Introduction to Multimodal Urban Transportation Systems (MUTS)

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Module No # 11

Lecture No # 51

Urban Transport & Sustainability: Multimodal transportation (MMT) environment

Welcome back friends now that we have looked at different types of urban transportation systems throughout these class. We are entering into the last segment of this class we are going to discuss about multimodal transportation and which is a key element of the sustainability in urban transportation.

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As such in this first class what we are going to look at are the different multimodal transportation planning concepts. What is the key consideration for multimodal consideration? I will give you some examples of multimodal transportation systems in India and look at how you assess them with respect to public transportation. We have to assess if your multimodal system is working good or not.

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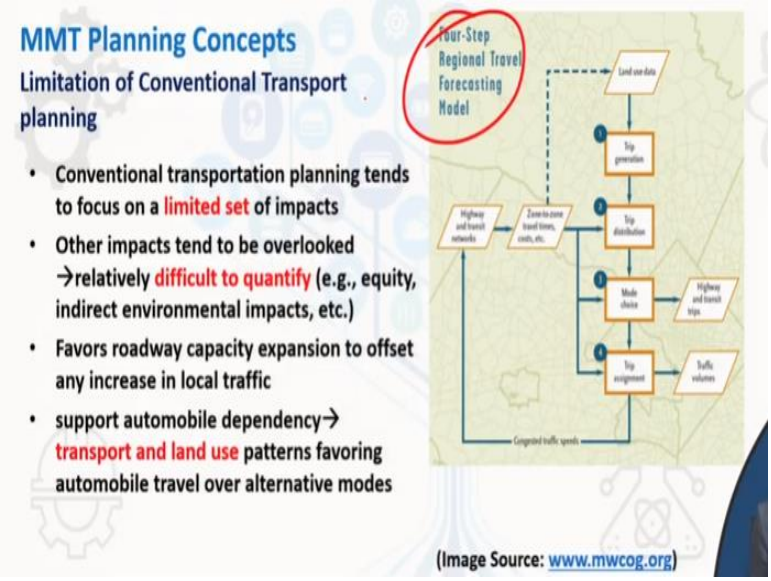

So what is a multimodal transportation planning? We always have different modes in our urban transportation system, we have buses, metros commuter rail, auto-rickshaws. So there are a multitude of modes so what is the meaning of multimodal transportation and why that has to be dealt with differently or separately from individual urban transportation modes. If you look back into the history of urban transportation what we have been trying to do for many decades now is to concentrate our efforts in developing tools that enable the movement of vehicles in our urban transportation system. After the advent of the automobile it became the dominant mode of transport in many of our urban areas around the world even in India. So then we started to solve the problem of the automobile. How to manage it better? How to forecast it better? If by better forecasting we may provide the facilities for it in a better manner. If you look at the traditional 4 step planning process where trip generation, distribution, mode choice, and assignment all of that is focused towards 4 wheeler private car. It is not even focused much towards motorized public transportation and it is definitely not yet towards non-motorized transportation like bicycle or pedestrians. So we have historically been looking at urban transportation purely from the prism of 4 wheeler motorized transportation and automobile transportation, essentially, and all our land uses are also geared towards that kind of a system. We want to have a wide enough road even in our neighborhood so that we can accommodate our car getting in a neighborhood. We do not like narrow streets because then how can I access my car and then should I park my car. Even in our

transportation network everything is geared towards private automobiles especially the 4 wheeler not even the 2 wheeler. So this has been the conventional way of urban transportation planning.

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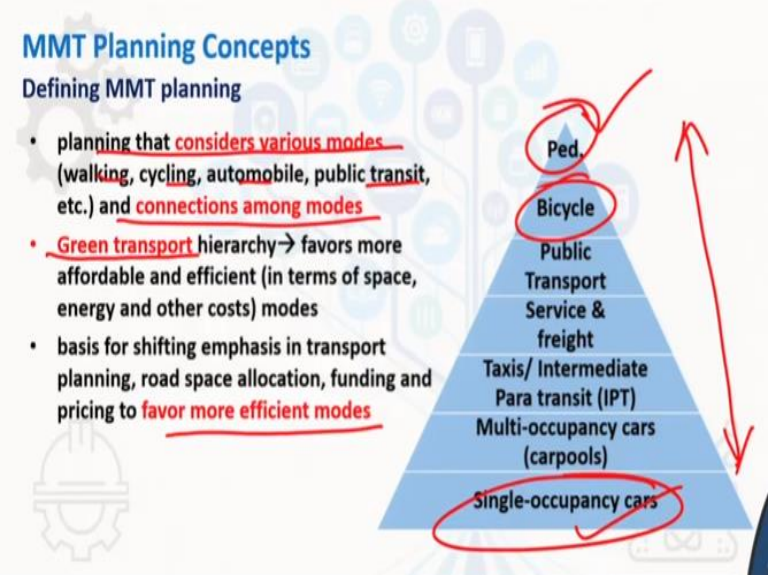
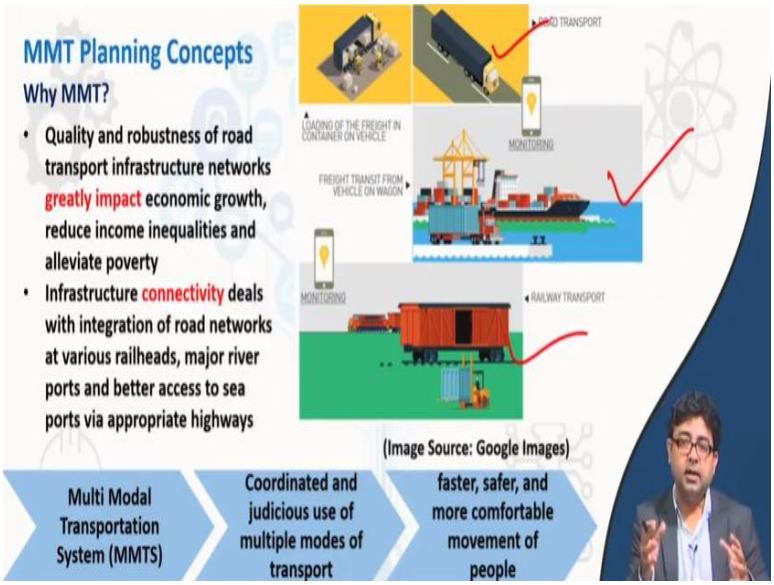


But what multimodal transportation planning does is it not looks at your single occupancy cars. It looks at all the other modes available to you in your urban area and tries to integrate, multimodal transportation in one way is to plan for various modes with includes walking, cycling, automobiles, public transit and connection among these modes. These whole concepts arose because more and more urban transport professional saw that, despite there being a good public transportation network in a city, people were not using that public transportation system at all. Meaning their ride share was way below the mode share of private cars. So then researchers thought that maybe there is not enough access to these public transportation systems. So the minute you talk about access different modes becomes high priority. Now for access, pedestrian modes is very important, for access bicycle modes too are very important. So their came the need for integrating these different modes. Even when you are talking about single occupancy cars you need to park them somewhere and then access your final destination. Not every time you will find parking right at your destination. If you look at any of the major metropolitan cites in India today it is very difficult to find parking. Maybe you need to park 500 meters away your final destination and then you have to walk. So then see if you do not provide good walking infrastructure then you face a problem. Maybe that business loses out because now people are not accessing that business. So there is economics now starting to get involved. So all of these

aspects are integrated within or researched within this umbrella of multimodal transportation. So what people started seeing was if you consider multimodal transportation you will be developing a more green and sustainable transportation for urban areas and also you will be efficiently or effectively using your modes that are available to you. Lot of people walk on Indian streets lot of people use bicycles but are they efficiently using the space or is there even space available for them to go from one point to the other? Despite there being so high ridership or so high mode share for these modes we are not effectively or efficiently utilizing them or encouraging them to use these modes more and more. So multimodal transportation planning does that. **(Refer Slide Time: 07:24)**



And if you look at from the other perspective of freight and freight has always been multimodal. If you look at any kind of shipment or about anything that you order online today. It might come from a different country right so it may include a ship that is bringing your goods or airplane that is bringing your goods. There are 1 or 2 modes right there then. The goods comes to the country and then maybe it has to be transport on rail or on truck. So there is couple of modes right there again. And then finally the last mail of delivery is on motorcycle or a smaller truck. So there are so many modes that are already involved in multimodal freight shipment. Freight has always been multimodal but passenger has never been multimodal. So lot of the multimodal concepts in passenger transports are being developed keeping in mind this value chain or this supply chain or logistics of freight. Because freight values time a whole, especially if you are ordering some goods that are perishable which have to be reached very quickly to the destination.. So this

concept of time becoming money is what the essence of even urban passenger multimodal transportation is, here you say that if you integrate these modes the people maybe will reach or access their destinations quicker, rather than if you don't integrate and allow them to run parallel and do their own thing. So that is the entire concept of multimodal transportation

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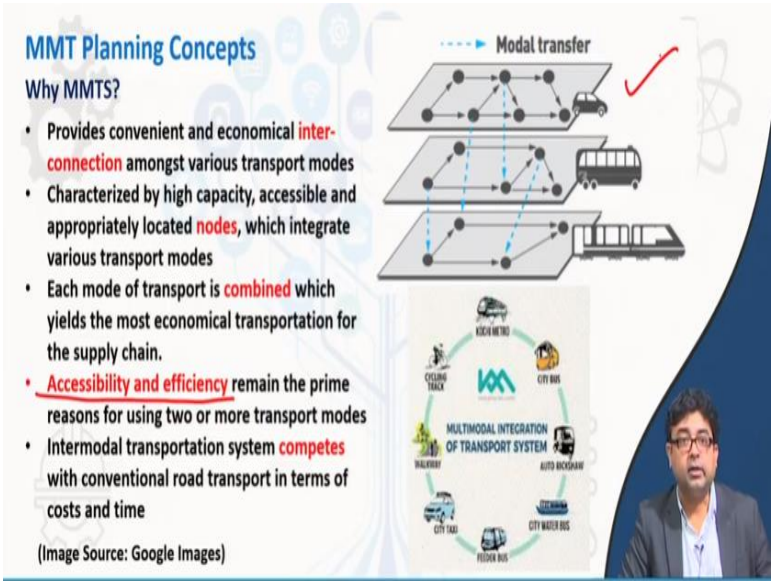

Again these are what we have already looked at. Accessibility and efficiency are the two words that are associated with multimodal transportation. We are, no longer wanting to only provide mobility. It is something which is associated with vehicular urban transportation a whole lot where people want to reach between two points in the fastest manner possible. Whereas accessibility you want to access the locations rather than just go between 2 points in a quick manner. So we are more and more looking at accessibility now, transfer points are becoming crucial. When we are looking at station design in the previous lectures of this class. One of those stations could be transit stations where the multiple modes are involved. So, terminal stations modal transfers become a very important in multimodal transportation.

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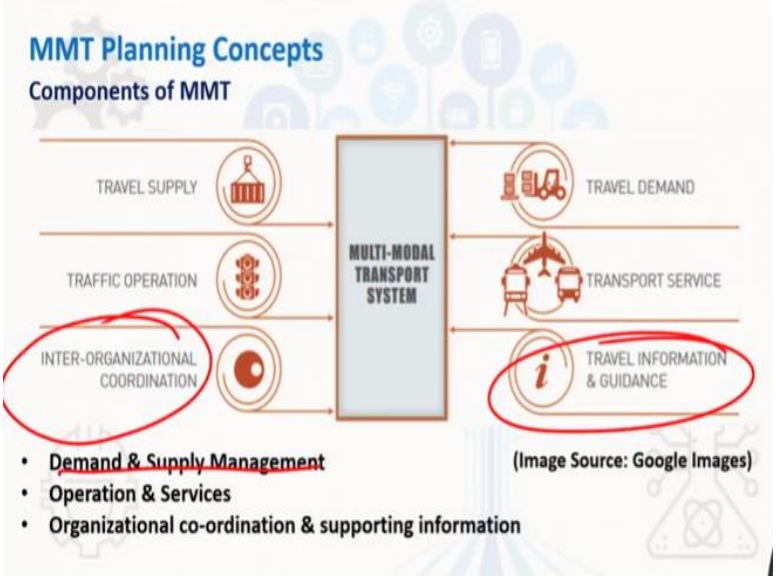

The different components like we are already looked at are demand. Everything is coming from demand and supply chain management point of view where time is money. So, all of the modes have to be integrated in a good fashion in an efficient manner so that people can move from one point to other very quickly. If there has to be lot of ICT devices that are providing information to the end users. If you do not integrate these different systems or different supply chains together and do not provide those information, for example, many a times we get annoyed when we see that we have "shipment received till point A" information but after that system is not updating and we do not know whether the package actually reached the destination or not. So that is called integrating information systems also. Information systems have to be integrated across different supply chains. And of course there has to be now of inter organizational coordination. So this organizational was now operating on it is own but now they have to be integrated. So those are essentially the main components.

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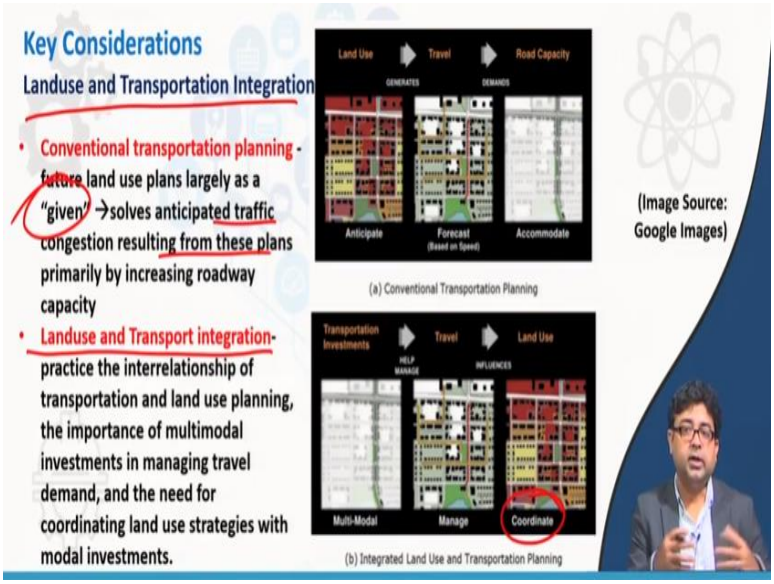

This is an example of how land use and transportation integration can be achieved through multimodal transportation. Traditionally if you know the 4 step model we always assume a land use plan and then give our solutions for traffic based on that assumption. So we are not really integrating the transportation in the land use we are just taking the land use as the given and then bringing in the solutions of transportation. When we now look at the new means of integrating land use and transportation point of view of multimodal transportation what we see is that we have to coordinate much more between land use and transportation and we have to see that they are dynamically related. You cannot assume a land use and then try to impose a transportation solution on it or neither can you assume a network and then have a land use plan developed on it. It has to be developed in parallel and synchronously so that access is provided to everybody. So is how multimodal transportation can be improved.

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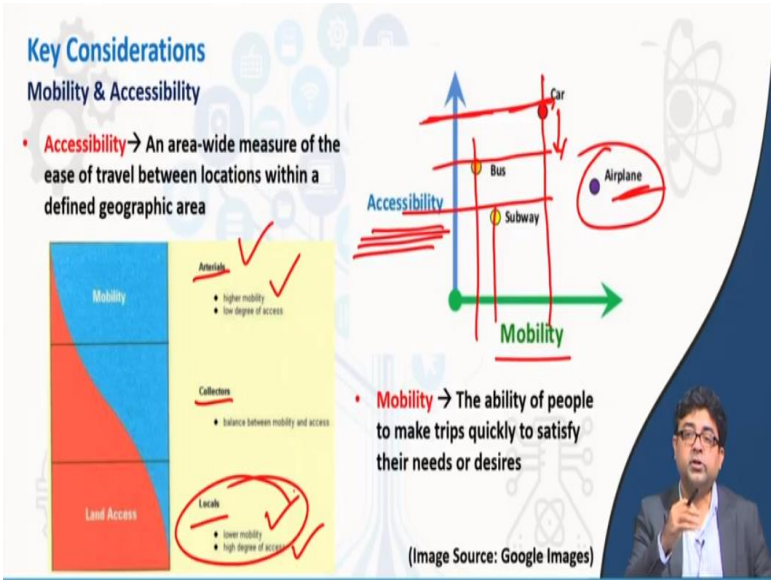

Like we said, we are now shifting away a little bit from mobility and more towards accessibility. So you see that airplane provides the highest mobility we can take people from point A to point B. Airplanes are the fastest, that was always what the mobility always meant. But when you look at urban transportation mode, car provided the maximum mobility and took people very quickly between each points. However bus and subway provide the least mobility and subway provided the kind of intermediate mobility. But now we are looking at it from the point of view of accessibility as well. If you do not change land use if you do not make a system multimodal we would still believe that car is the one that provides the highest accessibility as well. Say for example, if you provide parking at every location or every destination then well you can use your car and access that destination perfectly fine. But you know that providing parking at CBD especially is very difficult. So the land use has to be then changed and say that no we cannot provide parking and the resource needs to be uses for other means. So parking has to be further away and if parking is further away then, car starts losing out on its accessibility. Car users starts saying that we are no longer very accessible, rather than if the land use is more multimodal in nature of transportation and not just car oriented neighborhood. So that is the difference between a car and a kind of bus and subway when it comes to mobility versus accessibility. Also if you look at from different types of roads arterial usually provide higher mobility because they provide fast speed they have fewer, access point and multiple lanes. Whereas local road they provide a high degree of accessibility but their mobility is very low. Since they are narrow streets

you cannot go faster but narrow streets can go into any location and provide access to that location. So that is the different between accessibility or mobility and multimodal transportation supports accessibility by not compromising on mobility as well. It does not comprise on mobility but it brings accessibility into the forefront. It says that first you have to be accessible then you could be providing mobility in the same fashion.

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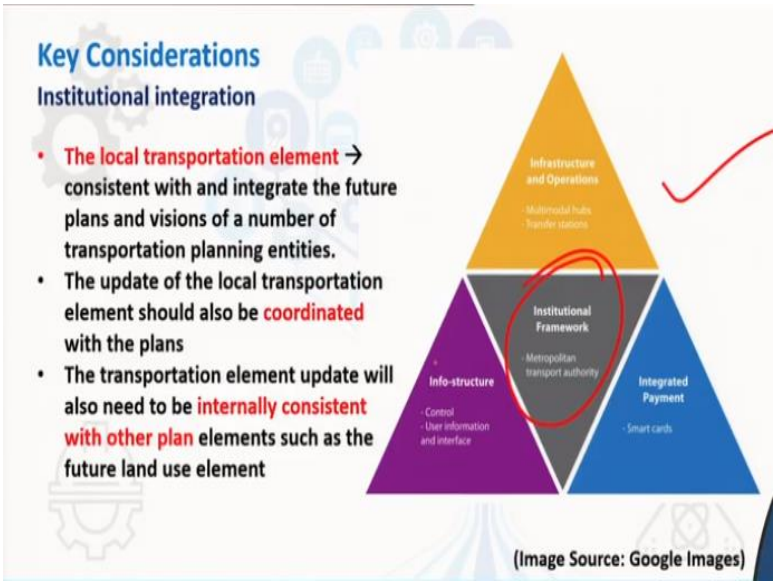

Now this is just an institutional framework example where you have to have different organizations and all of them have to be integrated.

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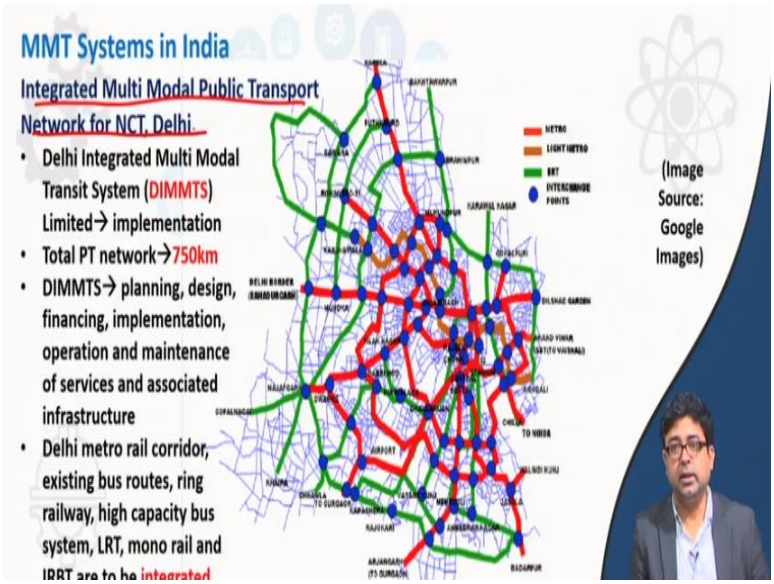

We will look at one example right here where if you take the integrated multimodal transportation network for the national capital region of Delhi. What you will see is that? Delhi is trying to develop a multimodal system where it as integrated smart cards which can be used on Delhi metro and also on their buses. So now you do not have to pay different fares when you are getting on bus when you getting on the metro and it will makes your life easier. And it encourages citizens to use public transportation a whole lot. Whereas previously maybe you had metro but you did not have the feeder bus at the end and so you have to walk almost one kilometer to reach your destination. That was not appealing to you, so you said that, well, you have the 2 wheeler I will just take my 2 wheeler and go to my destination and forget about the metro. But now what Delhi metro has done is it has developed this integrated smart cards now. So what it now allow you to do is you get off at your destination metro station but there will be a bus that you can access from there and go to your final destination with just one smart card. You do not even have to pay twice or you just have to tap that smart card twice maybe to pay for your entire journey. So that is the kind of multimodal transportation integrated with urban transportation that we are trying to teach you through this course. We have taught you the individual the elements of it now we are trying to give you a picture of combining these various elements together in this last module.

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The other example is the Kashi Inter-Modal Station which is outside Varanasi where they have existing railway station which is under the Indian railways. But what they are now trying to

convert that existing railway station into a proposed railway station integrated with a bus terminus as well as Inland Waterways Terminal, it is right on the banks of the river Ganga. So what they are trying to convert that is the integrated intermodal transit stations. So where people can get off. If you know familiar with Varanasi you know that people do use boats to access the various Ghats and locals do use that. So now those people who you are using the boats to come to this station can come there and then take on a bus and then go to other destinations where they want to go to. Or people who are getting off the railways station at Kashi they can now take the boats and go to their homes or local destinations inside Varanasi. This is allowing you to develop one modal point with a lot of integration between bus, rail and water modes and by doing so it is encouraging the people to use public transportation modes. And it is on the other hand discouraging people from using your private modes right. So otherwise what you would have done is if you have often got off at Kashi station you would have asked somebody to come and pick you up. And most likely that person would have to come in their own car or rented a car and that private vehicle would have added to congestion on the roads. So now you have easy access to maybe the ferry system. You get on the ferry and just go to your location destination where want to go or you have public transportation in the form of buses. So that is an intermodal terminal and those kind of terminals are very essential in a multimodal transportation network. Otherwise you would have no connection between these different modes.

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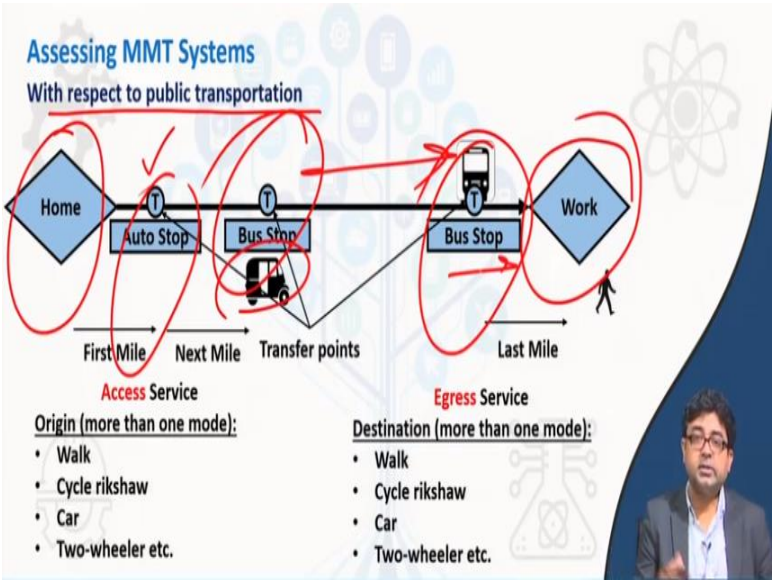

Now when you look at it from the point of view of your daily commute and public transportation, you are at your home you take an auto to go to nearest bus stop or your metro station then your bus takes you to your final destination and then you walk from there to your work destination. This is usually what most likely many of us do so even not even by thinking you are being multimodal. If you use multimodal transportation, all these links now become very important so auto rickshaws becoming important or your final walking from your final destination. So you should have good proper sidewalks, proper shading, all of those maybe important. Otherwise you would not make this entire trip on public transportation.

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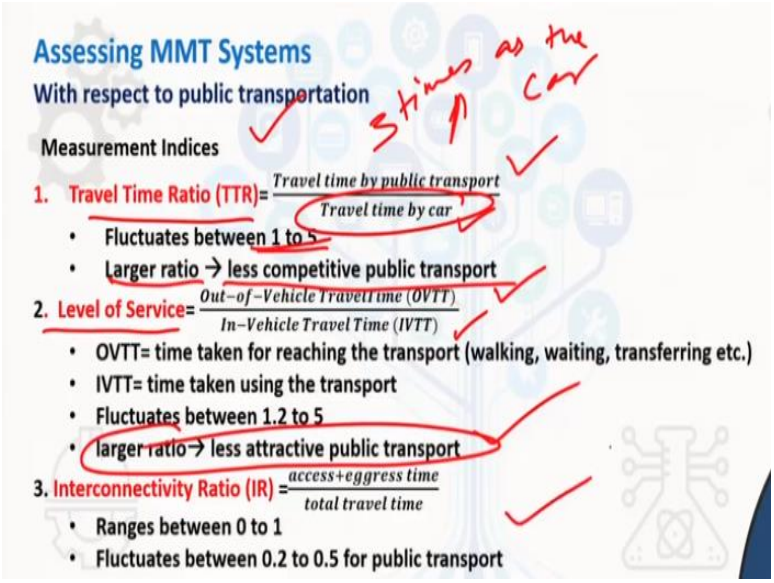

Now that you understand these multimodal transportation system you also have to evaluate how well they are working. Should I make my trip multimodal or should I just take my private car or private 2 wheeler and access my destination? What should you choose? So in order to choose you have to have certain metrics that you can follow in your mind. If this metric is larger or this metric is smaller I will make this choice versus that choice. So there are some measurement indices that quickly allows you to do so, say, the travel time ratio is the travel time public transport divided by travel time by car. So for example if the ratio is larger, meaning the travel time by public transport is too high between the two origin and destination then less competitive is the public transport. Then more you are likely to use own car. The car provides the quickest time that is how traditionally streets have been designed to reduce the travel time on car right. So car provides the quickest travel time but the public transportation time should not be so high. Say

for example it fluctuates within 1 to 5. So it should not be that the public transportation time is say for example 3 times as the time taken by car. If it becomes 3 times a car can reach my destination in 15 minutes whereas it will take 45 minutes if I take public transportation then the public transportation system is inefficient, then you cannot have a good multimodal system in your city. So that is one metrics that allows you to quickly check how good your multimodal transportation network in your city. Similarly there is another metric, level of service metric which tells you that out of vehicle travel time divided by the in vehicle travel time as to be as low as possible. Because the larger the ratio less attractive is public transportation. Out of vehicle travel time as you must be familiar with the by now is the time that it takes you to reach any of the station. Whereas in vehicle travel time, is the time taken while you are on the public transportation route when you are travelling on it. The accessing time should not be too high when compared to the actual travel time on the transit line, then your level of service drops and public transportation becomes less attractive.

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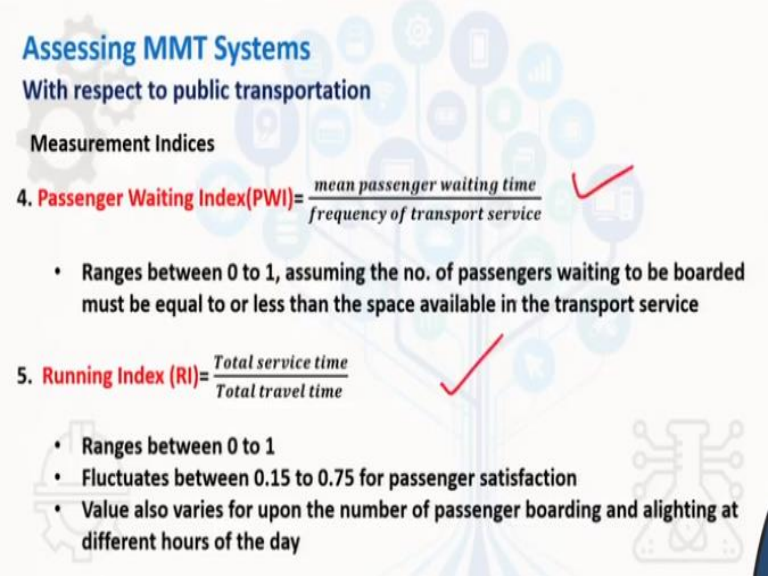

Similarly these are some 3 other ratio which are easy to understand. You can follow through them.

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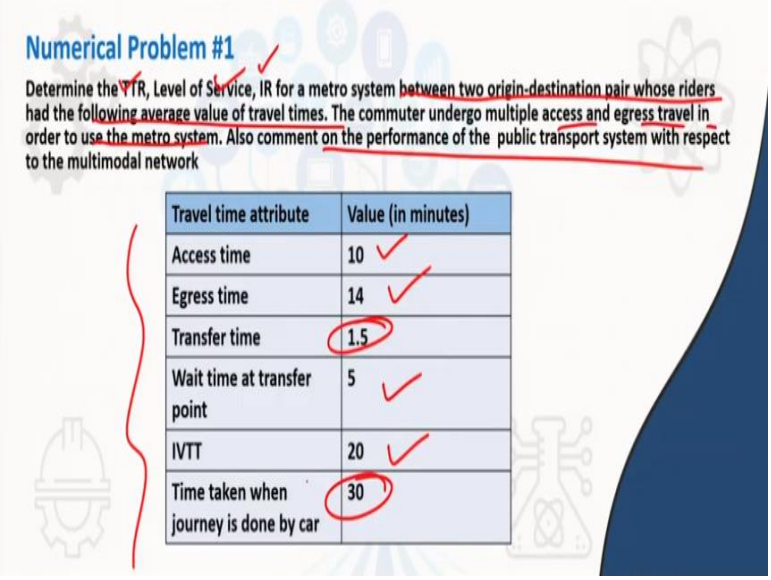

If you quickly look at one problem which allows us to determine how good these metrics are in your city. To determine the TTR, the level of service and IR for a metro system between two origin-destination pair whose rider had the following average travel times. The commuter undergoes multiple access and egress travel in order to use the metro system. Also comment on the performance of the public transportation system. So for example your access time to the metro stop is 10 minutes once you get off the metro stop the regress time is 14 minutes. Your transfer time involves maybe changing lines. Say there is change in 2 lines in metro station the transfer time is a minute and half and your waiting time in this transfer point is about 5 minutes. Your in-vehicle travel time on the metro is 20 minutes. And the journey taken by car will take just 30 minutes. Now if this is your real life scenario, would you choose to ride the metro or not that is what the decision you are going to make.

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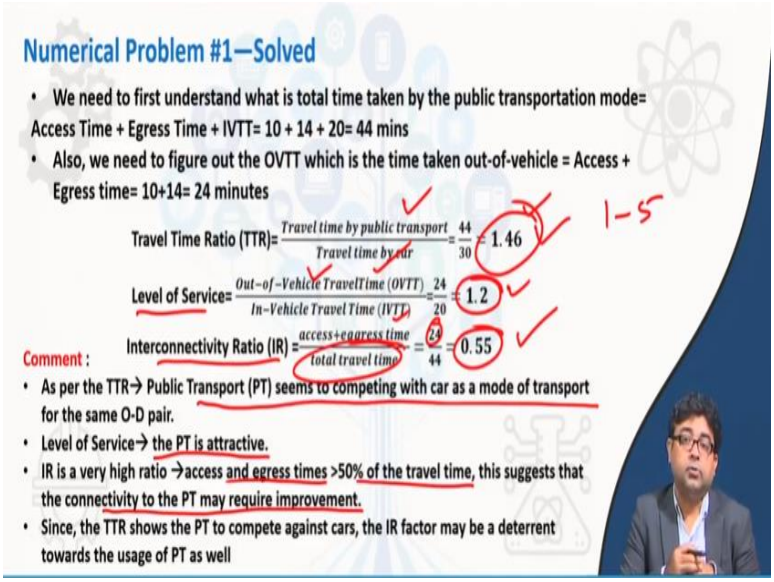

So if you just calculate each of these metrices you will see that the travel time ratio is 1.46. So the travel time taken by the public transportation divided by travel time taken by car is 1.46 so what does that tell you? The public transportation seems to be competing with the car mode so its travel seems to be higher. Remember it fluctuates in 1 to 5 and it is only 1.46 so we can never expected to be same. I mean if it is same as the public transportation as the car mode than it is more attractive or if it is less than the car mode then you are in multimodal heaven almost and that is a very good system. But even if it is only 1.46, so it is not very bad it is still trying to compete with the car for your choice. It is not a bad mode. At the level of service provided by out vehicle travel time divided by the in vehicle travel time. While you are on the metro system this is only is 1.2. So it seems like a public transportation is attractive. There are good number of access modes that is providing you decent access to the metro station. So that is also good and then finally interconnectivity ratio which is the access plus egress time divided by the total travel time is 0.55. So what that tells you is access plus egress time is greater than 50% of the travel time. PT may require some improvement that means it is taking a lot of time towards accessing or egressing your metro system. So maybe you are walking now and there is a need for a public bicycle sharing system for example. That will reduce your access plus egress time versus your total travel time. So that is what this ratio is telling you. Now you know where your multimodal system in your urban areas stands. Now once you know where it stands you can make appropriate improvements to your public transportation system to your landuse. This would allow the public transportation system to be more attractive and that will attract more people

taking the public transportation system. So this is an example by which you can quickly measure using very simple ratios, how good your multimodal transportation system in your city is.

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That brings us to the end of this lecture. Provided here are the references which we have used for developing this last segment. So please download all of these resources they are free for download and read through them for getting a better understanding of these lectures.

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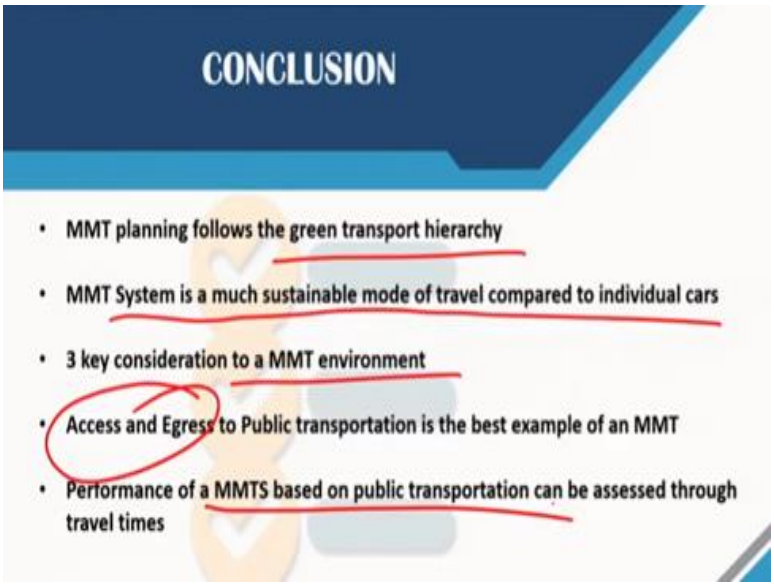

So in conclusion what we started looking at today is the concept of multimodal transportation planning where we said that it follows the green transport hierarchy. If you remember the triangle that we looked at the multimodal system, which is much sustainable mode of

transportation compared to individual cars. Our urban areas have to be more multimodal in nature. We looked at the different consideration of multimodal transport. We looked at access and egress time to public transportation which is a very good example of how your everyday travel is actually a multimodal, even without you recognizing it. And then we looked at the performance metrics or the measures that can give you an understanding of how good your current multimodal transport system in your city is. Thank you very much for your attention.