

**Urban Transportation Systems Planning**  
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**Lecture - 01**

**Urbanization, Urban Transportation and Transportation Demand**

Welcome, Module A Introduction to Urban Transportation Systems Planning and this will be covered in 1 week, today is the 1 lecture where we will cover urbanization, urban transportation and the transport demand.

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**Urbanization and Urban Transportation**

**Urbanization**

- Population and economic growth has fostered urbanization in the country
- Several factors at play that have led to the urbanization in India
  - ✓ Population growth
  - ✓ Migration
  - ✓ Expansion of towns and cities

Urbanization in India

Year	Level of Urbanisation (%)
1951	17.3
1961	18.2
1971	20
1981	23.3
1991	25.7
2001	27.78
2011	31.16
2021	32.29

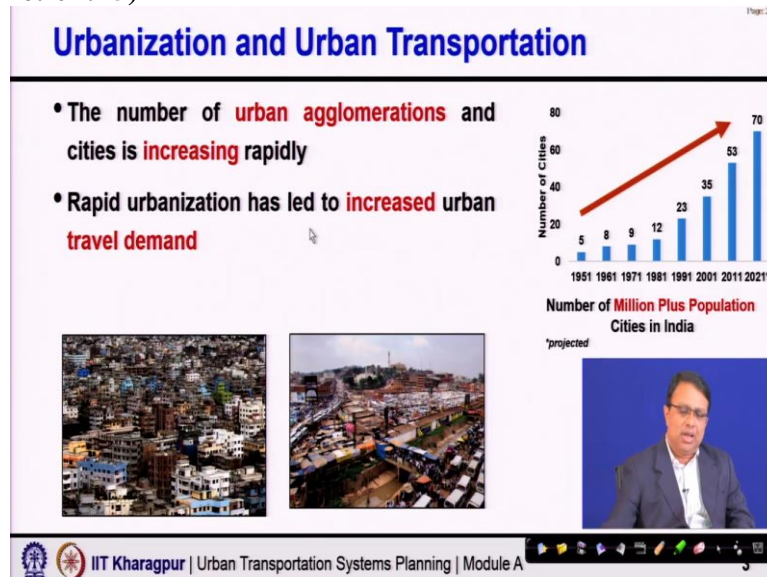
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As you know that the country is going through rapid urbanization, population is growing and economic growth is also there which are altogether boosting the urbanization in the country. As you can see in the figure, the share of urban population is growing steadily over the last several decades and presently nearly 32% of Indian population are living in urban areas and with the current trend in future soon we will have nearly 50% of population staying in urban areas.

So, the whole country wrapped in the whole country the urbanization is happening very fast, there are several factors which are actually causing this urbanization to happen faster namely, population growth. As you know, the countries even though the population is also growing lot of migrations do happen when people come from rural area to urban area, because of various reasons getting the facilities better facilities, better education, health care, better, you know, recreational facilities all the things are there.

Then the cities and towns are also expanding, if you look at the towns, all the big towns are the mega cities in India they are expanding. So, whatever was the boundary of say Calcutta or Bombay practically the city boundary has you know boundaries have expanded. So, as a result altogether the share of urban population is increasing and India is actually showing a very distinct trend of urbanization.

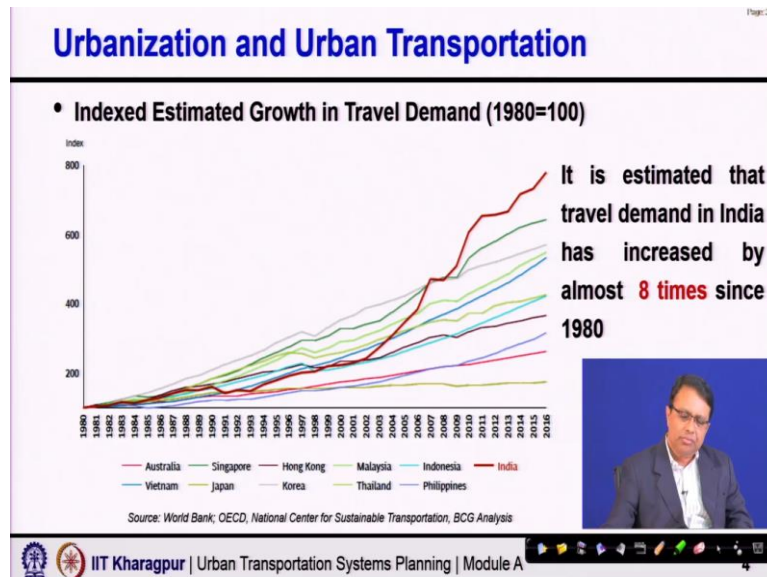
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The number of urban agglomerations and the cities is also increasing here in the right hand side I have shown how the million plus population cities number of million plus population cities is increasing in India, you can say that there is a very steady growth and as per the prediction around 2021 22 we are expected to have nearly 70 cities in India where 1 million or poor population will live.

So, that shows the magnitude of urbanization and the kind of transformation that is taking place in Indian scenario. The big question here is urbanization happening the way it is expected or desirable, the answer is probably no. Even though most of our cities are not planned cities, and the urbanization is not really taking place in a very systematic manner.

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Now, this urbanization, because more people are living in urban area, the travel you know demand is also increasing more people are living so, more people want to travel. So, obviously, the overall travel demand in urban area is also increasing. Here I have shown an interesting representation of indexed estimated growth in travel demand, why it is indexed that means 1980 is if we take the 1980 as 100.

Then how the growth has happened over you know, years that is shown here for a few cities. The interesting part is you may not be able to read everything it is not necessary also, but look at this rate line. This rate line shows how the estimated growth has happened for India. And what we find that the increase is almost 8 times since 1980. This again shows that not only the urbanization is happening, but overall the travel growth in India is enormous and definitely it is going to be very similar if not higher in urban Indian context.

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## Urbanization and Urban Transportation

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### Urban Transportation

- An efficient transportation system is needed to **support** the ever **increasing** urban **travel demand**
- It is also required to **support the complex activity patterns**, necessary for **ensuring the vitality** of the urban area
- Transportation system has a **strong influence** on the **growth** of an urban area which may **promote** or **hinder** development and vice-versa

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As I said that because of urbanization and because simply more people are living in urban areas, we need an efficient transportation system to support this ever increasing urban travel demand, because people if they people stay in an urban area people are required to move out they want to travel they want to travel to various destinations for various purposes, people want to go to school, college, shopping areas for medical requirements, number of things are there in urban areas and they need to travel.

So, we need an efficient transport system to support this level of urbanization and to support this level of requirement of travel. Also, often in urban area, we observe complex activity patterns people go people need to there are different types of land use different activities located in different places. So, we need an efficient transportation system for ensuring the vitality of the urban area.

So, in urban area obviously, always look very vibrant, if the transport system is good, in fact, I would say for me, the very first impression I develop about any place is through its transport system, whenever I travelled to a place, the moment I come out of the railway station or the airport and get the first impression about the city or the place is through his transportation system.

Now, it is important for all of us to appreciate and understand clearly that transportation has a strong influence on the growth of an urban area and which may promote or hinder development and vice versa. That means what I am trying to say or indicate here see a city cannot grow unless his transportation system is good. I mean, if all around the city you cannot move the roads are bad and the traffic is congested always you know and the city cannot grow.

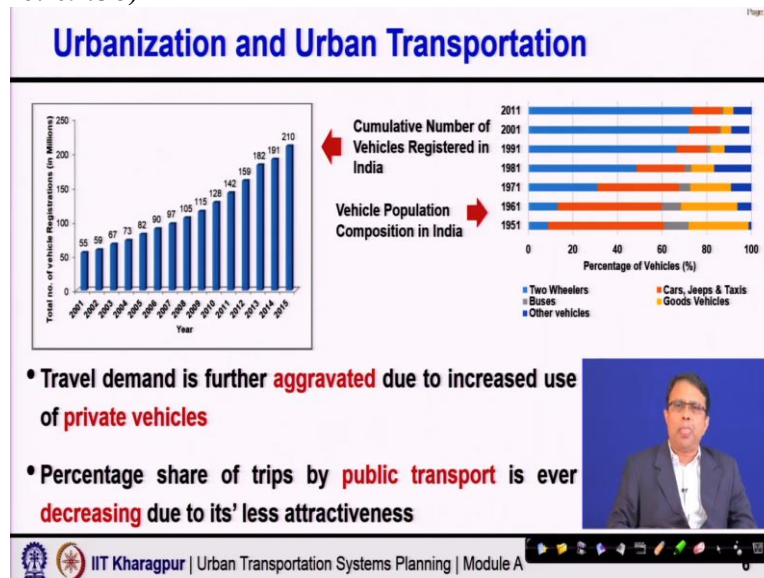
Because the economy roles on transport. So, unless the transport system is good, the cities cannot grow further. The 2nd part what I am trying to say is that the transport system may act as a catalyst to promote the development in certain geographical region say the city is expanding and you have open land which you also want to include and recognize as a part of future development of the city.

Now, this you want to promote the development the best thing would be to have good road connectivity or rail connectivity in general I could say the transport connectivity and also you

know to have good public transportation system. So, if you just have a good public transportation system connecting you know this place and good road system or rail system as I said, then you will find automatically that area will develop.

So, if you want to promote the development of an area or image in a particular geographical region, the best thing is to develop its transportation system. So, one way since the place is developed, you will require people need to travel to you will require transportation system. So development also put pressure on the requirement of transportation development. And if you want to improve the transport system or think of the transport system development, that will also boost up the development of the overall area.

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Now, one way because simply urbanization is happening and more people are staying in urban area, so naturally more people want to travel. So there is a pressure on the transportation system the demand is more the other thing is also happening that you know that travel demand initially we can measure in terms of the number of person trips. Say if we are talking about passenger transport.

So people want to move. So it is basically the passenger transport but then the percent eventually gets transformed into vehicular trips somebody using bus somebody using car somebody using two wheeler. So, when you see a road, it is full of traffic. So, the passenger trips somewhere getting converted into number of vehicle trips. So, end of the day that vehicle trips actually matter because how much is the road space available.

What is the road capacity and how many vehicles are trying to use that road. So, there we find that along with the increase in the overall urban population, which is anyhow creating the higher travel demand and creating pressure on the existing transport system, travel demand is also further aggravated due to increase in the use of private vehicles. If we see India is really a big market for the cars.

You can see a lot of companies even Indian manufacturer, foreign manufacturer as they are all they have you know outlets in India and the economy is growing developing, they are a tremendous aspiration among youth to own private vehicle, we cannot deny that. So, higher the private vehicle usage, obviously, the same number of persons to carry you need to more vehicles.

Because if you just consider 50 people going in a bus and each 50 of them you know, they want to go by private vehicle theoretically, then that will mean 50 vehicles on roads. So, in terms of congestion in terms of everything, they will mean entirely different urban transport scenario. So, this is also again very important thing. One more important thing in this context is percentage share of trips, but public transport is ever decreasing due to its less attractiveness.

So, the left side I have shown a figure here, you can see how the total registered vehicle is growing in India. So, you can clearly see that this is the kind of growth that is really happening. So, and this growth is happening, because of the primarily the growth of private vehicles, why I am saying if you go to the right side, you can see this is actually the share of public transport that is happening.

And I have shown starting right from 1951 the lowest bar is for 1951 and the top 1 is for 2011. So, if you at see that the share is really decreasing. So, look at this situation here somewhere, this is a small share of trips that is taken by public transport, whereas, in 1951 that share was somewhere here and in between if I have to say it is here, it is further getting reduced and so on.

So, you can clearly see the number is not important, you cannot remember the number, but this message is very important that the share of trips by public transport that is you know the percentage of vehicle I can have said here in terms of percentage of vehicle. So, the

percentage of vehicle in the overall vehicle population that is showing a declining trend if we consider buses.

The same thing is true even for the share of trips that are made by public transport, both in terms of percentage of vehicles and percentage of trips shared by you know public transport both cases, there is a declining trend. Although looking at this pressure.

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**Urbanization and Urban Transportation**

- Transportation in most cities in India **predominantly** remains as **road-based** transportation
- Road capacity has **not been augmented** upto the level and has **lagged far behind** demand due to fiscal and physical constraints
- This has created a **significant strain** on transport infrastructure and services which has resulted in heavy **imbalance in transportation demand and supply**

**Road Space in Indian Cities**  
Note: Ideally, it should be 30%

City	Road Space (%)
Kolkata	6%
Hyderabad	6%
Chennai	10%
Mumbai	10%
Bangalore	12%
Delhi	18%

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So, what is really happening because of all these one more thing is very very important for you to understand that transportation in most Indian cities is basically road based transport, you know, the primary in the form of transport is basically road based then there are different modes the water transport, the rail transport, the share for all this transport is really negligible.

So, one way to how much and how the demand is getting served primarily by road base transportation system. Now, if there is so much of urbanization people are more and more people living in urban area more and more people want travel there is also a change in the preference of personalized mode like private vehicle more and more getting used by vehicle and preferred by people public transport share in terms of composition in terms of you know, the share of trips is reducing.

So, what we need and it is all road base transport, so, then what we need, we want definitely more physical capacity of road infrastructure more wider road more or new roads, because other is how we will be able to accommodate the growing demand. So, we need to widen the

roads we need to enhance the road capacity. Unfortunately, that is not really happening. If you look at the thing, the road capacity has not been augmented up to the level and has always lagged far behind due to physical and physical constraints.

What I mean by physical constraints and what I mean by physical constraints physical constraints is you may not have sufficient fund really to develop infrastructure that may be true and also it is true for Indian scenario we have limited fund every country we have got limited funds. So, some cases some towns some cities some urban agglomeration, you are not able to develop infrastructure, maybe because of the shortage of funds.

That is one kind of problem. The other is more severe problem I would say is the physical constraints. Now, why I am saying physical constraint, because if you look at the cities, the urbanization as I indicated has not happened the way it is, you know, desirable. So, they are not Indian cities and towns are not planned development just the growth has happened. So, because they are not planned development.

We have you know, less road space and also you know, you cannot widen road look at the city if some of you are from urban area or if you know that Bombay or Calcutta or even many other urban areas. How much is the scope really to widen the road, you cannot widen because both sides of the road are already fully developed and it will mean maybe land acquisition dismantling the existing structures or housing you know, you cannot do that.

So, as a result even if you have money if somebody gives you a lot of money they your city their transportation problem is very severe. So, you take a lot of money and you widen all the roads, physically you cannot make it happen you cannot think of any new road because you cannot take a road through the land, new road through the land because you will not get open land all are developed mostly.

And you cannot run a road completely unless you know between 2 points, you are able to run the entire road, I cannot say I have got 200 meter developer route it does not give the connectivity in that sense. So, what is really happening all together, what we find there is a huge imbalance between the transport demand and transport supply in the road transport sector in urban context. So, there is a huge imbalance.


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## Urbanization and Urban Transportation

- Although, **efforts are undertaken to improve the urban transport** situation (e.g. New metro rail networks in megacities, Bus rapid transit systems, etc.), significant imbalance still remains
- This imbalance has only **aggravated transport externalities** such congestion, energy, accidents, emissions, etc.
- Overall, current urban transport scenario is an **major issue** in India which plague contemporary urban areas



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So, what is really then we can do so, obviously, there are several efforts taken up by the government of India and also by several state governments to you know, improve the urban transport knowing that there are problems. So, for example, several cities in India are trying to develop metro network. Now, whether it is good to develop metro whether for all cities we really should go ahead or metro or not, that is a different question.

Because metro is a enormously capital intensive project, so it is not very much like every city let us go for metro. It is not luxury, and one has to think really properly, how much cost we can recover, we are not even able to recover properly the operational part of the operational cost. That is the kind of situation so several other cities are going for blood test bus rapid transit system, and so many other, you know, initiatives are being taken up.

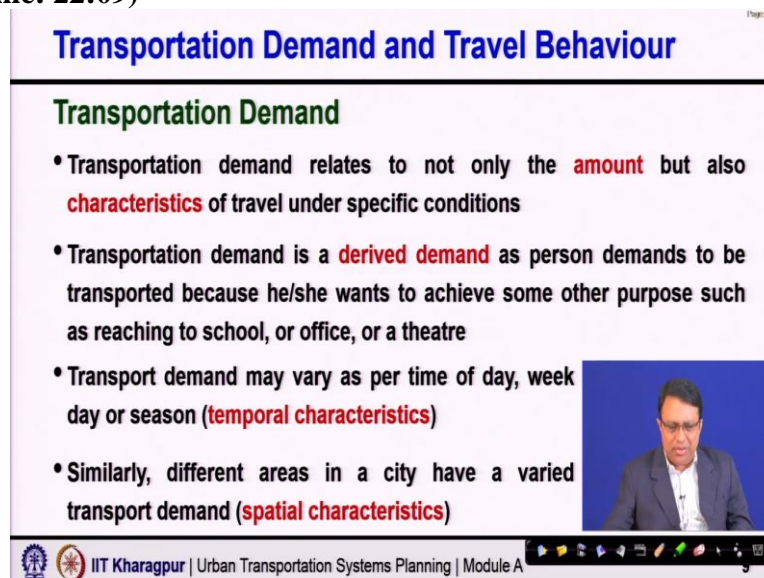
So, I cannot say that nothing is really happening a lot of things are happening, but if you look at the urban areas in India, you will find still there are issues and because of this imbalance, we have serious issues of externalities, which are directly affecting the quality of urban life people go to urban areas hoping that they will have a better quality of life, but the transport itself and of course, not only transport there are several other.

Health sector and so many other things that they are education health So, many other things are there, but I would say that transport is one of the major areas and severely you know, the quality of life is getting impacted because of the externalities, which is coming out of this imbalance between the demand and supply in the transport sector. So, what are the externalities, primary externalities, I would say congestion, traffic congestion.

Then you know inefficient energy use and energy management, then road safety issues a lot of accidents are happening most urban areas are you know air pollution level is much higher than what is the safe limit. So, the emission the condition, the energy, the safety, all these are externalities out of you know, transport sector and the whole struggle is there, how to really mitigate these externalities.

How to address the concerns related to these externalities, if we want to, you know, live a good life or a higher better quality of life in an urban area. So, overall, the urban transport scenario has become as marched as a major area. And, you know, we need to focus and do something to address these major concerns which are related to our you know externalities, namely condition, energy, accident, emission etcetera.

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The slide is titled "Transportation Demand and Travel Behaviour" in blue text. Below the title, the section "Transportation Demand" is highlighted in green. It contains four bullet points: 1) "Transportation demand relates to not only the amount but also characteristics of travel under specific conditions"; 2) "Transportation demand is a derived demand as person demands to be transported because he/she wants to achieve some other purpose such as reaching to school, or office, or a theatre"; 3) "Transport demand may vary as per time of day, week day or season (temporal characteristics)"; 4) "Similarly, different areas in a city have a varied transport demand (spatial characteristics)". A small video inset shows a man in a suit speaking. The footer includes the IIT Kharagpur logo and the text "IIT Kharagpur | Urban Transportation Systems Planning | Module A".

Now, with this, we said about transport demand, but let us really look at the transport demand because there is something more for us to understand. Transport demand relates to not only the amount but also the characteristics of the travel under specified condition, how many people are traveling, that is obviously the number of the quantity or the amount but it is also important about the characteristics of travel.

Say for example, are they travelling really longer distance or a shorter distance. The same trips if they are travelling longer that means you are actually spending more energy more emission and everything by which mode they are using, if people are walking probably we

have no issue because it is the sustainable mode, there is no pollution, no energy related issues. No traffic congestion also, because people are walking.

So, it depends on how by which mode they are working by which path for what purpose they are making trips, how long or short is the trip length. And so, this characteristic of travel is also very, very important. So, both the amount and the characteristics are important when we are talking about the transport demand. The second thing what you must understand that transport is a derived demand.

What I mean by the derived demand, suppose, it is not you know consumed because there is a direct demand for it. So, nobody consumes like most of the products which are demanded or consumed directly, but here the transport is not consumed automatically or demanded automatically it is demanded because of something else. What I mean again, you stay somewhere, leave somewhere you want to go to school is located in a different place.

Your shopping area is located on market is located in a different place medicines are available in a different location. So, our health facility hospitals are available in a different location. So, there are activities and spatially distributed and you want to get access to those activities. So you need to travel that is what I said the transport is a derived demand as per demand to be transported.

Because he or she wants to achieve some other purpose such as reaching to school or office or theatre. The 2 other things which are important again, 1 is that the temporal characteristics of the demand road is a physical element is the physical infrastructure. So, once we develop a 2 lane road or a 4 lane road, the capacity is same hourly how many vehicles it can accommodate that capacity is fixed.

But your demand is not fixed over time the same road at 10 o'clock where you know a lot of congestion in night time night 10'o'clock, if you go there, you will find there is no condition because there is no demand 6'o'clock in the morning the scenario and 10'o'clock in the morning in office hours, the scenarios are entirely different. So, we have to remember in this aspect that the transport demand has temporal characteristics.



know, there is a demand elasticity with respect to price the price goes up the demand will get influenced and for most commodities, including transport, the price goes up the demand will come down.

So, it how much is the demand depends on what is the price in data price being said in this case a public transport in it you want to use a bus how much fear you have to pay or if you want to travel by car, then what is the price you have to pay for petrol or diesel depending on which type of car you are using or how much total you have to pay what is the maintenance cost.

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**Transportation Demand and Travel Behaviour**

- **Transport options:** Walking, cycling, public transit, ridesharing, private vehicles, taxi services, delivery services
- **Service quality:** Speed and delay, reliability, comfort, safety and security, waiting conditions, parking conditions, user information, social status
- **Land use (spatial distribution):** Density, mixed land use, walkability, connectivity, transit service proximity, roadway design
- **Travel behavior:** Decision making of individuals and households related to their mode, departure time, and route choices

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Then it also depends on transport options, what are the alternatives available to us. I mean we want to travel from point A to point B can we walk is it a distance which you know you have roads you have also equally footpaths available nice footpath available and the trip length is reasonable for you to work if not then what are the you know transport other transport modes, motorized modes, what are the options available.

May be bus may be available maybe taxis available, shared auto or shared taxi may be available private vehicle may be available. So, what are the transport modes depends on that the transport demand also influence and get influenced. Similarly, the transport demand also depends on the service quality. What is the quality of service if the city is too congested if travel is really a problem and you know safety is a major issue transport security is also a major issue you want to travel but you do not get the parking place?

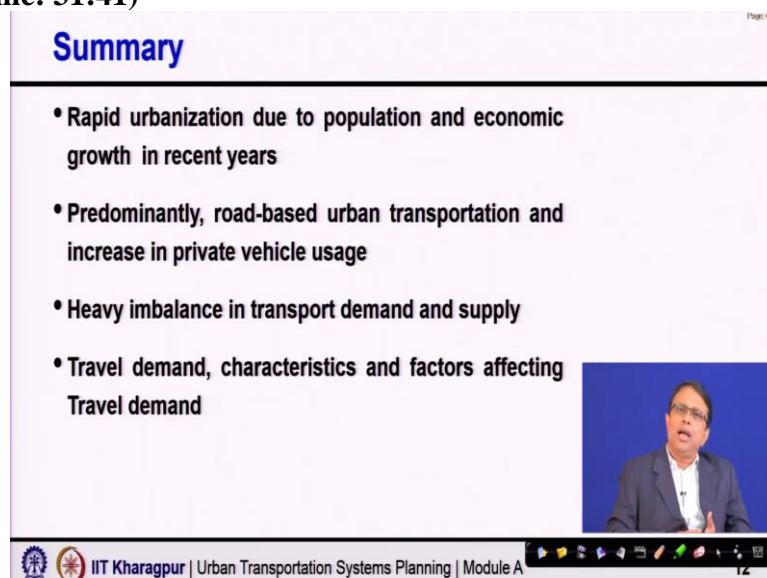
You know there are a lot of things related to this which altogether you know detail when the quality service quality of the transport overall sense actually we can even think you know deeper go into each category of service and then see what is the kind of level of service or service quality that services offering but overall service quality influence similarly the land is you know your requirements suppose if your market is located even in the next building.

Kind of mix development simply will may not be required to travel as well. But if there are market is one location and residents are purely in another location school are in entirely in another part of the city obviously had to travel more. So, it depends on what is the density what kind of whether it is a mixed land use, what is the walkability how the connectivity of that area, so, the land use and spatial distribution.

That really will influence similarly, the travel behaviour is again another very important issue, decision making by individual the options may be there, I may have 3 options, but which options I am taking, that is my decision. So, every individual will make and every time they are making multiple decisions about transport, who had to leave what to go by which mode to go by which route to take, if it is a private vehicle.

So, all these decisions together decide how many vehicles will be there at a given location at a given time and whether that vehicle load will be you know, adequate you will have adequate road capacity to handle the vehicle load. So, the travel behaviour is also very important.

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**Summary**

- Rapid urbanization due to population and economic growth in recent years
- Predominantly, road-based urban transportation and increase in private vehicle usage
- Heavy imbalance in transport demand and supply
- Travel demand, characteristics and factors affecting Travel demand

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So, if I have to summarize, I will say what we discussed today about the rapid urbanization that the country is experiencing due to population growth due to economic growth. The 2nd is that we have our transport is predominantly road based transportation, there is a growth of private vehicle usage and ownership and usage there is a public transport share in now, both in terms of vehicle and the share of trips is reducing.

And as a result there is a huge imbalance in the urban transport sector. This imbalance is bringing or augmenting or aggravating the externalities such as congestion such as safety issues such as emission such as you know, energy related aspects. Then we have that we tried to relook at the transport demand and try to see that transport demand it is not only the amount of travel, but the characteristics are important.

We noted down the transport demand is temporal transport demand is spatial and transport is a derived demand. Then we identified various factors which influence the transport demand. And you know with those factors we today, we close our first lecture.