consumption and helps in climate change.

Obviously, it helps it helps to conserve resources because now you are using much fewer nonrenewable sources of energy. Reduced congestion, we showed you that. Lower infrastructure costs. Now you are not building these expensive flyovers or expensive ring roads. Rather you are improving the demand side of it. So it results in lower infrastructure costs. Generates additional revenue.

So you will see that you can providing a toll road for example is a demand management strategy. So if you now start tolling your urban roads, what happens is it is a source of revenue as well and it also lowers traffic congestion.

And all of that put together it improves the quality of life of the communities, improved access to the labor force now, all of whom who are trying to go to work,

they are they have better access to work because they can, congestion is lower and they can access more workspaces and also reduces parking demand because you are no longer using your private vehicles.

So expensive parking structures, which are on lands that are prime lands in the central business district could be now redeveloped into better sustainable land uses or lucrative land uses as well. So these are different benefits that people have measured, when they have implemented one or the any other or different types of travel demand management strategies in their urban areas.

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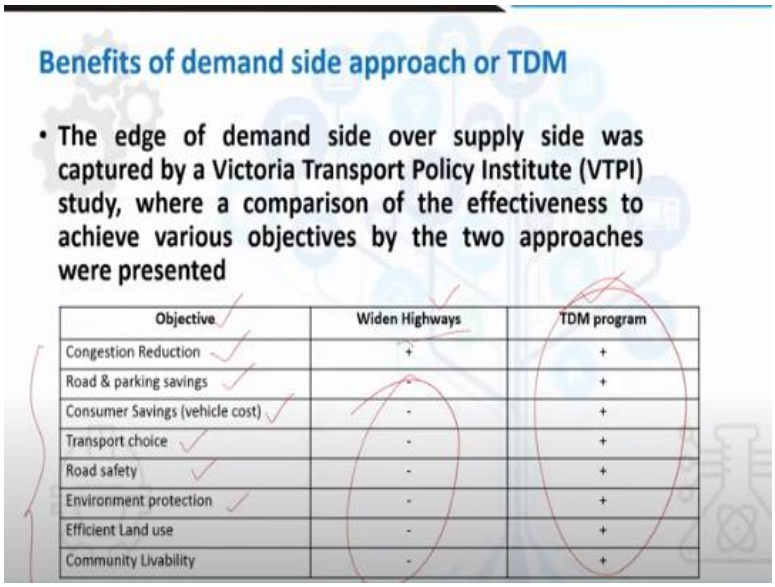

They have also compared what different objectives. Usually the objectives of improving any urban transportation facility or to reduce congestion to save road and parking costs or to reduce to provide consumer savings. So these are usually the objectives. With any intervention with any solution in an urban area, we want to achieve these.

We want to provide better choice, we want to improve the safety, we want environmental protection. But what happens is if we compare between the supply side and the demand side strategies, you would see that most of these objectives are usually fulfilled by the demand side strategies and not very many are fulfilled by just by the expansion of highways.

One of them yes, congestion reduction does happen by widening the highways and we saw that. But in the long term even that is not feasible or viable.

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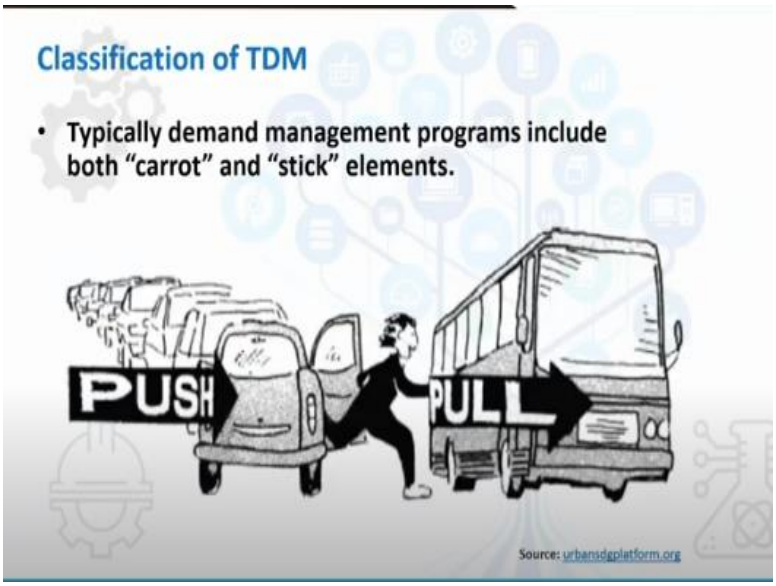

So what many times people define or classify TDM in two different uh in two different measures. They see they see they call one measure as pull measure and they call the other measure as a push measure. So what is this pull measure and push measure, we will give you an idea of.

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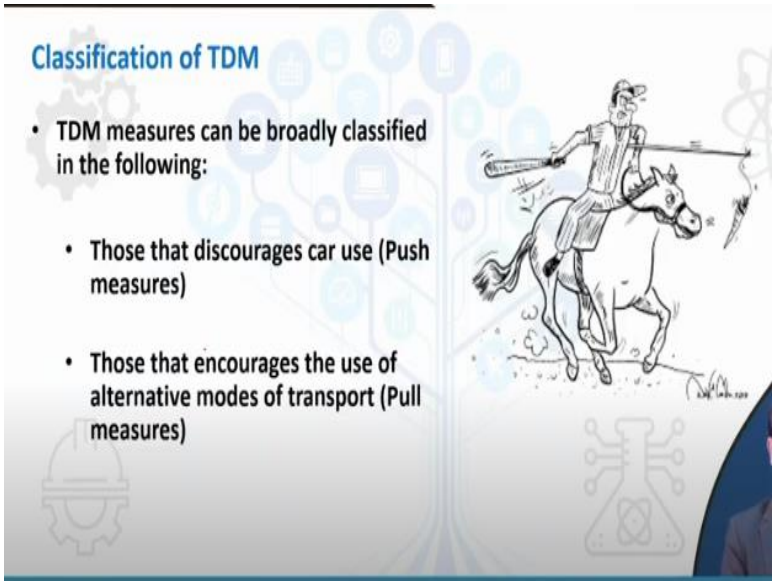

A push measure usually a push measure usually what it does is it pushes you out of your private transport mode. So by implementing that policy, remember these are all policy measures that have to be implemented. In an in an area wide policy, it may be a

particular part of the city or it may be a citywide policy, or it may be agency wide policy also like your office may have a certain policy of carpooling, for example.

If you come, if you use carpooling to come to your office, you get certain rebates or something like that. So those are those are all these are all policies at whatever scale they are implemented. So push policy is something that will encourage you to not to not use your private vehicle or it will push you out of your private vehicle, right. Whereas a pull measure is something at the same time, it will attract you to a more sustainable form of transport.

So these two measures together, together or individually, can help in managing the demand of travel in your urban area. So you can either have a push measure, or you can have a pull measure. We will also tell you that people are also thinking more and more research is now looking at having the push and the pull measure together to have a larger impact on reducing congestion.

But traditionally what many of the cities have done is they have implemented one or the other. So they have said that well, I will push you out of the car by, for example, one of the measures could be by increasing parking prices, right? Suddenly you make parking price go up. What people start thinking is well, why should I pay so much for parking, I will just take public transportation, and hence I can avoid the parking cost.

So that is a push measure. But at the same time, a pull measure should be that you are providing better standards or better quality of public transportation. If you do not have this pull measure what usually happens is there are not enough people that get pushed out of their cars. They will see that well in the car I had so much comfort, maybe the extra parking that is being charged, I can pay that now to get this comfort.

So suddenly, comfort comes into play. But if you now provide that same comfort that he or she had in his car by improving the quality of service of your public transportation, which is a pull measure, then there would be more and more people who would be willing to be pushed out of their cars or willing to keep their cars at home and use this public transportation measure.

So that essentially, sometimes people call it the carrot and stick method the push and pull or the carrot and stick method. So but essentially you get the point, right. You should not be pushed out of your cars and not provided an alternative or better alternative than that. If you are not given a better alternative better pull measure, then you are less likely to be pushed out and you continue with your old behavior. So you those are push and pull measures.

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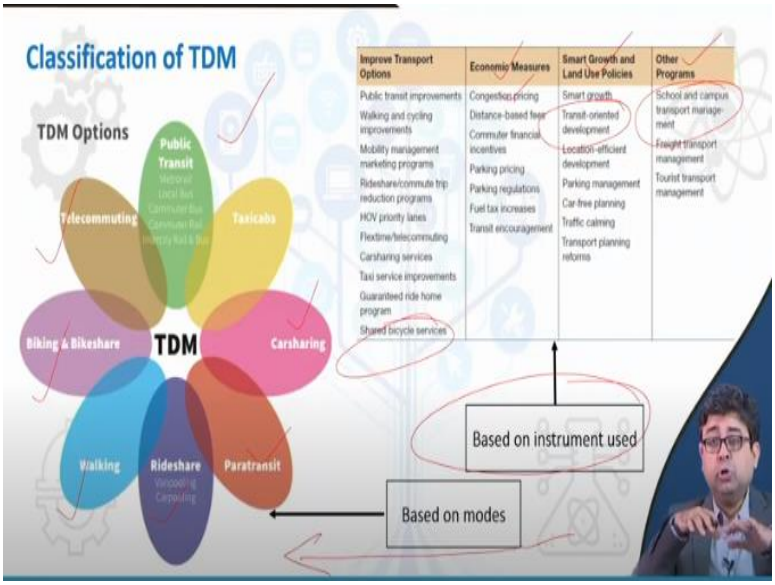

So what are the different classifications of TDM apart from push and pull? You can, these TDM methods can be either mode based. So you see a car sharing, paratransit, ride sharing, so all these all Ola, Uber shares. Ola, Uber shares are you are very good TDM strategy. Ola, Uber by itself is not the best TDM strategy, but they still are better than using your private vehicle.

In some cases, we are finding out it is not so good. But overall, Ola Share or Uber Pool, they are a better TDM strategy to implement. Walking, bicycle sharing. So many of the cities now you see that are implementing public bicycle sharing. So those are all strategies, pull strategies, right? So they are attracting people to now leave their private vehicles and come use bicycles that are available for you to take you there.

Telecommuting is a huge TDM measure where you totally avoid traveling to your work and just work from home. So there is a less vehicle on the road. And more the fewer the vehicles on the road, the fewer is the congestion. So that is a and since we

are recording this class in during the COVID-19 pandemic, and you are seeing the effect of this pandemic on the congestion levels on the streets.

Everybody is working from home or telecommuting, hence you have no congestion. So although we are now being forced to do that, but think of a situation where you have you have incentives to do that, right. Even though you have the option to go to work, but you have you are incentivized to telecommute from your home. So if you have such incentives, then you may choose, will willfully you may choose to work from home.

Whereas under the pandemic situations, you are not willfully doing it. Most likely because you are being forced to sit at home, which is the safe thing to do under these pandemics. But the situation is different when under normal situations, under normal conditions if you were to look at it, right. So these are different TDM options mode wise. TDM can be classified based on the instrument that is being used as well.

So there could be economic measures such as congestion pricing could be a TDM measure. Smart growth or land use policies. ToD transit oriented development is a TDM measure. Other programs could be school and campus transport management. So all these pool cars that takes students to their schools, those could be a TDM strategy that could be applied versus every parent taking their child using their private vehicle to the school, which is an unsustainable solution for school children.

Shared bicycle services we have already looked at. So you can look at it look at TDM strategies from the point of view of modes, you can look at it packaged into different types of instruments.

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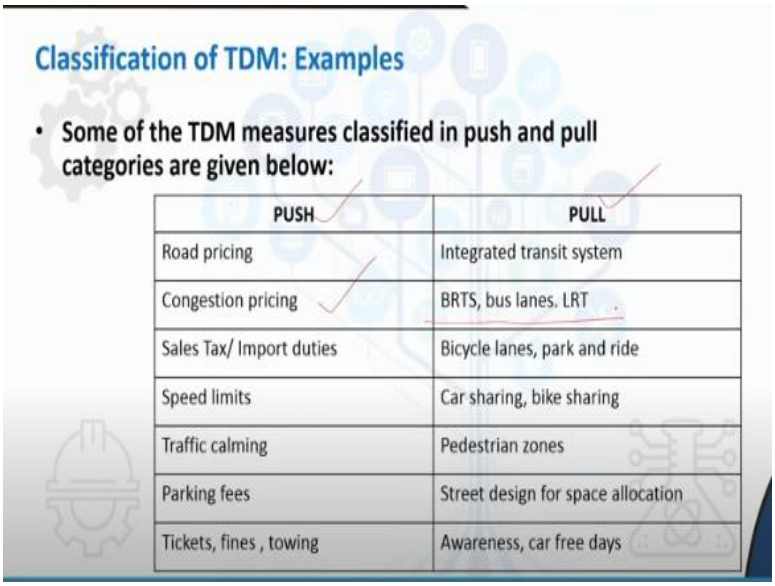

And you can definitely now, hopefully classify, which is a push and a pull. So if you are asked that is congestion pricing a push measure or a pull measure? So first we will tell you what congestion pricing is, of course, but then if you if anybody asks you, you should be able to understand if you are asked congestion pricing is a push or a pull, we should have you should think in your mind that is it attracting people to different mode or is it pushing people out from your existing mode?

So in that way, if you think you can, you can classify them. It is usually a push measure, congestion pricing is a push measure, whereas implementing of a metro, right? Why are metros being implemented in in many of Indian cities and many of the cities worldwide? Because it is a huge pull measure. It is attracting people towards public transportation, right. It is a huge pull measure.

So those are implementing of such BRTS or any kind of rapid transit system. They are all pull measures. So you can now classify them into these categories.

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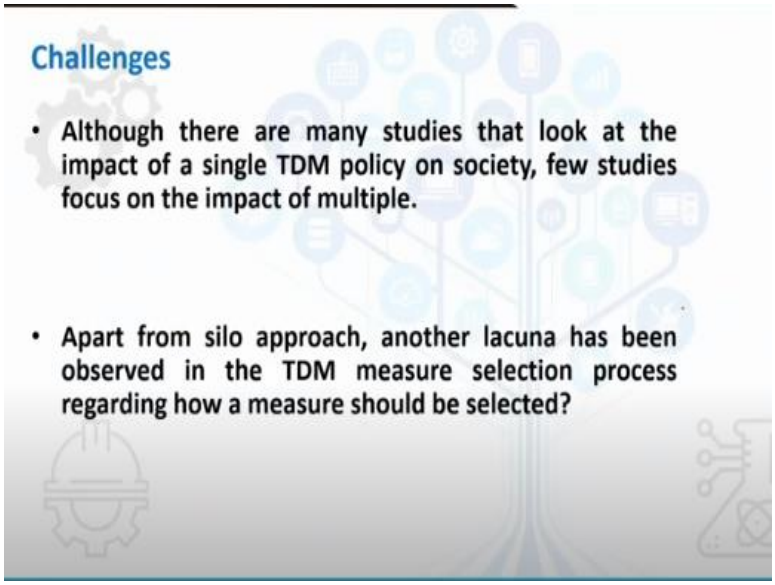

Challenges. Of course, there are challenges in TDM. One of the biggest challenge is because it is a behavioral change. Because it needs behavioral change. So it needs time to show results. And that makes it a challenge for many of the policymakers because the policymakers also want solutions which are inevitably tied to their for example, election cycles or whatever they may be.

So people want quick solutions to these problems and hence, many a times, demand management strategies do not work or are not implemented the right way. And hence, supply side solutions are often implemented or often prioritized over TDM strategies. And that is the biggest challenge that we are facing.

However, more and more people are now getting convinced or more and more policymakers are getting convinced that TDM is the way to go because there is just lack of space in the urban area to widen any roads. And since the flyovers, the experiments with improving with putting flyovers to solve congestion is not working out.

So there are people, there are policymakers now, who are convinced that let us make better use of the existing resources and use demand management strategies rather than go towards widening of the streets, go towards widening of the streets blindly. So that it is it is to say that that is the only option. We no longer are thinking that as the only option, it is one of the options.

It may be the last option that you carry out. So that is the biggest challenge. The other challenges are of course, which strategy to implement in order to get the best bang for your buck. So for example, there are many TDM strategies implementing a parking pricing versus developing a public bicycle sharing system which would give you the best reduction in congestion is something that many cities are grappling with.

People have quantified them separately, but they have never, there are very few cities that have implemented two or three policies at the same time so that they get a combined effect and they can measure the combined effect of it on congestion. So people, policymakers and researchers have are still coming to terms with the fact of how to select which measure is the best for their city.

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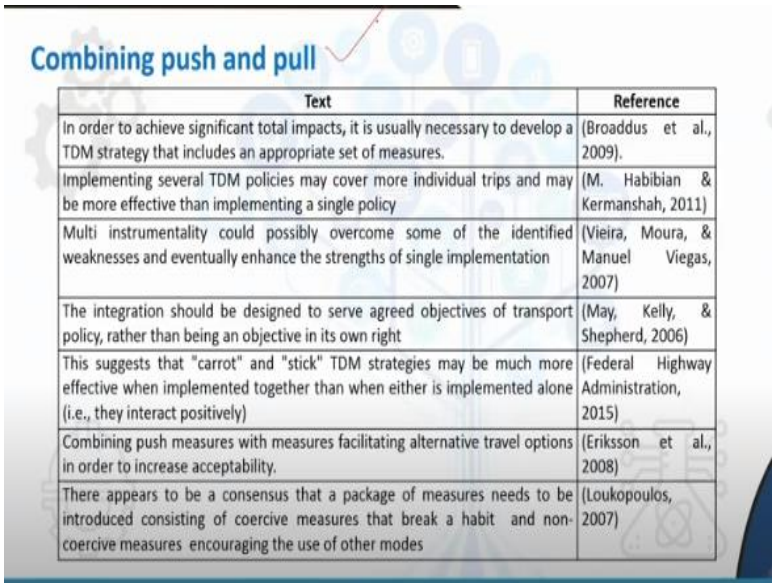

So that is what people are, the other challenges in implementing this is combining push and pull is another challenge because for example, many of the cities now who have implemented or who has a metro rail system for a long period of time, which is a big pull measure, are starting to notice that well having Metro is fine, but there is still congestion on the streets. So what do we do?

We can we I mean they have expanded Metro, it is a city wide network now, even then the streets are congested. So what do we do next? So what is the the next thing that very, very few cities have then tried is to add a push measure along with this pull measure, right. So this is the the pull measure of the having the Metro is to attract

people to the public transportation system, but there is not enough disincentive for people to still drive, right.

So there is no push out of your, there is no mechanism to push you out of your of your private cars. So what for example, London has done now has implemented they not only have their metro rail system, but now they have implemented what is called congestion pricing. So now they have said that to come into the central business district of London, if you come into that CBD during morning peak hours in your private vehicle, you have to pay an additional toll.

So now that is a disincentive. Now that is that will tell you that and they have also made parking very expensive within the CBD. So there are two push measures that they have implemented. One huge pull measure is they have made a good network, a good frequency of their subway what their metro rail system is called.

So along with these two, they have really or these three measures, one pull and two push measures, they have seen that there is a substantial reduction in congestion, improvement in air quality and so on and so forth. So there is a lot of people lot of researchers who are suggesting this, that there has to be a combination of a push and a pull measure at least in order to see the benefits of TDM strategies.

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That brings us to the end of this lecture series, where we hopefully have been able to give you an overview of what is travel demand management. How travel demand

management can be classified into different sections. The primary textbook that you can follow is by Eric Ferguson on travel demand management and public policy. And there are additional examples that we have taken from UK and Canada, which you can follow as well.

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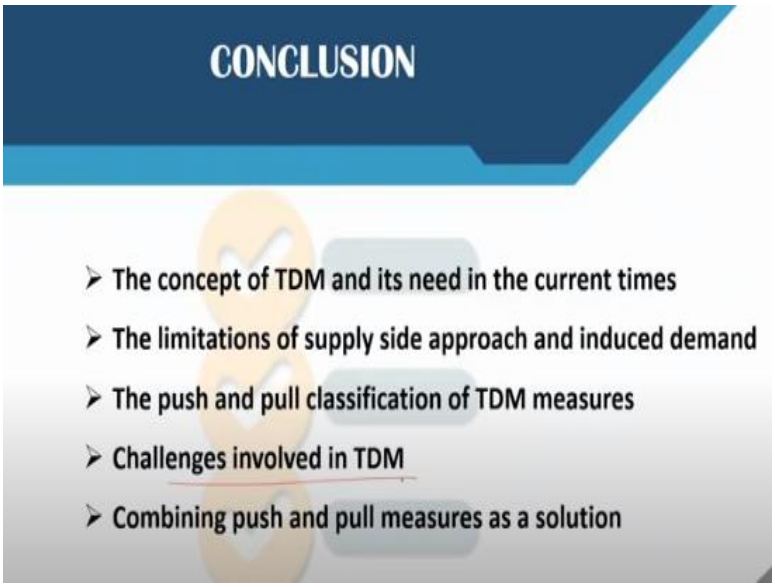

So in conclusion TDM has although has several challenges involved and it takes time in implementing, in getting the benefits of TDM but TDM is more and more looking as the fundamental solution to the problem of congestion rather than only the supply of roads. So that is what we have tried to explain to you in this set of slides. Thank you for your attention.