Urban Transportation Planning

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Lecture No. # 03

Introduction Contd.

This is lecture 3 on urban transportation planning. In this lecture, we will continue with the introduction part, and try to complete the introduction part with in this lecture. Before we proceed with lecture 3, let us recall what we did in the previous lecture, you may remember that we started our discussion about transportation system. The modes different components of each of the modes and then different steps involved in the development of each the components. Then we discussed about the number of modes available for urban travel, we found that there are 9 different modes available for transportation in our cities and towns. Then we discussed about the model characteristics and ranking of the different modes based on the users point of view.

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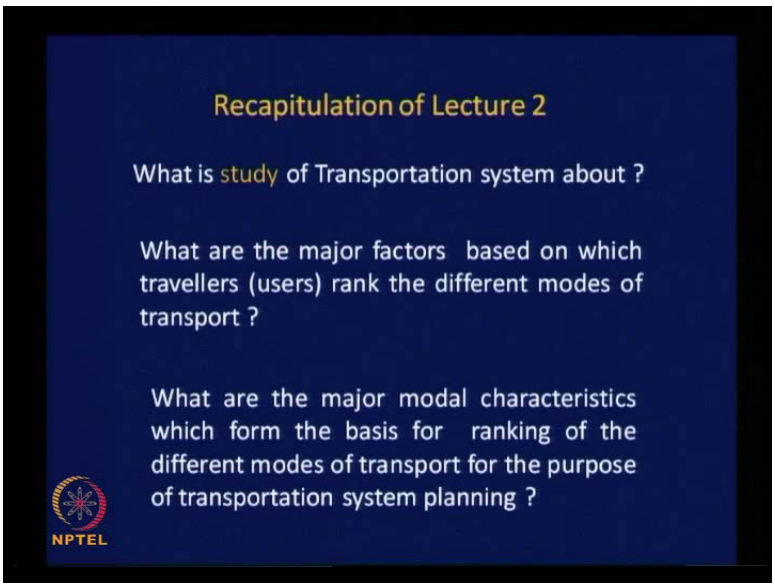

Then we discussed about ranking of the different modes based on the characteristics, but in planner's point of view. Let us try to recollect few specific points on the previous lecture by posting these questions to us recapitulation of lecture 2. The first question is

what is study of transportation system about? Let me answer this question study of transportation system or comprehensive study of transportation system is the study of planning, evaluation, design, construction operation and maintenance of all the components, namely the way the vehicle the terminal and the control concern with all the 7 modes of transportation namely highways, railways, airways, waterways, ropeways, pipeline and conveyors. This is how we can adjust we can understand the comprehensive study of transportation system. I hope you will be able to answer this question, which is rather simple the next question is what are the major factors based on which travelers the users of the different modes rank the different modes of transport. You may recollect the ranking by the uses is based on the technical and leveler service characteristics of different modes.

Could you identify this factors anybody it is basically the user point of view the speed the cost the level of comfort the accessibility and the terminal points. So, these are the factors that are influencing the ranking of the different modes by the users the speed of the different modes. The accessibility level of accessibility to the different modes cost implication with regard to each of the modes, and then level of comfort available in these modes. These are the factors that are influencing the ranking in their own perception by the users the last question related to the previous lecture is this.

What are the major model characteristics which form the basis for ranking of the different modes of transport for the purpose of transportation system planning or in other words in planners point of view how the different modes are ranked. Any response anybody planners rank the modes based on global factors like environmental impact made by each of this modes energy conception implication by the different modes. Environmental impact was measured in terms of air pollution cost by different modes per passenger kilometer of travel. And energy consumption was also considered in terms of energy consumed per passenger kilometer, so that we have a common base for ranking of different modes for the purpose of planning.

The ultimate adjective is to plan for the sustainable transportation system, which will consume least energy and protect the environment to the extent possible. Now, let us pass on to take the over view of the factors influencing travel demand you may recall that I mentioned you study of causal factors is a very important component of

transportation system planning. In that context you must look at this aspect of an over view of the factors influencing travel demand.

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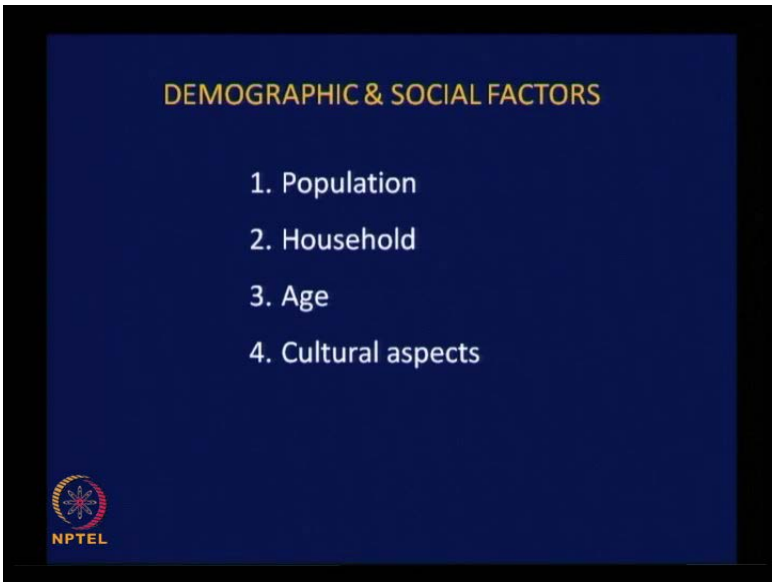

The factors could be related to demographic and social aspects. The most important one is the population. More the population in an urban area more will be the travel demand, where than a population a planner should be concerned about the pattern of increasing population in urban areas. To understand the possible changes in the demand for transportation and next important factor is the household. What is house hold? For the time being, you can understand household as just family. Even though it is not exactly family for the time being let us assume that household means family, later on I will give you precise definition about household.

Now, the question is how household influences the demand for transportation. Let us consider two cities, one city in a developing country, another city in developed country. Let us say, the household size in the developing country is about 5 and the household size in the developed country is likely to be less or more? Less, let us say about 3.5, the population is going to be same. But if you work out the number of households based on the total population, you will end up with less number of households in the case of developing countries and more number of households in the case of developed countries for the same population.

Simultaneously, we must remember that the mobility requirement for a household is based on the requirements of an independent household. So, that way you can easily perceive that when you have more number or households, it is likely that when you get more trips made in urban area, irrespective of population households also influence the travel demand. Next important factor is the age. Let us consider two similar cities, in one city the average age of the community is higher than the average age of community in another city which city will have more intensity of travel, more demand for transportation? Same population, but average age is different, one city higher average age, another city as relatively less average age.

How will we classify as the higher ratio, because let us say incase of (( )) higher let us say 40, they have the nurving influence to (( )).

I appreciate a point, we consider two cities of similar economic characteristic. Let us say still age will play an important role. The city which has got average age be higher will have more of elderly people whose mobility will be relatively less compared to younger and middle age group of people. So that is how we must understand the influence of age on demand for transportation. In developed countries now, the concern is higher level of average age that is really telling on, the overall productivity of the nation itself apart from other aspect like travel demand and so on.

So, average age of a community plays a vital role in various aspects related to the overall development as well as demand for transportation in a city or a country. Lastly, cultural aspects, you may agree that cultural aspects are closely related to the activity pattern of households. It may have historical connections and the activity pattern is closely related to the travel demand. So, that is how we need to understand cultural aspects also have a very important role to play in influencing the demand for transportation in urban areas. So, as planners, we should try to understand the influence of these aspects the major factors in there right respective.

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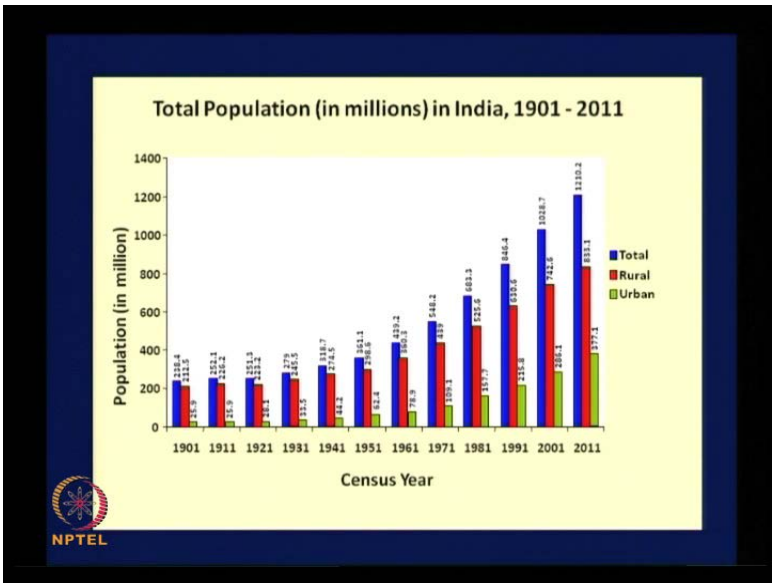

Let us now, a closer look at the first aspect of population in respect of our country India. Let us see, how population as changed right from 1901 to 2011 in our country, this was the population in 1901 in India population in million. You can see the urban population, which is shown in green color is very small compare to the total population as well as rural population. This scenario did not change much even in the subsequent decade in the year 1911, that is all most same there was no change in the proportion of urban population with respect to the total. We move forward to 1921, we find that there is no significant change.

The same story even in the year 1931 not much of change as for as the proportion of urban population with respect to the total. 1941 we find picture is not very much different compare to the previous trend. Whereas in 1951, there is some change you can see increased height for a green bar. Obviously, 1951 is the free India condition, earlier India was a British colony and social setup been not change much. After freedom, you find that there is some kind of mobility from rural area to urban area resulting in higher percentage of urban population. And this strength continued subsequently, this was the best scenario in 1961. This is what happened in the subsequent decade in the year 1971, you can see a significant increase in urban population.

1981 picture is much better compare to the previous cases increase in urban population 1991 also follows a same trend. 2001 can see a significant increase in urban population

and now, in 2011 this is the scenario, that present total population of India is 1.2 billion as per the recent censes record. And there is a significant increase in the proportion of urban population. Let us take a closer look at the growth of urban population in our country in respect of the past decade.

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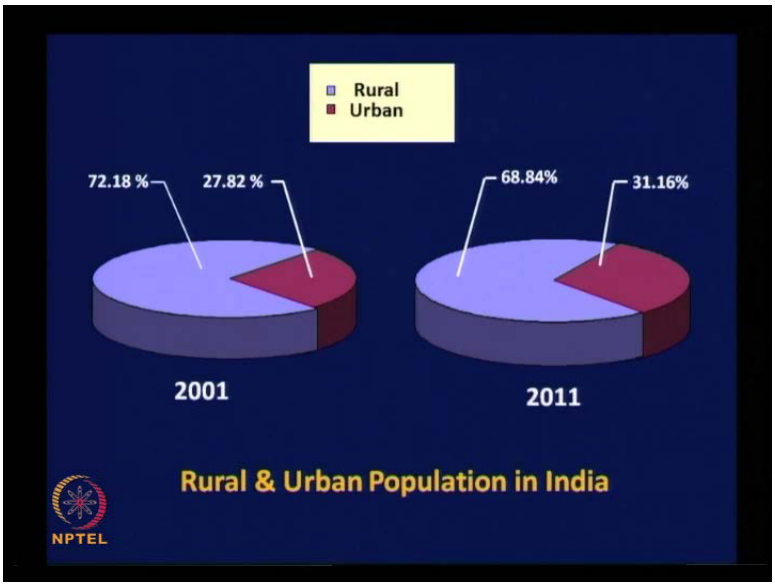

This is the trend or the proportion of urban population and the rural population. In 2001 urban population constitutes about 27.82 percent and the rural population was just 72.18 percent. What is happened in 2011, there is a significant increase in the urban population, the percentage being 31.16 and the rural population constitutes 68.84 percent. Now, my question is how this happens? See, because the population growth of urban dwellers is more. Is it indigenously generated in urban areas or due to some other factor?

(( ))

How the population of our cities and towns increased?

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That is a point; there is a significant migration of rural population to urban areas to take advantage of better employment opportunities available in urban areas, better educational opportunities available in urban areas, better health facilities available in urban areas and so on. So, it is mainly due to migrative process our cities and towns are growing at a very

fast rate. This indicates that in the near future, the economic developments of most of the countries are going to be decided by the rated development of the urban areas.

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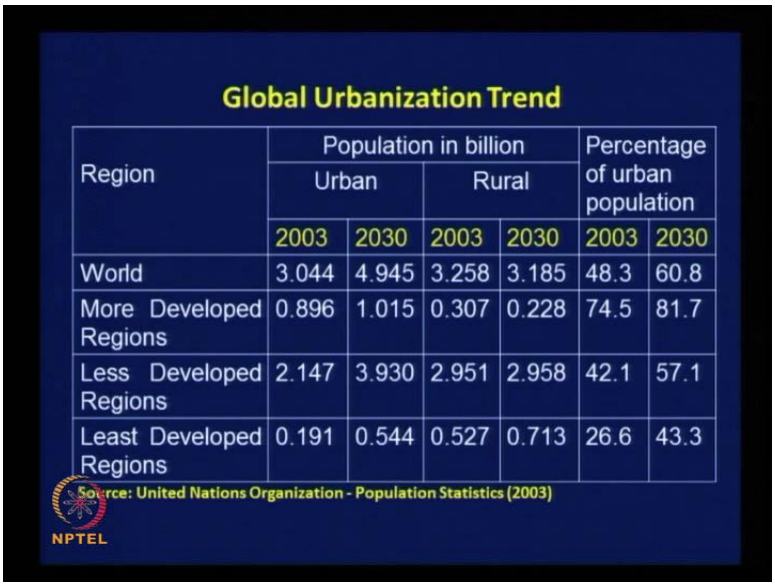

The urban areas are going to be really engines of economic development of any country that is a trend, that should be understood very clearly and this fact has been reinforced by a recent study by United Nations organizations. This statistic is produced by the population statistic department of U N O. They have given information about urban and rural population for the years 2003 and 2030. At the global level they have also given the break up for developed countries as well as developed and least developed countries. For example, if you take the whole scenario for the whole world, the urban population in 2003 was 3.044 billion. In 2030, it is expected to change to 4.945 billion. Similarly, rural population will decrease from 3.258 in 2003 to 3.185 in 2030.

The corresponding percentages are 48.3 percent of the whole world will be living in urban as lived in urban area in 2003 and it is going to be nearly 61 percent in 2030. 61 percent of the whole world is going to live in urban areas as in the near future and scenario in the case of more developed regions is very interesting. See look at the percentages in 2003, 74.5 percent of the people in highly developed countries already livid in urban areas and it is going to be 81.7 percent in 2030. Can imagine just round 19 or 18 percent of people will be living in rural areas supporting the rural economy like agriculture and so on.

And if you look at the scenario in case of less developed regions, the percentage in respect of 2003 is 42.1 and it is going to be 57.1 percent in 2030. And for least developed regions, it will be 43.3 percent in 2030 and it was 26.6 percent in 2003. India comes under which category, less developed regions or least developed regions, you can identify based on the already available data in respect of India. In 2001, what is the percentage of urban population in India? It is about 27 percent; it is very close to the percentage given here in respect of least developed regions. We can say that India lies in between less developed regions and least developed regions category as far as statistic is concerned.

And based on this statistic, can you just extra plate the percentage of urban population that is likely to be in India in the year 2030? Optimistic estimate is about 50 percent, pessimistic could be around 45. It is going to rate between 45 to 50 percent of Indians will be living in cities and towns in the year 2030. It is a very important factor, which is going to have significant influence from the overall economic development as well as infrastructure needs of the cities and towns in India.

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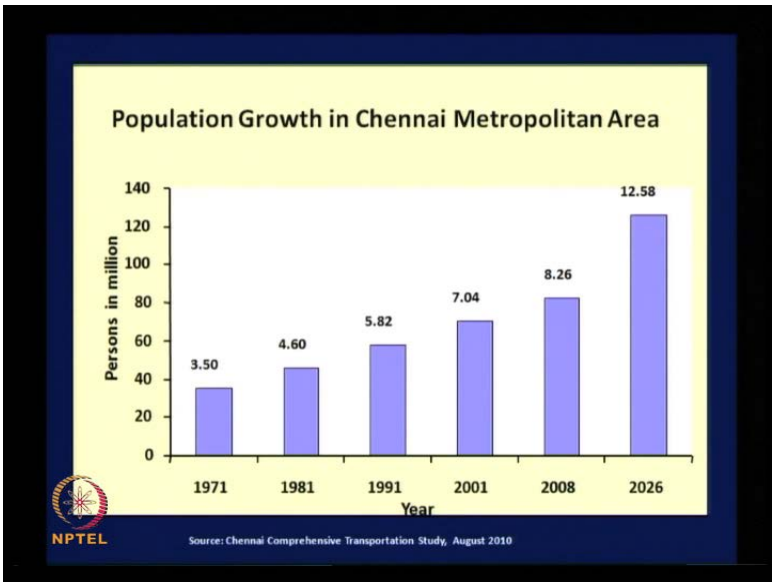

Let us have a closer look at the population statistics for one city namely the city of Chennai. This is based on a recent comprehensive study done for this city and completed in the August 2010, last year it was completed. This is the population growth scenario for one urban area namely Chennai city. You can see that the population value for the year

2008 is given as 8.26 million and it is predicted to be about 12.58 million in the year 2026. You can assume the current population to be around 10 million for Chennai city approximately and this implies that if you compare the population 1971, it has almost more than triple in about 5 decades. That is the rate at which population is growing in our metropolitan cities. Chennai is one of the metropolitan cities, jumbo cities in our country, fourth largest city in India.

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Then, let us look at the economic factors that may have influence on the demand for transportation. What are the possible economic factors that might influence travel demand? Any suggestion, Economic factors; The most important one is employment, more the employees in a society, more will be the demand for transportation at least for work trips and related activities. Or in other words, when you have more employees per household, there will be more demand for transportation. Another related economic factor is the income itself, more the income, more will be the demand for transportation mainly because the increase of income might result in higher proportion of disposable income.

What do you understand by disposable income? Any family will have some basic needs like food shelter, clothing and so on. So, they have to spend some money to meet these basic needs. Then, whether it is individual or a family or a community there will be never ending wants by the people, need is different from want. So, disposable income is

made use of to satisfy your wants, whatever you want, you can refer to you can try to by using a disposable income. So, when the income increases, there is flexibility and the wants of the people increases, which generate more trips for various activities. Then vehicle ownership, when you have vehicle available to you, it is easy to make trips and the ease with which people make trip, motivate them to make more trips.

Let us say for example, the work place for a person is at a distance of about 3 kilometers from home. If the person is using public transit to go to work from home most probably, he or she will carry lunch also to work have her lunch in the office itself and return home one in the evening. If the person wants a motorized vehicle like two wheeler or car, he or she may be tempted to come home for lunch too, it is possible to come back quickly have a hot lunch and then go back for work. So, that is how vehicle ownership encourages people to make more trips for different activities. In this particular case, if we find that the number of trips simply get double, 2 trips become 4 trips, because vehicle is available. That is how vehicle ownership has very important barrel on the demand for transportation.

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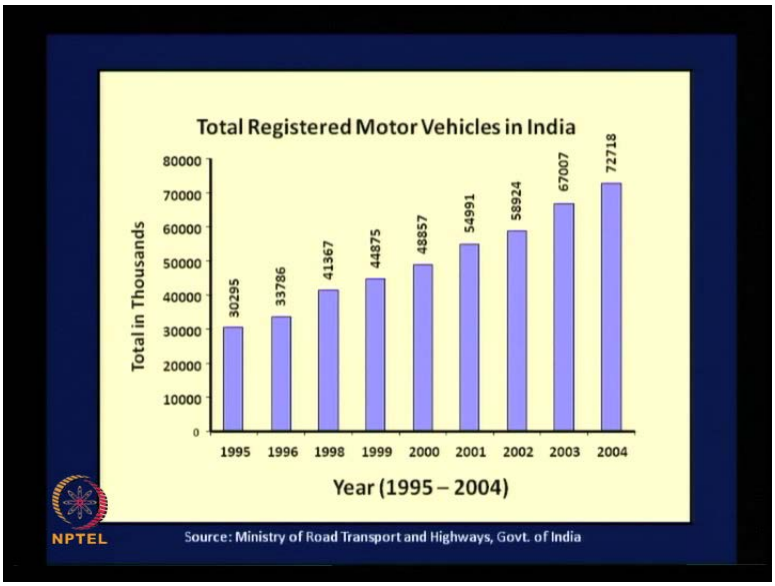

Let us look at, what is happened to about growth of motor vehicles in our country, the recent past covering the period from 1995 to 2004. The source for this information is the left side of the ministry of transportation highways government of India. In 1995 this was the total number of registered motor vehicles in our country, in Thousands, it works at to

30295. And it was increasing then on and became 30786 in the year 1996. And then 41000 plus 1999 value was 44000 plus and in 2000, it was 48000 or nearly 49000. 2001 54991, 2002 58924, 2003 67000, then see the rate of increase is very steed the recent past, then 72718 in 2004. What is a likely number of motor vehicles in our country today is 2011 in Thousands, 72 in 2004, any guess?

100000 minimum.

100000 minimum, is it not? But it is a very pessimistic estimate. In my opinion, it might have (( )) touched 200,000. We are talking about 2011, 2004 to 2011 7 years later, the rate of growth of the motor vehicle is very steed, it could be around 200,000. I do not have exact statistics provided by this ministry, they have not updated. And you can guess it is going to be nearly 200,000 motor vehicles of all categories together including heavy vehicles light vehicles motorized two wheelers all together.

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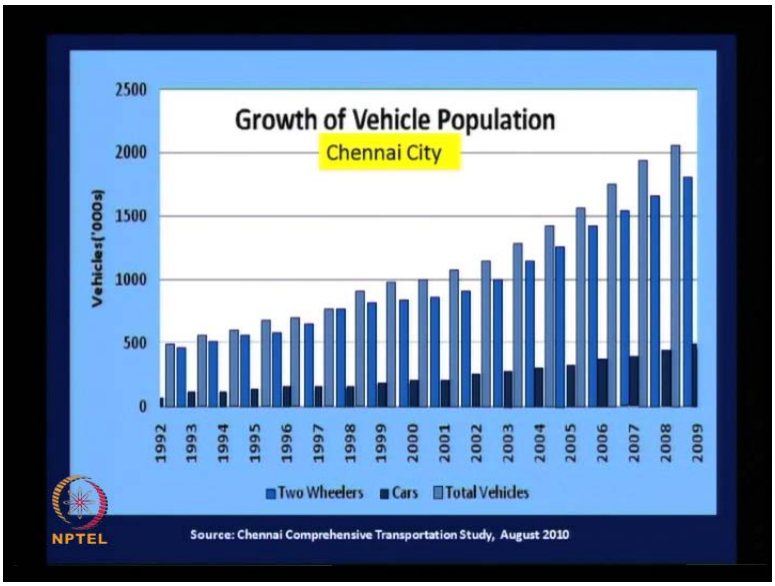

Let us have a closer look at the same aspect with regard to this particular city growth of vehicle population in Chennai city category wise that shows a better light into the impact of vehicle growth on travel demand. 3 categories are shown here two wheelers, cars and total vehicles. It is from 1992 to 2009, you can see that there is a steed increase in the rate of growth of motorized two wheelers, is it not? In Thousands, what is the total number of two wheelers in 2009? It is nearly, 100 and no; 1800 Thousands, nearly 1800 against the total of 2000 plus, cars have touched almost 500. And this is how the vehicle

ownership is increasing in a particular urban area. Please remember the vehicle ownership is totally different in the respective urban areas compare to rural areas. We have relatively low ownership in rural areas compare to cities and towns.

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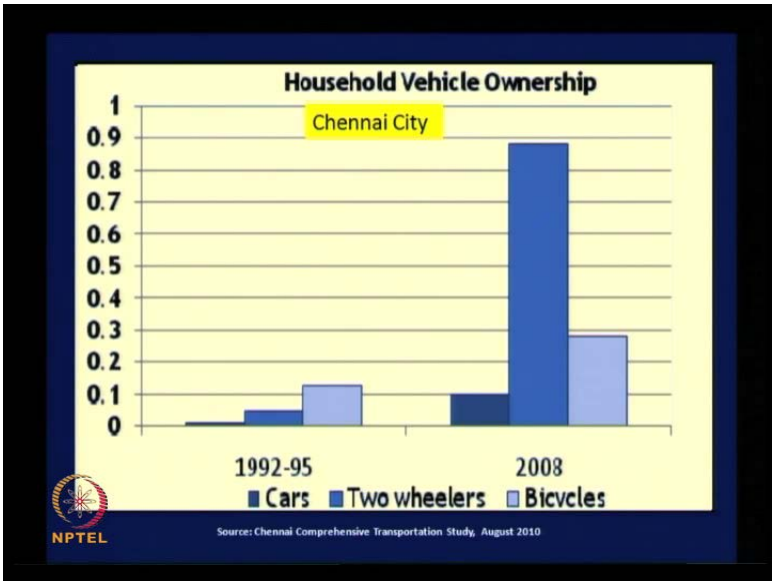

And let us extend this idea to understand the ownership of vehicles by households that will give a better picture about the mobility capability of members of a household in a city or town this pertains to Chennai city. In 19; the period between 1992 and 1995, if you look at a car ownership it is negligible almost close to 0, this is vehicle ownership per household per one family. And two wheeler ownership, as you could see had been about 0.05 two wheeler per household, this means that, there are one two wheeler for every 20 households. If you look at the bicycle ownership, it has been about 0.1 bicycles per household. This implies that, during that time there had been one bicycle for every 10 household.

Now, in 2008 you can see that, car ownership is 0.1 car per household, is it not? That means, there is one car available for every 10 household is it not? There is one car for every 10 households in 2008 in Chennai city. And motorized two wheelers, the value is point; nearly 0.p let us say. So, it is very high compare to the value of car ownership nearly 9 times the car ownership, bicycle ownership has only marginal increased to touch 0.3. And what is likely car ownership in developed countries? Or before that, can you

extend this statistics to get the number of cars for 1000 population in our country. For 2008 level car ownership is 0.1 car per family or one car for every 10 families.

Let us say, the family size is approximately 5 percents that means, there will be one car available every 50 percents. And for 1000 population approximately 20 cars per 1000 population that is the car ownership in India in the year 2008 and it is not going to be different. Now, may be slightly more than the value of 2008. What is the likely car ownership in developed countries? (N0 Audio From: 34:34 to 34:41) Cities, cities of developed countries.

(( ))

Yeah, your estimate is under estimate the car ownership is approximately 500 cars for every 1000 population, every alternate individual won a car, so it is a comparison of 20 against 500. And we think of for the traffic problems in our country, even now we find our roads are full of cost with such a low car ownership of just 20 cars for 1000 population. Why it is so?

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Yah, the numbers speak, even though percentages the proportions are less, the population is more. That is how we just feel the pinch on any infrastructure that is developed to meet the demand for transportation.

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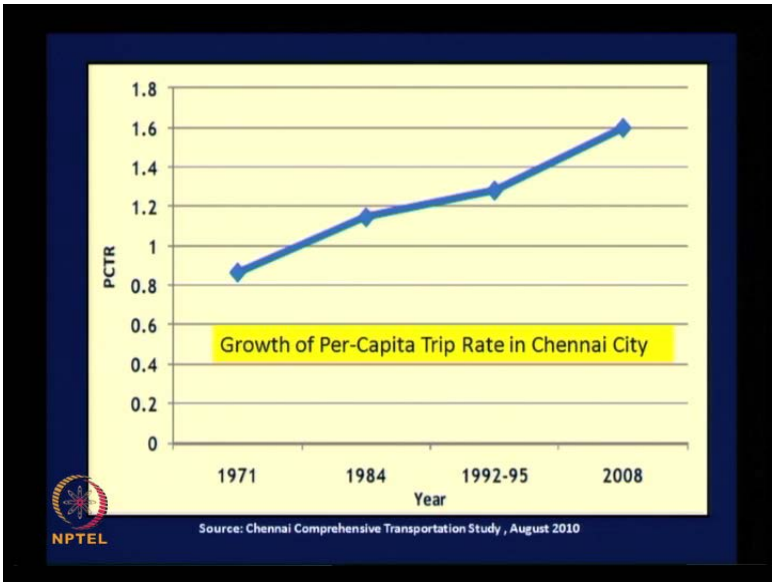

Let us try to understand the trip rate for the same city Chennai city, based on a same study then in 2010 of course, they have look into the past trend also. You can see that P C T R Per Capita Trip Rate, average number of trips made by any individual per day is Per Capita Trip Rate. There could be individuals making several trips 5 trips, 6 trips, there could be individuals making 0 trips. All taken together and the average is given here, it was point nearly 0.8 trips per head per day in 1971, then it rows to nearly 1.2 in 1984 and it was it say 1.3 in 1995 and it is 1.6 in 2008. Currently, it may be slightly more than 1.6 may be 1.65 or 1.7 trips per head per day, is it a high level of mobility? Please understand by definition here, trip means one way movement from an origin to a destination. Based on this definition, the trip rate is 1.6.

What is the likely trip rate, Per Capita Trip Rate in developed countries? Could you guess? Under estimate that is over estimate, it is around 3.5 trips per head per day. Why it is so high in developed countries?

Vehicle ownership(( )).

Vehicle ownership is the only reason, is it? Road conditions, income all together you can say that higher level of social economic activities leads to increased mobility in developed societies compare to what is happening in develop; developing countries. So, please understand in spite of such a low mobility level of just 1.6 trips per head per day in spite of low car ownership, we are unable to manage our traffic. Please understand that we are developing at a very fast rate our car ownership is increasing exponentially, motor vehicle ownership is increasing exponentially. Our economic status is increasing, our disposable income is increasing all these factors were lead to increased mobility of individuals both in urban as well as a rural areas.

How are we going to meet the demand for transportation in the near future? It is really daunting task, it is not that easy. So, it is a challenge to provide adequate transportation infrastructure to meet the future travel demand in our country that is going to be a major diversion of resources towards development of infrastructure in this country in the next few decades. Two three decades it is going to be only transportation and transportation, covering all the modes highways, railways, airways and waterways. That is how we can manage the demand, going demand for transportation of the country. And this means there is going to be enormous opportunity for transportation engineers for their carrier

development, better opportunities, job there is going to be shortage of transportation engineers in the near future in our country.

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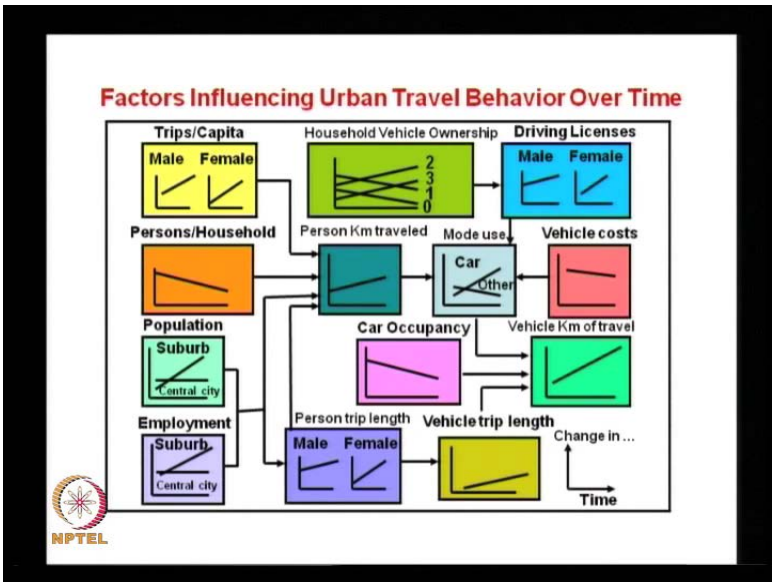

Now, let us see the effect of the influencing factors on travel pattern over a period of time, this will be discussed based on a series of plots made based on the experience of developed countries. They have already observed, how each of these factors have changed over your period of time. And the time here is taken along X axis and change in various factors is taken along Y axis, that is what is shown at the right hand bottom corner to you for reference. Later on, this will not be shown for each and every graph because we are going to show a number of smaller products covering the whole slide.

Let us start with one factor trips per capita about this just now we discussed. What is a historical development of trips per capita? This is what has happened in the past in developed countries. Trips Per Capita were very high initially with males and increased at a particular rate. In respect of female, it was relatively less, it start with and then picked up fast. And almost now it is on tor with male, there is no distinction in respect of mobility between male and female in developed countries as of now. And household vehicle ownership changed following this pattern; initially there were quite a good number of households with no vehicles, 0 vehicles owning households. Then, over a period of time that was decreasing faster touched almost the X axis making that every household owns a house.

Subsequently, it is observed that even households with ownership of one vehicle started decreasing, many households started buying more than one vehicle. You can see a decreasing trend shown here for vehicle ownership 1, but little flatter compare to 0 vehicle ownership. And there had been increasing trend of households two vehicles on top and see more number of households with two vehicles. And there were households the three vehicles too, three cars fine, this is the trend experienced in developed countries, please remember it is going to be the trend in our country in the near future.

Even now, there are quite a good number of households owning 2 cars more than 1 car in metropolitan cities and the trend is going to continue and no wonder that we also go through the similar trend in the near future. And this leads to what? This leads to increased number of people learning driving, owning driving license and this is what happened developed countries. Initially, lot of males only want driving license and that increased very few females were driving and later on both were almost on part like female male there is no difference in driving license ownership.

Let us look at, what is happened in persons for household or household size or let us say in general family size. This is a trend observed; there was a gradual decrease in the size of the household. Why should it happen? This does not mean that, there is a decrease in the whole population, only household size is decreasing, the size of family decreased, what could be the reason?

(( ))

Yes, individual family concept fine.

Nucleus.

Nucleus ok, and what could be the motivating factor for families becoming smaller and smaller? Obviously, economic prosperity brings in independence and more weight age for independence, privacy and so on, all these factors leads to smaller families. When you have joint families, you cannot be that independent, that private. So, when you have economic independence, the family size decreases the strength is noticed in urban areas right now in our country. Would have heard about families breaking away getting into smaller groups, because they want to be independent. So, this trend will be reflected shortly in our country too.

Then, population mainly they spread a population over urban space, what happened is this, the population growth in sub house increased at a cheap rate compared to population growth, which remain almost static in central part of the city. This will have an impact on the travel pattern as well as demand for transportation. Why it might happen? Obviously, because of quantum space one thing and people looking for better living environment. More living space and so on, which may not be available in the city centre and the environment might be much better in terms of air pollution, noise level etcetera in sub house compare to city centre, that is how there is a just movement of families from city centre to sub house.

Employment obviously followed a same pattern, more employment centers got developed in sub house, because they also could not afford to rent out building at reasonable rent. City centre at one reason and they have to follow the trend of population spread. So, this is what happen in the past developed countries and this is already happening in our country too in major metropolitan cities. And this spread will lead to obviously increase in person trip length still they may have work places mostly in the city centre, and they will be driving longer distances resulting increased trip length and again comparison of male female is similar trend.

And let us see, what will be the combined effect of all this together, taking the account increasing Per Capita Trip Rate and reduction in household size and spread of urban population towards sub house, as well as the increase in trip length all together will result in increased person kilometer travel. If you measure the travel intensity in terms of person kilometers, there will be a significant increase. As plan as we are interested to measure the travel intensity in terms of person kilometers first and then convert our intensity into vehicle kilometers based on the models weight.

The trend is going to be (( )) there will be study increase of trips in terms of person kilometers. There over other factors too, for example increased driving license, increased person kilometers will lead to a mode dues or mode choice as shown here. Since many people are driving, since person kilometer is increasing, there is going to be more and use of car usage and significant decrease in use of other modes this is what happened in mode cities of developed countries. They are fighting hard to bring people from car to public transport it is not working successfully so far.

Then let us say unfortunately the cost of cars is also decreasing due to some reason may be healthy competition so on. This will add oil to the fire; this will add to the increase in car usage, this as happen in several cities around the world. The competition let to reduce price of car giving loans to purchase of cars and so on. Again all these things will lead to increased usage of personal vehicle. Added to that car occupancy decreases, less and less number of people in car only one person driving a huge car, because can afford to home. And let us see the combined effect of all, person trip length increase will lead to obviously, vehicle trip length increase, there is decrease in cover occupancy and increase in vehicle trip length. All these things will result in one aspect namely increased travel in terms of vehicle kilometer, that is what we see realize on our roads.

So, this is how we must try to relate the causal factors to the traffic scenario that we observed on our roads. Any question on this particular flow chart? This is a comprehensive presentation of various factors that influence the travel demand and the resulting traffic that we observed on the road. So, this is not the end of the story, total travel in vehicle kilometer is known to us, but this travel is a complex commodity. The total travel demand in terms of vehicle kilometer you can measure that is fine, how to beat this demand? This demand is spread over time and space, each individual is travelling from a particular origin to a particular destination at a particular point of time.

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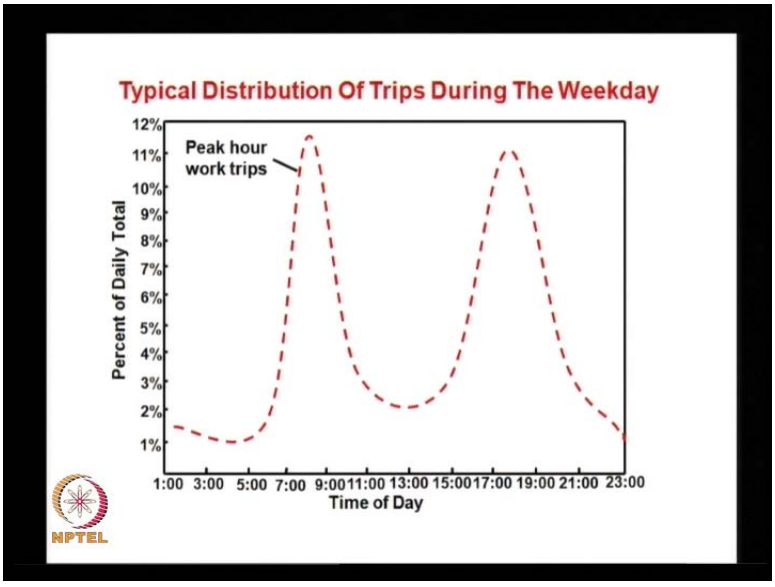

So, take for example, the traffic pattern for work this is what happens. You find there is a very high traffic movement in the morning peak falling between let us say 7 30 and 10 30 am very high demand. Similarly, during evening peak say between 5 30 and 7 30 again it picks up. So, this temporal variation in demand for transportation creates lot of difficulty in transport system management. If you allow all the vehicles to meet or to go towards work places, then during return trips all the vehicles will be returning empty. So, we must find some way out to effectively make use of the available fleet of transit system. Simultaneously, see that demand is met as per the desire of the people, which is spread and first nightly over time as well as space.

To summarize today's discussion, we started our discussion in understanding the factors that influenced demand for transportation particularly in urban areas. First we discussed about demographic and social factors that influenced the demand for transportation starting from population household, then age of the population and cultural background of the population. Then we discussed about economic factors that influence the demand for transportation starting from employment, income and vehicle ownership. And finally, we took an over view of all the factors put together and found that all these factors have their own contribution towards increased vehicle kilometer that we observed on city roads. And meeting this demand is a challenge, because this demand is spread over space and time, with this we will conclude our discussion in this lecture will proceed, the rest of it in the next class.