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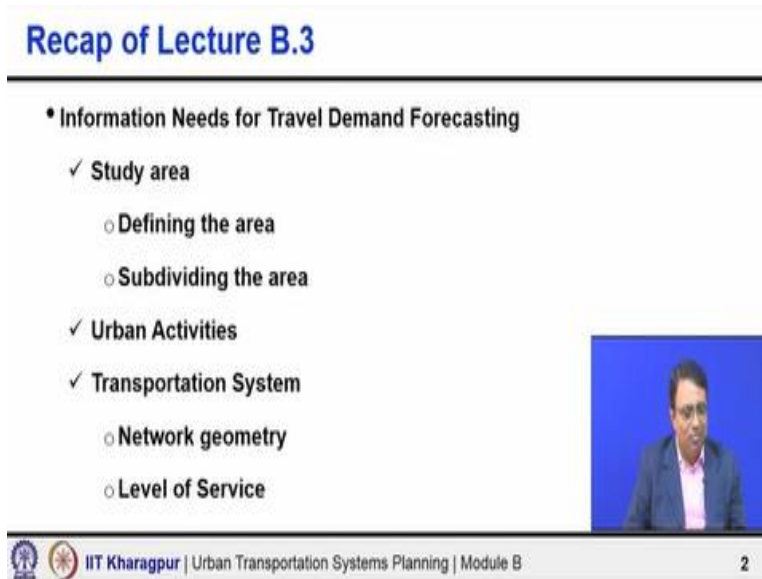**Prof. Bhargab Maitra**
Department of Civil Engineering
Indian Institute of Technology, Kharagpur

Lecture - 09
Information needs for Travel Demand Forecasting: Travel Information

Welcome to module B lecture 4.

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In lecture 3, we were discussing about information needs for travel demand forecasting. We discussed about the importance of the study area how to define the study area boundary how to subdivide this study area into different traffic zones, then we talked about the data related to urban activities also the data related to transportation systems, we talked about the network geometry.

What is connected to what point and then what kind of level of service or how comfortably they are connected or what is the travel time or the travel cost. Let us do that, so that is the level of service what gets connected to what and how good or bad they are connected. So all these are important we also discussed about the networks transportation network development or network related data for private vehicles and also for the transit.

And, we said that how different they are why they are different why multiple layers are important all these were discussed.

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So if we come back, this to recall or to remind ourselves again that there are four major areas, we need the data. One relates to the study area, then urban activities, then transportation system and then travel information and if we have all these four data's in all these four areas covering all these four areas, then we are ready to go ahead with the travel demand forecasting process. So we discussed about study area urban activities and transportation system.

What was pending is? Travel information. So this lecture we focus on this aspect that is travel information.

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Information Needs for Travel Demand Forecasting

Travel Information

- Information on how, when, and where people are currently traveling is of obvious importance in the forecasting process

- This information is studied to determine the underlying factors causing people to make certain travel decisions so that models can be calibrated and used to forecast how people will travel in the future or in response to changing conditions now

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Now, information on how, when and where people are currently travelling that is the key for the forecasting process. Many cases we said that you know we talked about the distribution we talked about the mode choice we talked about the traffic assignment in all places we need information such as how, when and where people are currently traveling. This information is studied to determine basically the underlying factors causing people to make certain travel decisions.

So our objective is basically to model this decision how the decisions are made. When to travel, where to travel by which mode people are traveling, how such decisions are made which are the factors that are controlling decision and then to develop a model. So that we can predict that under similar or even a changed scenario what the decisions are expected to be and linking those decisions to the overall travel demand forecast.

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Information Needs for Travel Demand Forecasting

Origin-Destination Data

- Information on where trips come from, where they go, by what mode, for what purpose, and characteristics of trip maker and activities at the origin and destination
- Origin-destination survey data are generally available in sufficient detail and of proper statistical stability to allow accurate estimates of the model parameters
- Various data collection techniques are used to collect O-D data which are discussed later

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So data which are extremely important, there are many data's which are really important related to travel. One very common but very vital data is basically the origin destination data. So origin destination data provides information on where trips come from, where they go, by what mode the trips are being made, for what purpose the trips are made and also the characteristics of the trip makers and what are the kind of activities that are there at the origin zone and the destination zone.

So practically a very good amount of information that we get from the OD data, I repeat it here where from the trip is coming, where they are going by which mode the trips are being made for what purpose the trips are being made characteristics of the trip makers and also the kind of activities in the origin area and the destination area through simple questions we try to get answer to get all this information.

Various data collection techniques are used to get the OD data insufficient details and we use it for multiple purposes. Basically to estimate the model parameters as I said, this is very, very important because in the Bayesian you need to know the dependent and independent variables both then you can develop the relationship. So model building is all about capturing the relationship. So we need independent and dependent variables both.

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Information Needs for Travel Demand Forecasting

Initial Decisions

- Before proceeding with the processing of travel data, some decision must be made

  ✓ To use vehicle trips or person trips in the analysis?

  ✓ How to stratify trip purpose classifications?

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Some of the initial decisions which are very important and I mentioning here just to avoid any kind of confusion in this regard some of the points are very important that is why I bring it here. Say the decisions related to whether to use vehicle trips or person trips for the analysis. One can do both one can use person one can use also vehicle trips and the second is how to stratify trip purpose classification.

These are the two initial decisions that we need to make when we are developing the database related to travel.

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Information Needs for Travel Demand Forecasting

- **Vehicle Trips or Person Trips**

  ✓ The decision is directly related to the needs and objectives of the study

  ✓ Areas with significant public transit issues, regardless of size, require mode usage models to be developed requiring person trip models for trip generation and trip distribution

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Coming to the first point whether to use vehicle trips or the person trips that decision directly relates to the needs and objective of the study what for we are doing, suppose, for example, if we are doing it for anything related to public transport is the consideration then obviously the person trip data is the key and if we take the person trip of data then actually the mode choice models of course also gets developed based on that.

Because the person trip data can give us lot of other information as I said that just imagine the mode choice model is very, very important and if you are really developing the model for an area of where you have lot of choice riders and you are talking about the working on the public transport aspect then obviously the person data. So generally I would say yes more desirable and probably for many works you need to use the person trip data.

But, of course there could be occasions where the requirement is very different and in those cases, you can also use vehicle trip data or even vehicle trip wise you develop the matrix that means you develop the also sometimes we do like we developed a person trip data or maybe the vehicle trip wise we develop the matrix. Say public transport matrix, intermediate public transport matrix, private vehicle matrix, separately we develop.

So it depends on the purpose but you understand it very clearly that what is the gain or where we actually, really need the person trip data especially in the context of public transport.

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Information Needs for Travel Demand Forecasting

• Stratification of Trip Purpose Classifications

✓ The number of classifications depends on the size of the study area and the scope and objectives of the study

✓ It is necessary to make sure that enough trips are recorded under each classification

✓ The amount of data preparation time, computer time, and analysis time should also be considered while deciding the stratification

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Stratification again the number of classification depends on the size of the study area and the scope and objective of the study. Again, what is your focus? What for you are doing? What is the problem that there at the back of the mind? Which motivated you to take up this work or sometimes it is not that nobody will take a transportation planning is just for doing it then it is specific objectives that there are certain problems which are the focus and you need to carry out a transportation planning study to systematically approach to that problem and to get solution.

So based on that a higher number or a lower number of classifications you may do it. Remember one thing if we are making classification for each classification of trips, we need adequate data. Otherwise we cannot develop, cannot treat this kind of trips separately in our whole analysis. So that is one very important thing, you know that how much resource you have what the computer time is available what kind of how much time you can spend for the data preparation.

So all such things should be duly considered and the implications must be known right before you do it. So it is basically the context the need and also how much resources available and knowing that if I am taking, five different ways I am classifying the trip then for each classification I need adequate number of data or adequate data to really use that trip classification successfully in the subsequent analysis.

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Information Needs for Travel Demand Forecasting

Example of trip purpose stratification

✓ Home-based work: Trips between a person's home and place of employment for work purpose

✓ Home-based other: Trips between a person's home and any other destination for any other purpose

✓ Non-home-based: Trips that have neither end at home, regardless of purpose

✓ Internal-External trips: Trips with one end inside the study area and one outside the study area

✓ Through trips: Trips that have neither end in the study area but pass through it

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Some of the examples I gave that trip purpose stratification say, for example home based work, Home based other non-home based trip. So what are they mean home based work means trips between a person so when the place of employment for work purpose. That is always so if one end is home the other end is work, it does not matter when you ask the person maybe he is going from home to office or he may be going from back home from office.

So one case he may say I am coming from home and going to office another case he or she may say I am coming from office and going back to home but in both cases it is home based work because home is there in one end. So it is a home based trip and because that other ends it is work purpose so you can say home based work. So similarly home based other means again one end is the home end or the other end the travel is for any other purpose other than work so it may be home based other.

So similarly, non-home based trip that the neither end of the trip is actually home you go to the office and from office you go to bank and come back to office neither end is home so this will come under non-home based trip. Similarly other way you can think internal external trips, in this module itself somewhere we told about this cordon area when we talked about the study area boundary we said that imaginary line is called the cordon.

So cordon also we need to do the survey because we need to understand how many vehicles or how many trips or how many persons are traveling from outside to inside or inside to outside. So it may be external internal trips, internal external trips that means trip is getting produced inside but actually going outside. So the destination is outside may be people living in the city area, which is within the study area but going outside the study area for work.

So every day from the city they go outside for work and then come back in the evening, maybe through trip what is through trip, through trip means the origin of the trip is outside the study area and the trip is actually going to again a place which is also outside the study area. So the trip is neither originating within this area within the study area not it is terminating within the study area everything is outside.

But then what is the context may be simply it is actually traveling through the study area, why may be the road is passing through that you want to travel from A to B, A is also not within your study area B is also not within your study area but the road what is connecting A to B is passing through the urban centers or urban area. So that trip is still a relevant trip for you and may be you want to know say for example this through trip is typically very important when you want to do the bypass planning for a city whether you need a bypass or not.

So we need to find out how much is the through trip if through trip is really significant then to decongest the city road the best way if possible other way how depending on the land depending on other consideration is to have a bypass. So you do not want all these vehicles to go to the city because city roads are otherwise congested and you do not want to aggravate congestion and make the city more polluting and make all these vehicles emit smoke and dust basically inside the city road inside the city area.

So you will say okay these vehicles are nothing to do with the city simply the road is passing through the city, so they are going so let me have a bypass. So in different ways, it depends on what is really at the back of the mind for which this transportation study is taken or is being carried out, So depending on that you have to use a proper certification.

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Information Needs for Travel Demand Forecasting

Defining Productions and Attractions

- **Household characteristics related to travel** are easier to identify and forecast: Planners use the home as a base to predict travel

- This convention requires a distinction in the terms origin, destination, production, and attraction, which often cause confusion

- A **trip origin** is always the **beginning point** of the trip, and a **trip destination** is always the **ending point**: **Doesn't hold** true for **productions and attractions**

Then next part is defining the productions and attractions this is again, another very important aspect some of the very cardinal thing what are really important. Household characteristics relate to travel related to traveler easier to identify and forecast. So the planners use home as a base to predict travel. So that is one aspect this convention requires a distinction in terms of origin destination and production attraction which often cause confusion.

Home is very, very important home is always important whether it is for transportation planning or for any other purpose. So the home and the household characteristics are very, very important, but then sometimes there is confusion about origin destination and production attraction. So let us try to make it clear once for all where is a origin destination any trip the beginning of the trip is the origin point the end of the trip is the destination point.

So any trip starts from, A Starting from A going to B, A is the origin B is the destination no confusion; but that does not hold true for productions and attractions. We cannot say a travel trip is made from A to B. So the production is at A and attraction is at B that is not always true. Why? Let us understand that.

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Information Needs for Travel Demand Forecasting

A few rules to follow:

* Rule 1: Trips that either begin or end at the traveler's home are produced at the home end

* Rule 2: Trips that either begin or end at the traveler's home are attracted to the non-home end

* Rule 3: Trips that begin at a non-home location and end at another non-home location are produced at the origin and attracted to the destination

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I am mentioning here a few rules which will be very important for you, rule 1 is trips that either begin or in the traveler's home are always produced at the home end. So if origin or destination any one of these is homemade then the trip production is always at home end, why? Even though you are intercepting; somebody when that person is coming back from office to home or a coming back from office.

It simply he is saying I am coming from office going back home because you are actually capturing or intercepting him in the afternoon or evening when is or she is going back that is the simple reason. But trip does not produce, office does not produce trip office attractive, production is always homemade if there is so if there is origin or destination if any one end is basically the home end so trip is always produced at the home end.

Rule 2, trips that either begin or aimed at travelers home are attracted to the non-home end. So production if it is home end then obviously the other end is the attraction so being it office being it shopping being it any other purpose. Rule 3 is trips that begin at a non home end or non home location and end at another non home location. For those trips the neither end is home end in that case we can say the trip production where at the origin destiny attraction where at the destination, simply.
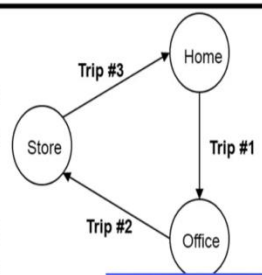
In that case only origin destination production and attraction may be you can consider synonymous origin means that is the production destination means that is the attraction but the moment the home is there it is not so, any trip whether the origin or the destination if there is one end is the home end then trip is always produced in the home end the production is the home end and attraction is the other end. So, that is the three rules what you should always remember.

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Then let us consider a person starts from home going to office that step number one then office going to store and from store going back to home so three trips are made home to office, office to store, store to home so trip number one what we say produced at home and attracted to office so it is what it is basically home-based work trip as per the definition. Trip number two produced at the office and attracted to store.

So this is what? This is non-home based other trip because neither end is the home end. Trip three is from store to home, but one end is home so we are saying produced at home and attracted to store. So it is also home-based but not home based work but home-based other trip. So the three examples is get earlier we said that three possible classification home based work home based other non-home based. So all three examples we gave you here.

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Information Needs for Travel Demand Forecasting

Processing Travel Data

Developing Calibration Files

- From edited trip information, a file that includes an entry for each trip surveyed can be developed

- Each entry represents a complete description of a trip: Information about the trip maker along with where the trip was produced, where it was attracted, its purpose, mode. etc.

- The calibration file can then be used in various phases of the forecasting process to provide the observed travel information against which models are calibrated

Then when you are processing the data, the very first thing travel data processing you need to develop calibration file what are calibration file from additive trip information a file that includes an entry of each trip service can be developed each trip. Earlier example where I gave I say trip one trip two trip three, so each trip information is recorded each entry represents a complete description of trip.

That means information about the trip makers along with where the trip was produced where it was attracted, what was the purpose of that, what was the mode used for that, trip all are there so one record for a complete record for one trip this calibration file then be used in various phases of the forecasting process. It may be used for trip distribution it may be used for mode choice analysis right depending on what is the context.

It may used in different phases of the forecasting process to provide observed travel information against the models are calibrated. So they give you the observed travel information against which we will calibrate the model.

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Information Needs for Travel Demand Forecasting

Developing Trip Tables

- A trip table is simply a matrix showing how many trips are interchanged between the various zones in the study area

- The calibration file just mentioned provides the basic data to generate what is called a trip table

- A trip table is produced for each trip purpose category defined

Then next part is developing trip table; what is that? a trip table is simply a matrix representation showing many trips are interchanged between the various zones in the study area. Once you have basically the calibration files there will be many trips now all trips together once you try to analyze you will find A to B so many tips are happening. So you simply finally make a trip table simply a matrix showing that how many trips are interchange between the various zone, i to j how many trips are happening?

The calibration file just mentioned provides the basic data to generate what is called a trip table where from the trip table is getting we are getting how we are getting the trip table we are getting from basically the calibration data calibration file. So calibration file put together, so many trips individual trips we are then developing the trip table, if trip table will be produced for each trip purpose category.

We can say that all work trips we extract separately and make a matrix which is for the work trip similarly may be home based work home based other, non-home based trip and so on so forth, we can have different stratification as per the requirement of the project.

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Information Needs for Travel Demand Forecasting

Developing Trip Tables

- 10 trip productions from Zone I stay in Zone 1, 30 go to Zone 2, 20 to Zone 3 , etc.

- The sum of the rows of the trip table is equivalent to zone trip productions, and the sum of the columns is zone trip attraction.

		Attraction Zones			
		1	2	3	Sum
Production Zones	1	10	30	20	60
	2	20	15	35	70
	3	40	56	74	170
Sum		70	101	129	

An example of three-zone trip table

Then this is an example of trip table that is what I have shown here what it says that ten tips are produced in zone I but those 10 trips stay within zone I itself, zone one itself. So they are produced in zone I and they stay in that is the one so what we say here so that is the 10 trips they are produced in zone one and stays back in zone one then 30 go to zone two, so these are the thirty trips which are going to zone two.

And, these are the 20 trips which are getting generated in zone one, but getting attracted to zone three. So this kind of trip tables I get, the sum of the rows of the trip table is equivalent to zone trip production, so one to one if we just consider that there are only three zones then one to one, one to two, one to three, if I add all of them what does it mean how many is total is produced in zone one, so that is 60, 60 is the production.

Similarly, if I take any column; so let us say middle column if I take this column we say one to two, two to two, three to two That means how many total are going to do if I add all this I will get how many total are going to do that means that is the trip attraction for zone two.

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Developing Initial Travel Impedances

- Travel forecasting process relies on feedback to check initial assumptions on travel times

- Initial travel times are best derived by loading the trip tables produced by the calibration file onto the network that provides estimates of zone-to-zone travel times

- Impedance estimates are required in trip distribution and mode usage analysis

Now developing the initial travel impedance that is the next one; travel forecasting process relies on the feedback to check the initial assumptions on travel times. We said, we started with some assumption or travel time then only based on that travel time or travel cost we did the distribution, we did the mode choice, but then finally assignment we know how many much actual load will come on a given link.

So and the load will determine that how many how much will be the really travel time or travel cost. So we need some kind of checking, so that is what we say the travel forecasting process relies on feedback to check the initial assumptions on travel time, initial travel times are best derived by loading the trip table produced by calibration file onto the network, so you say you know, you got the data.

So what is the average thing, you know they take that and that may be a good starting point from zone to zone because you have collected the data and that gives you some representation. So impedance estimator required in trip distribution and mode usage analysis, so we need that.
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- Information Needs for Travel Demand Forecasting
- Travel information
  - ✓ Origin-Destination Data
  - ✓ Vehicle Trips or Person Trips
  - ✓ Trip purpose stratification
  - ✓ Defining Productions and Attractions (Rules)
  - ✓ Processing Travel Data
    - o Developing calibration files, trip tables, initial travel impedances

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So what we discussed today in summary. In this lecture again, we told you that there are four major areas, we need the information for carrying out travel demand forecasting and out of those in this lecture we discussed in details about the travel information. So we talked about the OD data which is very, very important we said that the confusion should not be there whether we need the vehicle trips or the person trip, we said that if public transport or that kind of work we are doing, so we obviously need the person trip data.

In other cases also we may use person trip data, but overall it depends on the purpose. What is the project about and what is the aim of the project context according we have to take a final call. Similarly the trip purpose stratifications, we say we explained you what are the different possibilities are possible stratification that one can use and we say that it is again context specific the transportation planning nobody will just give you, okay?

Let us do a transportation clinic study. There must be having some purpose in mind. So, of course once you do it you can do many other things probably but what is the basic objective of doing this work? Accordingly, we have to select the stratification then we said something very clearly how origin destination and production attractions may be same or may be different they may not be same.

If there is a home end in either origin or destination if there is a home end whether its origin whether it is a destination trip is always produced at home and get attracted to other end. And if none of these origin or destination is actually home end then trip is produced at origin and get attracted at the destination. Then we discussed briefly about the processing of travel data how to develop the calibration file trip tables and the initial travel impedance.

Once you have the trip table data, you know, so many people are travel from one zone to another zone what is their travel time by different modes. So you get some ideas of the zone to zone travel time which you use as a starting point for doing your trip distribution more choice assignment all these but then finally you can always go back because you know, once the loading has been done based on actual loading what is then the actual travel time or travel cost according you may go and update the whole process, thank you so much.