**Urban Transportation Systems Planning**
**Prof. Bhargab Maitra**
**Department of Civil Engineering**
**Indian Institute of Technology, Kharagpur**

**Lecture - 08**
**Information needs for Travel Demand Forecasting: Study Area, Urban Activities, Transportation System**

Welcome to module B lecture 3.

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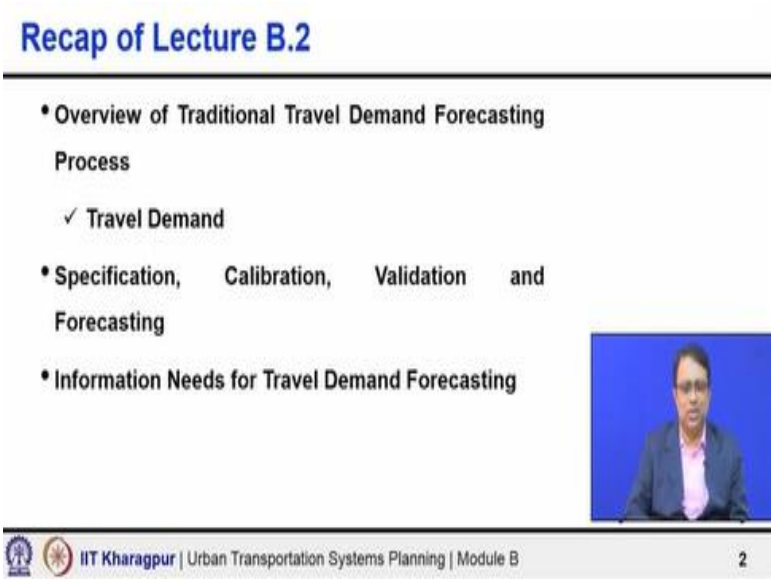


In lecture 2, we discussed about the overview of the travel demand forecasting process, particularly the role of the travel demand, how we use the base year, you know and the horizon year for doing the travel demand forecast, how we develop the models in the base year and we apply it those models in the horizon years. Then we also discussed about specification model specification, then model calibration, validation of the models.

How it is done in the fourth stage planning process and also forecasting using the calibrated and validated model. Then we briefly introduced various types of information that are required for travel demand forecasting process. So this will be our point to carry forward the discussion in today's lecture.

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So the information needs may be classified under four broad categories. First information related to study area, information related to urban activities, information related to transportation systems and information related to travel information. All these information data are required, decisions are required and once we have all these information in hand then we can go ahead with the travel demand forecasting process using the four stages; trip generation, trip distribution, more choice and traffic assignment.

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First about the study area, the study area in the context of study area the very first thing what need to be done is defining the boundaries. What is our study area, that is to be defined? We do the transportation planning for an urban area, but then how we define the boundary of that urban

area for our study purpose or for our four stage planning purpose. So before extracting or before even forecasting travel for an urban area, it is necessary to define clearly the exact area to be considered for four stage planning or transportation planning.

What this area should include? Generally or naturally this must include the area, which is presently developed. In any city whatever wherever people are living now where intense land these activities are going on or commercial areas are there. So the presently developed area obviously will be included but remember we are doing this transportation planning studies keeping the next 20 years or more in mind.

So if we consider only the presently developed area, then it is not adequate. So along with the presently developed area, we also have to consider the areas which are likely to be developed within the next 20 years or 30 years. Those areas also we should include within our study area. Then only with the future allocation as I said models we developed not for the base year.

We developed model in the base year but the very purpose of model development is to apply those models in the future year or horizon year. So if you want to apply it for horizon year after 10 years or after 20 years, we must be able to consider the land use allocations at that time. So which is likely to be a encompassing the area beyond the presently developed area. Now, this imaginary boundary; what we are drawing to demarcate our study area.

Remember that I am saying imaginary boundary, we are not building a wall. This is just an imaginary boundary. To demarcate that that is what is my study area or anything which is within that boundary the geographical area is our study area. So that imaginary line boundary line is actually called a cordon line. So cordon line defines the boundary of the study area. Sometimes we call it external cordon also we use this terminology external cordon.

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In addition to considering the future growth the establishment of the cordon lines should also take into account the political jurisdiction, the census area boundaries and the natural boundaries. Why we said this? Why this is important? Remember that we require lot of other data say for example, we need the population data, we need the economic census data, different types of employment and all other things, we also need the vehicle ownership data.

So if I do not match my whole study area boundary with the census boundary, then how I can readily use the data? I will not be able to use that data. Sometimes you know political jurisdiction you have the data with based on that political jurisdiction. So try to match as far as possible the political jurisdiction census area, I should not unnecessarily you should not cut these areas.

Because if we cut in extreme case if we really have very genuine results and if it is unavoidable you have to cut then remember that the data we will not be able to use directly. Because whatever data will be there data will be available based on census area demarcation or political jurisdiction area demarcation. So we have to then if you get population is x thousand then in our study area.

We have to calculate separately that out of those x thousand how many will come or how many will be there in our study area depending on development, depending on the kind of land which is included or excluded. So it will increase the complexity. So as far as possible we try to match

with the political jurisdiction, census area boundaries and natural boundaries just to make ourselves comfortable.

And, so that we can use very conveniently all the available resources in terms of data, the other important point is the cordon area or the cordon should intersect a minimum number of roads. We do not want the cordon to cut many roads, why? Again there is a reason, the reason is that this is an imaginary line it is not a boundary wall. So whatever line you take because land is continuous always and some routes or other will get cut imaginary through this imaginary line.

So always through those roads some trip or some vehicles some trips will interchange will happen between our study areas and outside. So we define a boundary, so some trips will definitely go out of the boundary will come from external area to our study area and we have to account or we have to count those trips. How we will count? At all the locations where the roads are intersecting the cordon line, we have to do the traffic volume survey; we have to do the OD survey.

Then only we know how many trips are coming from outside area. So you want to minimize our effort, minimize our effort, so we want actually the cordon line to intersect minimum number of roads. So maybe there are two roads leading to south but you know after 100 meter or so two roads are actually meeting and finally it is leading to one national highway which is leading to south.

So obviously we can extend the imaginary line, we can consider that we will stretch the boundary to 100 meter and then consider that is what is my boundary where then instead of two roads will cut only one road. So these are some important consideration.

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Then we are doing the demand forecast and we understand and appreciate that demand is temporal and special in nature. So what we would like to do we need to divide this whole study area into smaller geographical, you know pockets, why? Because you say just imagine any city. There is parking requirement. So you estimate where you know, how many parking requirements places are required.

I say in the whole study area somewhere in the town I will provide that many parking spaces will that work? That will not work. Why it will not work? Because you need the parking place where there is a parking demand and this square means you are we are attaching it to a geographical reference may be where the market is there you need parking. So the transportation demand is so much special in nature.

If we work taking the whole study area, the total trip generation and then you know all the things taking the whole study area, it will not work. So we need to then once we have defined the study area that is the first job. Then the next job is to divide this study area into suitable small pockets, those are called zones. So that is what I have said here the study area must be divided into analysis units to enable the planners to link information about activities about travel and transportation to physical location of the study area, that is what I said.

Tagging to the geo reference or the geo coordinates, special pattern. So when we do it is it that we just simply cut it and divide it by 10 divided by 50, 20, and 70 any number. No, there are also we need to divide them into smaller units but there are again certain principle which are very important, for example where you have high intensity development typically the civil area, central business district, the city core, very high density development.

So there obviously will have smaller zones, as you are coming to the sewer or outer periphery may be the intensity is of development is low, some areas may not be that densely or that way the development is not may not be that developed. So there you consider bigger zone. So the typical thing is smaller zones in the civil area or high intensity development little larger zone in the outer periphery or load intensity development.

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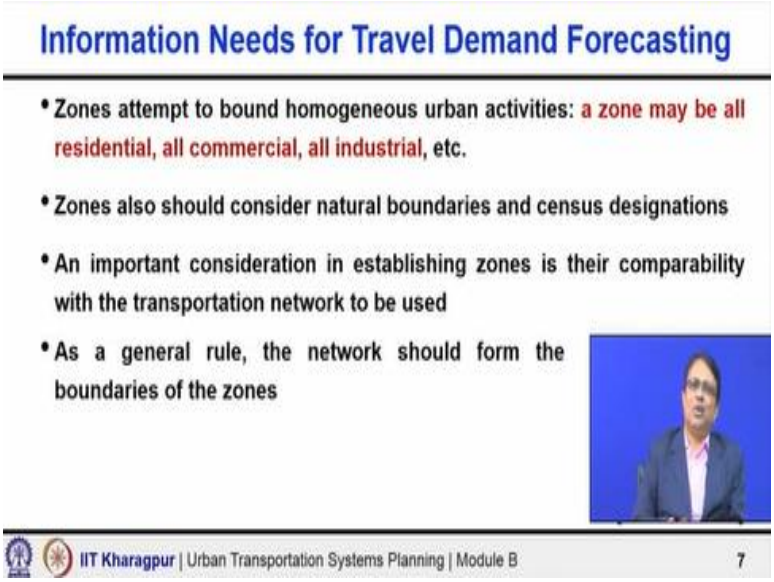


Similarly, when we are deciding the zone boundaries again like this study area boundary when we are deciding the zone boundary then also we would like to you know, keep in mind the census designations natural boundary, that is these are again important, why? Because as we need the population data, employment data, vehicle ownership data for the study area eventually we need the data for each pocket also each zone.

So obviously we would not like to break that you know census designations or you know, the way that transport department or the motor vehicles department they keep the vehicle registration

data and so those boundaries as far as possible we will try to retain. We do not want to unnecessary break it, you know some cases if you are you know bound to break then you have to think you have to again do probably another set of models you have to develop.

Analysis round of modeling will come that if my total, you know census data is like this for a zone and I am using part of that as my zone in my study area then what will be the population for my study area zone? Again some kind of modeling and some work will get will be involved. But we normally do not want to do that we try to imagine and a residential zone may be completely residential may be all commercial or all industrial.

And, we try to make it as homogeneous as possible, why I am saying this? That will be known when we go for the trip generation and other stages in details. But we try to make it as homogeneous as possible but sometimes it is ok also that that does not mean that every zone will have you know residential only or no other activity or only other activity residential is zero that you may not get but try to make it as homogeneous as possible.

Each zone should be homogenous. Also it is an important consideration as I say that compatibility with the transport network because the zones are geographical reference where actually the production and attraction will happen. But how the exchange will happen? Exchange will happen through the transport network. So again in the same way we do not want we have to keep in mind when we are defining the zones or dividing the study area into suitable number of zones, carrier are our roads.

So it is a natural or I say general practice or I would say it is a good practice we try to keep the road network as in the boundary of the zones. So that you know from adjacent zones, you can again load it to the on the network, the travel may be loaded on the transport network.

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Then next part that is; what about the study area, so defining the study area and dividing the study area into suitable number of traffic analysis zone. Two is urban activities. Now once the study area has been divided into appropriate analysis you need we need information related to what? Activities. So activities for each of these traffic area zones or traffic zones so and in this case stage knowledge of the forecasting procedure is essential.

Since, we want to get data only those data which are actually relevant. In many cases, you know, it is not a healthy practice, but you will find people go and simply start getting the data get the data. Now you in the process you put so much of effort to collect data maybe many of the things you have collected which are really not required for the work you are doing. So you must consider what work you want to do what is the real requirement of the data and accordingly only collect those data which are important for you and relevant for you.

We do need to collect any data which are not required. So we must understand that, you know, we must have knowledge about the forecasting procedures so that we know what data is actually required and we collect only those data. Activity analysis is usually done on a zonal basis providing the intensity and characteristics of activities every time have several. Whenever we talk about activity the intensity of activity is important but the character is also important.

Intensity means number, how many housing, how many households right? But also the character is important whether it is low income, medium income, high income, if it is an employment zone and what kind of employment that is the characteristics. So the intensity and characteristics both are important.

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The results of a typical activity analysis provide the planner with the present level of activities in zones to help in predicting future levels that provide basis for the forecasting. You know, we can also, you know, the historically we can take the data and then forecast right? You can simply do the population forecast if you know that the how the population is growing over the last several decades, you can just forecast it.

How the employment opportunities are how the employment data is growing you can simply forecast that also you can do also you can get the take the information from the planning authority if they have any specific plan program for development of an area and maybe a new residential area is to be developed or a new IT park to be developed such kind of things may not come in from the trend only.

So trend may be used and also additional information can be used to make this estimated activity both the quantity and also characteristics as you know, realistic as possible. Zone activity information might appear as follows in a few example zones.

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How they look like; so once you have done the activities maybe you know that one zone 3 for example may be a central business district will have so much retail employment and so much non-retail employment. Similarly another zone 136 is the zone number maybe it is a suburban shopping center which will have the parking space over about 700 and employment of 120 retail and 43 non retail.

Or maybe another zone, which is expected to be more like a residential zone which will hold may be about 1200 people will leave for with about say 400 household and with some income and so on so forth. That is the kind of type of it is just an example that is the kind of data which are expected to be available to us based on this work.

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Then the next information next category of information we talked about traffic zones we say that the study area then we talked about the urban activities the third is basically the transportation system. Now this is again very important because how travel takes place travel takes place through the transportation network. The transportation network is basically then the linkage that provides the linkage.

So transportation system allows or of an activity to communicate with one another right. So people travel to work, to shop, to visit friends and how do they travel using the transportation network. So in cities any city you take you will find some areas which are directly connected and which area may not be directly connected. In some cases you can travel very faster because the road is quite wide.

In some cases you cannot travel so faster may be some areas you have bus available, the system available, bus services available in some other it is not there. So we need to really develop these data ways but related to the transportation system very well so that actually we can do a meaningful one. So the variation of the accessibility requires the planner to describe the transportation system in terms of geometry and level of service, both; both are important.

What is geometry? Geometry is simply what connects what? That means two places are there you have a place A, you have a place B is place A and B directly connected or they are

connected to some other through some other node or through some other place. So how they are connected whether they are connected or not, connectivity that is basically the geometry,
What connects what? The level of service is a reflection of how well they are connected.

Maybe two places are connected, connected by a narrow consistent road or connected by two parts is basically connected by an urban expressway, access controlled expressway. That mean entirely, entirely, entirely different thing. So it is not only whether they are connected or not, but how they are connected matters a lot because that influence the level of service.

So when we are developing the transportation system related data, we need to care about the geometry as well as the level of surface.

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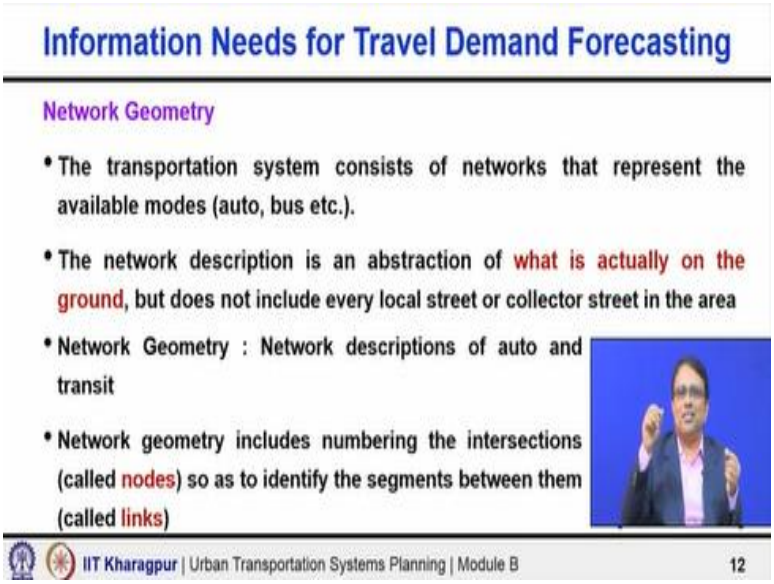


Now network geometry as I said the transportation system consists of network that represents the available mode, this network may not be same for all very modes. So if you are thinking of a bus network, bus operates only on certain routes and certain links then the bus network and the current network are not same. Autos, auto means here actually private vehicle, bus is the transit of the public transport.

So similarly if they are different we may have to develop the network geometry separately for these modes. The network descriptions remember that it is an abstraction of what is actually on

the ground. We may not really include each and every narrow gullies, streets and you know every local street in that one because you have to remember that what four you are doing the transportation planning study, in an urban whole urban area you are taking.

So basically the overall in the urban context, study area context, the mobility is very important. You are not really trying to focus more from you know, a very kind of localized travel, how each building is connected or how you know, a locality internally is connected that level of details, we are not doing because remember that I said it earlier the model at which level you are doing the model the level of modeling is also very, very important.

So your data collection everything depends on that. So the network geometry includes the number of intersection the nodes so as to identify the segments between them and we call them as a link. So nodes are basically you can call intersections or even the centroid of an area right and links are connecting to centroids or connecting to nodes.

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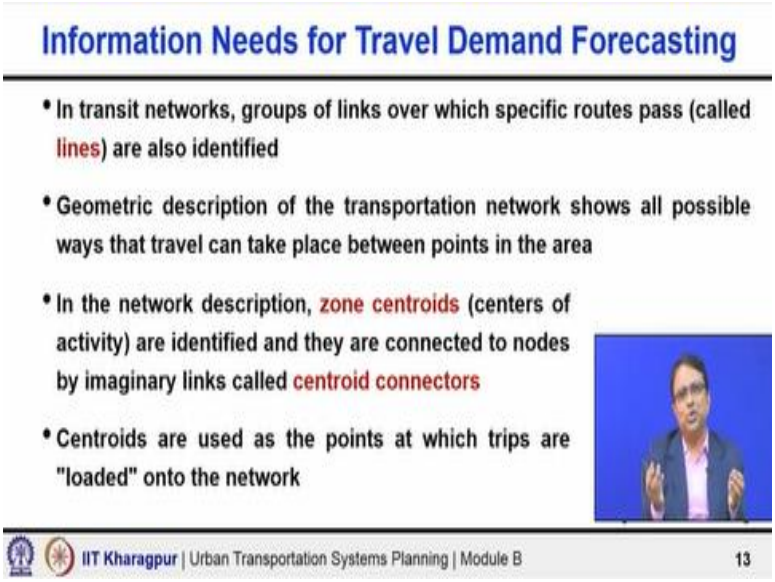


In transit network, if this there it is that is to be again coded separately that is normally called lines why that is important with the sequence of link has to be recorded again. So it is not same as the just auto network or private vehicle network. So these are some useful and important consideration then what we do when we are considering the network every zone actually represented by a centroid.

So we do not achieve the whole journey is not there is only a centroid. So every activity gets generated through that centroid and every activity gets terminated through that centroid. So the remaining zone practically the land use wise and everything we are not considering. So that zone everything is represented through the centroid then the centroid hypothetically we connect to the nearby network in all directions. This is not wrong, this is not wrong, please understand my friends, this is not wrong.

Why? Because if we are taking an academic in if say IIT Kharagpur is located in the Kharagpur town. So if IIT is taking as a zone, I am not doing you know interested to say how travel takes place within IIT from one hostel to another hostel that is not my focus, my focus probably would be how people travel from IIT to railway station, IIT to the big shopping area outside and so on so forth.

So the purpose of doing the transportation planning is not to understand the adequacy of the roads within the IIT campus. But it is basically to stay the road connecting railway station and IIT, Kharagpur whether that road is adequate? Whether that route needs some kind of improvement that is the kind of thing we are looking for. So this smaller things we simply internal travel can be assumed something right? And it is the representation that is what we do.

So the connectors are also the point that which trips are loaded into the network. So we do not consider each and every building in reality each and every building, even a multi storied building, each flat probably is generating the trip. But we do not consider that level of details we cannot consider in a in a in a four stage planning. And neither it may be necessary to do that so we consider it a smaller pocket.

It is another level whatever smaller unit you require you consider it in that way. If require instead of 50 zones, you consider 100 zones instead of 100 zones you consider 200 zones as per your requirement, but then represent the zone with the zones.

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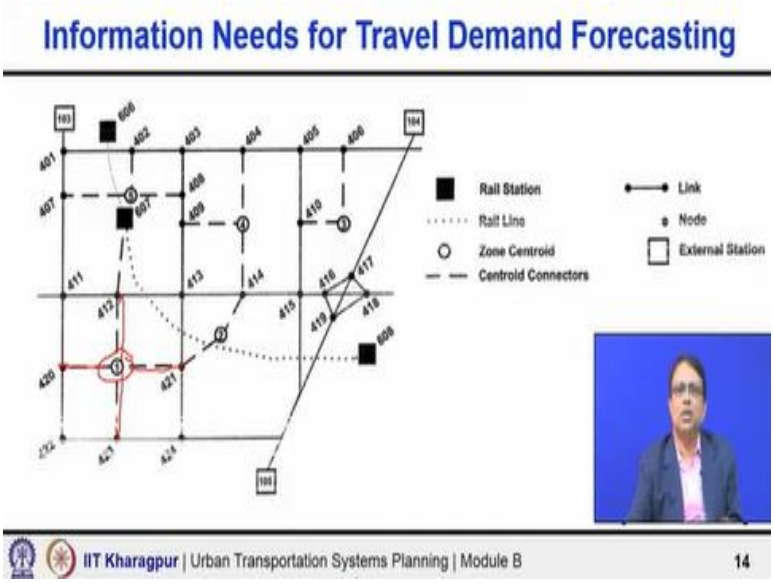


So it looks like that you know here you can see a you know zone centroid that is what is located and these are the hypothetical connectors we are connecting it to the nearby roads. So that way the network is getting represented.

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Then the level of service as I said it is important. So not only the connection, how well they are connected whether they are connected by arterial streets or by freeway or an expressway. It makes lot of difference. So we need all the data like what is the link laying what is how many is the number of laying, what type of facility is it arterial, it is sub arterial or it is you know, the you know, access control kind of facility, where it is located within the urban area.

What is the free flow speed there? All such kind of information are collected which may influence the level of service, so all these are collected.

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The transit network as I said is different because both the links and the sequence of links are very, very important. A bus route will take it will take this link then take right turn from that from that, you know node or the junction take right or left turn and then follow this link. So there is a specific sequence. So that needs to be again recorded and along with that how much is the travel time or the journey time that is needs to be calculated.

So we need both link and the lines, lines particularly for the public transit because transit case it is called line, a sequence of links that forms the line. So the first level is a system of links that define the segment of travel facilities between nodes, the travel time, the speed, the distance is of, you know, required to be travelled within a link and so on.

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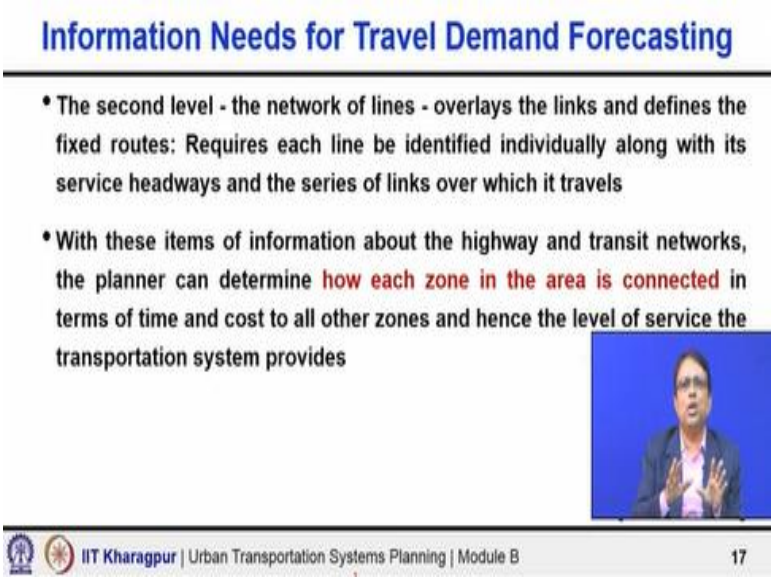


The second level is network of lines in the context of public transport that overlays the link and defines the fixed route requires each link or each line rather be defined individually along with its service headways and the series of links over which it travels. So bus route, you know that every 10 minute every half an hour or every 20 minute the bus is available. So what is the service headway, what exact sequence of links it will take?

And, then how much will be the journey time typically. All these are the next level or the second level detailed information that are requires for public transport. So with these items of information about the highway and transit network here highway means it is actually referred to the private vehicle network. Not that highway means it is national highway not like that. Highway network means in this sense, you know, it is basically the private vehicle network and transmits networks.

The planner can determine how each shown in the area is connected in terms of time in terms of cost to all other zones and hence what is the kind of level of service that the transportation system is provided. Level of service is a qualitative method, but often expressed based on certain quantitative basis, maybe travel time, maybe travel cost. In some cases volume to capacity ratio, how it is getting loaded, some cases even the delay.

So; all such kind of things as information as relevant need to be collected to describe the transportation system adequately and as per the requirement of the four stage planning process.

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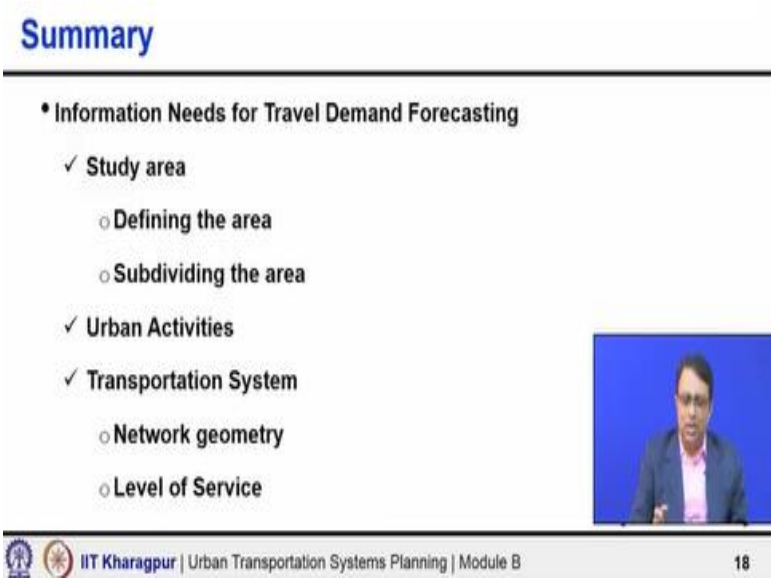


So if I have to summarize I say in this lecture, we talked about the you know, in details about the travel demand forecasting of whatever is the requirement information needs for travel demand forecasting. And we discussed the information requirement for three aspects namely the study area, what we do, how we define the study area boundary, how we divide them into different zones, then what are the data required typically for urban activities.

And also related to transportation system, what are the data we require? We also specifically mention about the network geometry and the level of service. Both are important also said the private vehicle network and the public transit network data requirement and how within the public transport network requirement data will be different from the private vehicle data, so all we tried to discuss and understand the kind of data requirement.

What is remaining is the travel related data because you remember that four broad areas we said the data requirements are there. So the travel related data that we shall discuss in the next lecture. Thank you so much.