Urban Transportation Systems Planning
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Lecture – 03
Approaches for Mitigating Externalities, Need for Transportation Planning & Transport Planning Morphology

Welcome to Module a lecture 3. Today, we shall discuss about various approaches for mitigating externalities, the need for transportation planning and also an introduction to transport planning morphology.

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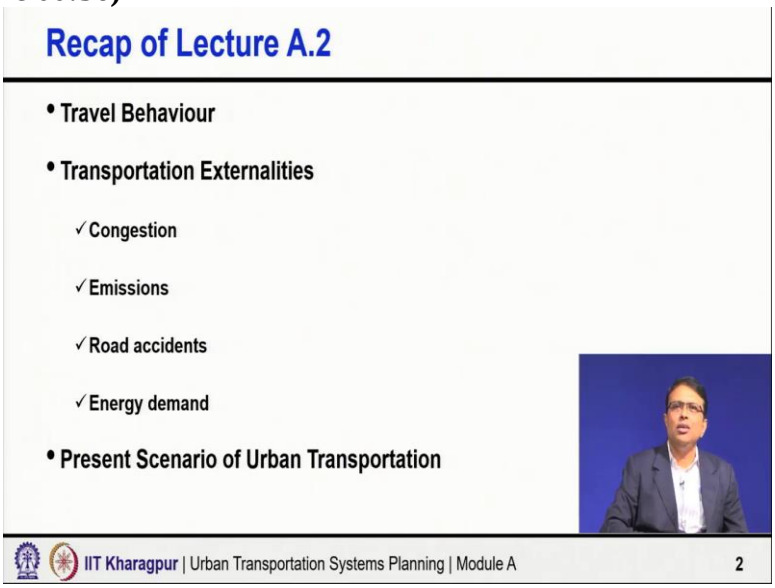

In the last class, we talked about the context or the importance of travel behaviour in the context of travel demand, then we talked about various externalities namely congestion, vehicular emission, traffic safety or the road safety or traffic accidents and then the energy aspect then, we also discussed the present scenario of urban transportation in India various characteristics or various features and to basically correlate that the present scenario and the transport except externalities.

So, obviously, you know the present scenario told us actually the reasons why such externalities are big issues in the context of urban transportation in India.

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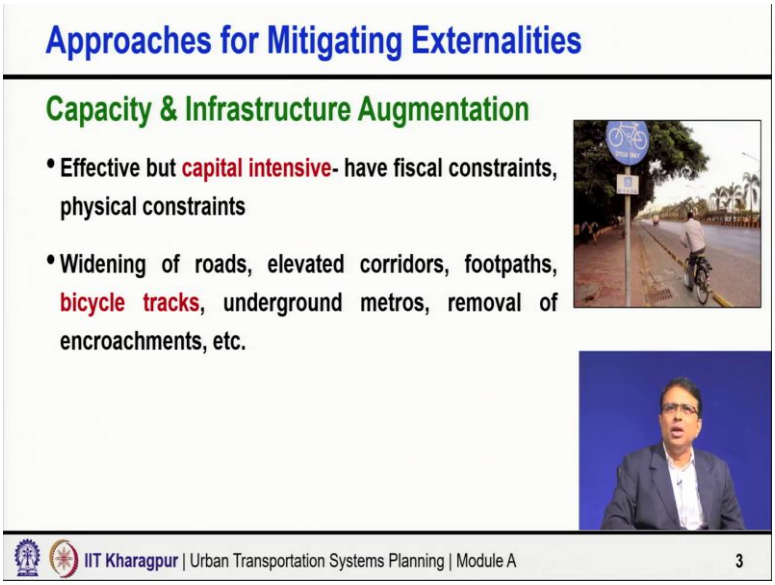

Today, with that background we will discuss now about various approaches for mitigating externalities. One major reason for externalities is the high demand supply imbalance that means, whatever is the load for the traffic our road capacity is inadequate. So, if we reduce this you know load to capacity ratio or the demand to capacity ratio, then obviously, this will provide relief to the traffic system and therefore, it will be also helpful to reduce the externalities.

So, how we can do that the very first thing could be augmentation of the infrastructure capacity. So, the capacity of augmentation or infrastructure of the augmentation that means, what I want to see we want to widen road we want to have new road, we want to have elevated or grade separated corridor, maybe underground system you know all other kinds of infrastructure.

Now, this approach is definitely effective, because if we are it is volume to capacity ratios if I improve the capacity, the capacity value becomes higher obviously, the volume capacity ratio or the demand to capacity ratio will reduce and that will mean a lot of relief right. But one thing is important to understand that this is basically capital-intensive approach that means, we are talking about development of capital-intensive infrastructure.

Widening road development of you know flyover or underground facilities, all these are extremely capital-intensive project, you need a lot of fund you need land and you know, all this are important consideration also, specially in urban Indian context, there are additional

fiscal constraints and physical constraints, what I mean by fiscal constraints and physical constraints, I will explain.

Fiscal constraints means these are capital intensive, so, you need a lot of money, you need money to build right without money, you cannot do it. Or rather you need significant amount of money. That is one part. The second is I said the physical constraints. Physical constraints mean that as I said in my previous lecture, that most of the Indian cities are not planned cities. So, you do not have you know, road space left already as part of long-term planning to widen road at a later date, nobody has kept any land.

So, right next to the road you will find buildings are there even you know temporary shops are right adjacent to the road and there is hardly any land available to widen the road. So, how you widen the road, if there is no land, you cannot take out any new road because if you want to connect 2 points you need to have a strip of land available to develop a road you cannot get a strip of land because everything is already buildings and buildings and buildings right all around.

So, there are more physical constraint. So, although this is effective, one is it is capital intensive requires a lot of funds. The second is in many cases, you will not be able to even augment capacity because of this physical constraints or spatial constraints, you can also call it a spatial constraint. But if we can do that, if we widen road if we have elevated corridor, if we have underground you know system, if we can widen the footpath, if we develop bicycle track, then all this infrastructure can help a lot in so many ways.

Footpath bicycle tracks you develop, it will actually help you to promote sustainable transportation modes that will people will walk people will use bicycle and therefore, it will overall you know in terms of energy in terms of every other aspect condition delay everything there will be a lot of benefit, emission, a lot of benefits will come.

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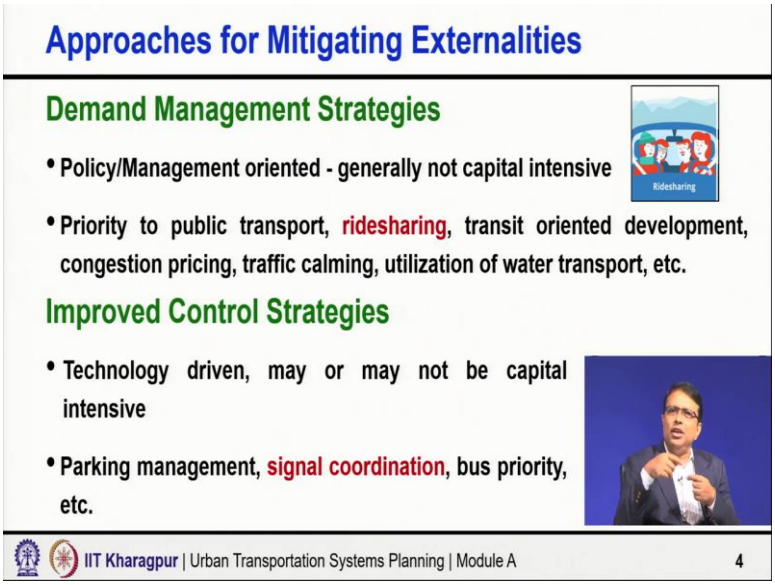

The second approach is it is demand to capacity. So, either I augment the demand or I reduce the capacity, I augment the capacity or I reduce the demand. So, the demand management is to see how I can reduce the demand, it is basically reducing demand, how will you reduce demand there are several policies or management-oriented methods that can be applied. And luckily, most of these methods are generally not capital intensive.

So, it is more important to have the right policy and right management intervention to encourage or to apply such kind of demand management methods and thereby provide relief to condition to a mission to all other externalities. Example of sustaining, maybe priority to public transport, providing or improving public transport, because if you see 100 people want to travel, if each of them using 1 car, then that will mean probably 100 vehicles on roads.

And if theoretically, all of them use a 50-seater bus and if you assume that only the seat capacity were utilizing, then that will probably mean to carry 100 people you need only 2 bus. Just imagine 2 roads one with 2 bus another with you knows 100 vehicles. So, in terms of congestion in terms of emission, everything, they will mean entirely 2 extremely opposite, you know, urban transport scenario.

So, this demand management, one way reducing the demand the other way, repackaging the demand, I am still carrying 100 people, but using less number of vehicle. So, how I can you know, carry you know, same people, but using less number of vehicles or even the peak hour demand is maximum. So, how I can influence so, that the, you know, peak hour demand get less become less and you know, the peak hour gets spread over a longer peak period.

So, maybe not just in 1 hour, so, many people are traveling, but you make some kind of staggered working hours or variable working hours in various offices. And people, not everybody will come to the office at 10'o clock, maybe some come at 9'o clock some come at 10'o clock, some will reach at 11'o clock, and that is all pre planned, you want to do it intentionally, because you know that your infrastructure capacity is limited.

So, if you actually you know, stagger or spread that demand over a longer period, then every hour the demand capacity ratio will improves. At the worst, whatever you are getting at that will come down. So, these are, you know, several things which are available under this demand management measures and which can be deployed and applied very effectively to bring down the peak hour condition and the because problem is always with work trips and most cases the problem is only with the peak hour.

So, if the cover you can provide relief whatever way it is possible, then that means a lot in terms of transport externalities and other reducing transport externalities. The third is how the demand and supply interact in a transportation system in the interface of control. So, you have roads you have vehicle but it also depends on the overall transport system performance will also depend on how you are controlling the traffic overall control system.

So, how you are doing your parking management how you are doing your pedestrian management how you are managing your traffic signal all such kind of mostly technology driven and management driven here also it is basically technology and management for traffic control, traffic management, overall transport management in a network level, corridor level.

So, managing the individual intersection how if I can if I can improve the signalization or do better signalization in an intersection obviously, the delay will increase the traffic can use it in a bit better way. Similarly, if I can coordinate the signal systems you have 2 or 3 signals. So, many times you will find the signal will become actually red by the time you reach near the signal when you are away from the signal you find green there is no vehicle.

I know no vehicle in front of the signal, but by the time you reach in front of the signal it becomes red. So, it could be reversed. So, when you are away when the vehicle bunch are a

platoon of vehicle is away from the signal it is red, but maybe by the time the vehicle platoons a bunch of vehicles is reaching the signal it becomes green. So how I coordinate this green time, so that you know once a vehicle gets green, all subsequent signals are coordinated and it starts getting green in all the signals.

So, similarly; how we want to encourage public transport usage. So, how we give the priority of buses at traffic signals, such kind of measures. So, what is the benefit, why I am saying it is improved control, because you improve the efficiency of the traffic operation by all these interventions. So, augment capacity, demand management and improved control strategy. So, these are the 3 broad approaches.

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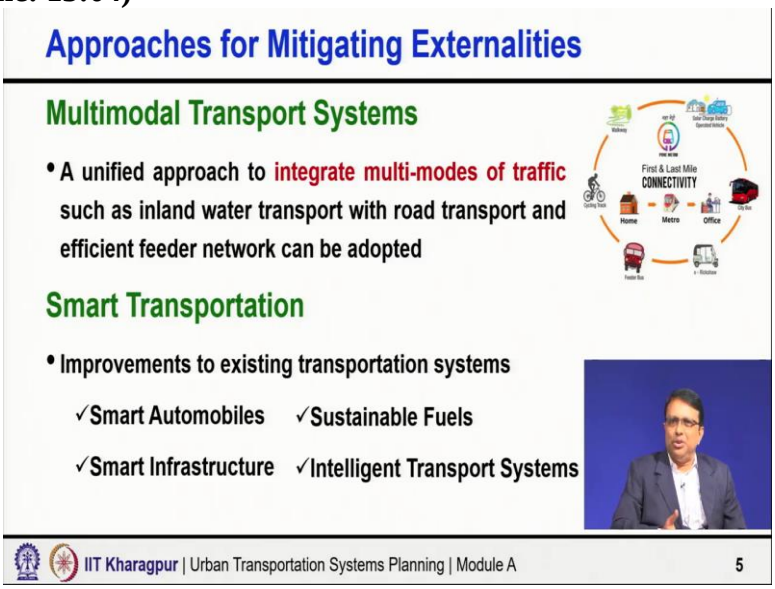

Other than that, we can also need to do multimodal transportation system integration, because typically if you see urban areas in India, you have multiple modes of transport, maybe even in some cases where Metro is there, people come out of Metro, but then they need either a bus or maybe Indian case auto is very, very popular, the auto means the 3-wheeler intermediate public transport mode is very popular. So, you come out of the metro station take a auto and travel maybe 2 kilometre.

Or some people may be staying in the very nearby area, they would like to walk and go back. So, you need proper integration of all these transport modes even some cases where water transport modes there. So, water transport we just used to cross the river maybe, but you then go to the other side you should get a bus. So, and then you get down from the bus you should

get an auto or you should be able to get a good infrastructure where you can walk for 5 to 10 minutes and to reach to your destination.

So, integration of all different modes of passenger transport is very very important because you know, when we are talking about transport system as a whole, it is not just 1 mode or 1 segment we are talking about you know a city wide if there are you know integrations all along with different modes of transport, road rail, water transport among different modes, even within the road transport, then you know the whole transport system will look very, very different in urban areas.

The last but not the least, is not just one thing but again several things which can come under this you know, approach we can say it is basically interventions related to smart transportation. Now, what we mean by with a smart transportation again information technology information, you can call that how I effectively use technology how I use available information, because transportation demand is spatial and temporal in nature.

So, condition varies you know problem that is everything has got a spatial dimension as a temporal dimension and you know, because of the variability not every day or stochasticity or I would say that the traffic is not same every day, there are natural variation you go to an intersection every day at 10'o clock, yes, maybe 10'o clock, since it is the peak hour that traffic will generally be heavy, but exactly not the same.

So, when you take you know travel every day, you can realize that, yes, more or less things may be same, but not every day, it is exactly same. Also, there could be some incidents, someday there may be a breakdown of vehicle somewhere someday there may be in an accident, which has occurred, so, the temporal and spatial information and then using that either for better traffic management, better traffic control or even passing that information to the road user.

So, that you know, you know, something is there you know, that the road is blocked, you know, that you cannot use that path today. So, that you can make your own decisions in a better way. So, hence most of take even the smart automobile, the automobile can also in the future generation or future automobile, we will see that people are talking about a completely different vehicle technology, even the driverless vehicle.

So, that of course, I mean driverless vehicle, I do not see any, you know, immediate use in terms of immediate use in reality in you know, in the immediate future. But, all such kind of improvements will come when suddenly attempts are being made to make the vehicle more intelligent, if there is a failure, the vehicle should not meet with an accident, it should tell you that there is a there is a problem in the vehicle.

So, the sensor will automatically tell morning, when you get into the vehicle, and you try to start the vehicle, it tells you something is wrong in the vehicle, it warns you. So, you do not have to really wait and do not have to really face an accident to understand that there was a failure. So, there are so many ways jam assist, if there are you know, traffic jam, then it can even you know, automatically communicate, and then guide you to take a path on a real time basis.

So, that you can reach to your destination faster, sustainable fuels, I mean, we are thinking of different fuels coming out of this conventional petrol, diesel, even going to people are talking about hybrid vehicle, electric vehicle, even solar energy driven vehicles, these are all the future. So, smart transportation may mean a number of things smart infrastructure, smart automobiles, smart fuel and intelligent transportation system altogether.

You know, using the real time information, spatial temporal information to do better management of the transport network. So, all these things can collectively help us to improve our transportation system and address the challenges which are, you know, coming out because of the externalities. So, eventually, they can help us to mitigate the externalities mitigate condition, mitigate vehicular emission and do better energy management, enhance safety of the road vehicle transportation system altogether. So, all these externalities can be addressed meaningfully.

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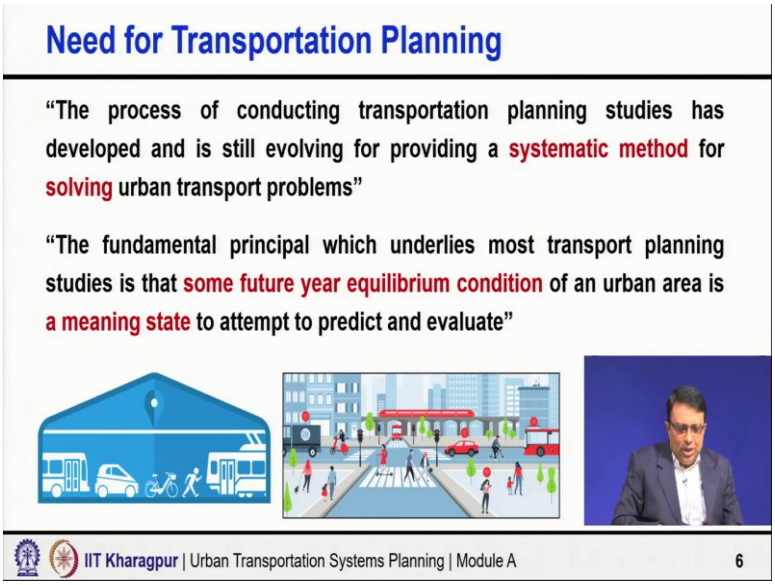

With this background, let us see now, why we need transportation planning. So, we have seen the urban transport scenario, we have discussed about the challenges, the problems, we have also understood what we can do probably at least broad approach wise not in details broad approach wise, what could be the alternative approaches to really try to improve for improving the urban transportation system.

Now, the process of conducting transportation planning studies has developed over the decades I should say and is still evolving while for providing a systematic method for solving urban transportation problem, I try to read it as it is written exactly, so that you understand that each and every word is important here I have highlighted some words, particularly systematic method, that is where it is the catch problem everybody all of us we try to solve problems, but how we solve problem do you always follow a systematic method?

Answer is no. So, we are actually looking for systematic method for solving transportation problem. Often you will find that there is a bridge across the river maybe in a city. And when the bridge becomes totally congested, people are not able to move, you know, hours together stuck into traffic jam, things are coming in the media creating pressure on the government, then the government start thinking that, let us have one more bridge to provide relief, but bridge you cannot get overnight.

So, then you start thinking where you can have the bridge, then you need to arrange your fund. Also, before that, you need to do your feasibility study, you need to do a detailed engineering to come out with what kind of structure what kind of bridge you want to use

there, have detailed engineering design to do the design, you need to do a lot of investigations, you know, what soil investigation to, you know, all other various types of investigations.

So, by the time then you go for the construction, you have to follow the tendering process. So, by the time you have the second bridge, probably, that is the time when you should actually think of a third bridge. So, always we are actually running behind why, because we never tried to understand the future requirement well in advance. So, systematic method means I am trying to say that further in a different way, in the next line.

The fundamental principle which underlies most transportation planning studies, is that some future years equilibrium condition of an urban area is a meaning state, rather than meaningful state to attempt to predict and evaluate. All what I am trying to say. Now, take this example of bridge if even when you actually need it, a few years before that, if we could assess that, yes, I would require a bridge after 4 years.

So, have got enough time I can start planning it properly, nothing nowhere I do compromise because of the pressure or the you know, shortage of time. I have time we properly workout alignment, we do all the investigation, and the best possible, you know, design we adopt? protecting all aspects which are necessary. And when in 2020, you need the bridge, the bridge is ready? It is available to you. So, and not only that, you know, we could also play around that if we do not do.

Suppose we do not do the breach. If we do not widen the road, if we do not improve the public transportation system, what will happen free service, if I do each of these improvement or combination of these improvements, then what will happen then, if I do not do anything, then which are the segment of the road that are going to be extremely critical in terms of condition in the future, then what kind of policy what kind of intervention if I do, I can test many things?

If I do this, what is going to happen? If I do that, what is going to happen? That various alternative possibilities, possible interventions, I could actually test and I could evaluate how much beneficial they would be in each case. And finally, maybe I select something which is

most beneficial, I plan properly? And then finally, I deliver it. So, that is what we say that it is really useful, if I could predict the future year state and that to under different scenarios.

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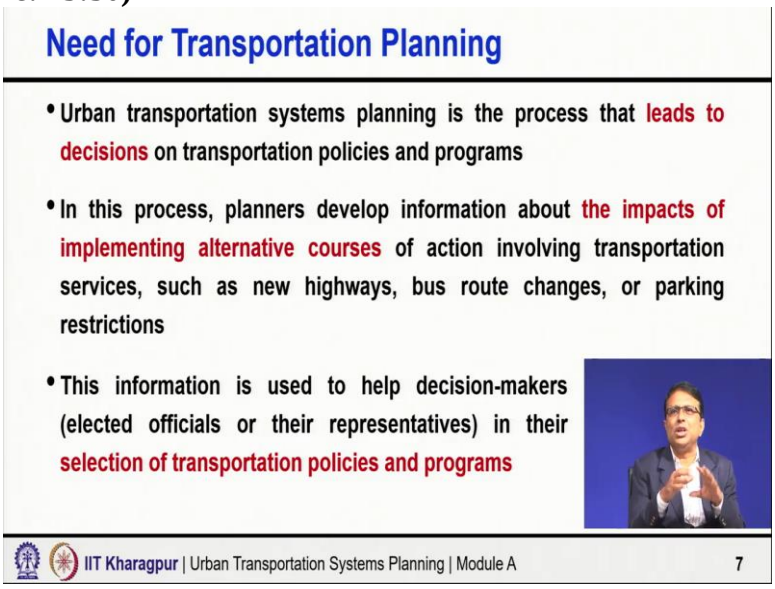

And as I said, if we can do that, then we can also say that urban transportation planning is the process that leads to the decision on transport policies and program, what program we should take, what policies we should take, so that our urban transportation system and externalities remain within permissible limit and within control. And we can also say that through this process, then planners develop information about the impacts of implementing alternative courses of action.

Involving transportation services; such as new highway, bus route changes, parking restriction, and any other intervention who can think. So, we can actually evaluate with and without how the future will look like. And that is the way we can think that we can come out with what is the best methods that I should take and at what time and by which date or which year I need to have that in practice.

So, that my, as the demand is growing, I am also ready with my infrastructure, I am ready with my program, I am ready with my policy all things you know dynamically and over a period of time. So that as the demand is growing, as the problem complexities are increasing, I am also ready to cope up with that and to ensure that you know, my overall transportation system remains as per my expectation.

So, all this information, if you do and if you have a tool like that, which you can use and play around right, then you can select really appropriate policies and programs and communicate it to the decision maker, you can tell also as a transport planner, maybe the transport ministry is interested to see that what they would need they do what they need to do, you tell them that if you do this thing, without doing anything, the situation is likely to be this and if you do this thing, then after 5 years, instead of that, the situation may be like this.

So naturally tells them clearly the necessity and why you need to take such kind of interventions and policies or infrastructure or a combination of all these.

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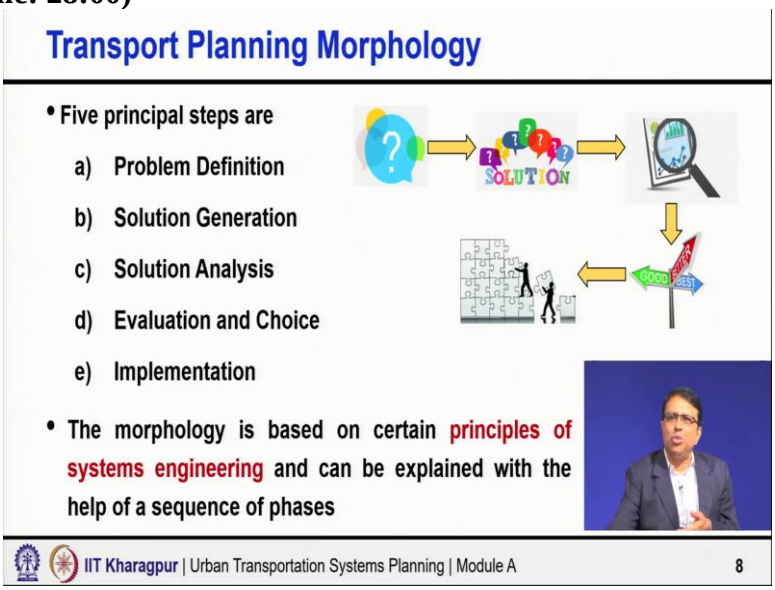

Now, next is basically transport planning morphology. Now, there are 5 principal steps for this planning morphology problem definition. So, when you are thinking of any transportation problem, the very first thing is, define the problem, how do I define the problem? Once I have understood the problem clearly, then I need to generate alternative solution then analyse each of these solutions, then I should be able to evaluate these alternatives and then choose the best one for the given context, then you implement it to benefit people.

So, problem definition, solution generation then analysis of solution then evaluation of all this alternative solution to select the best one and then finally implemented. So, this morphology is based on certain principles of systems engineering, and can be explained with the help of a sequence of phases as shown in this chart.

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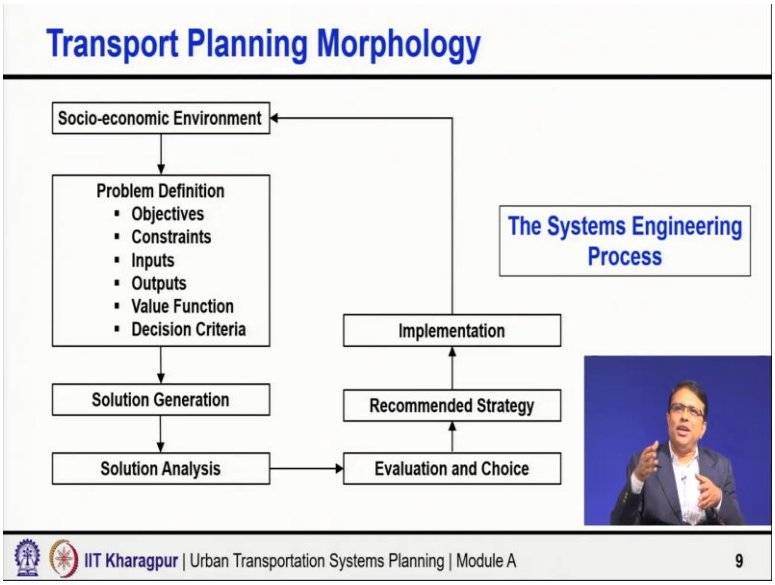

So, you have the socio-economic environment, then you have certain problems. You want to define the problem clearly with a definition of problem is everything. So, you need to define objective constraints, inputs, outputs, value function, decision criteria, with all this you actually define the problem, then you generate a solution, then you analyse it, implement it, you know evaluate and you know choose the best one, then that is what is recommended and implemented.

And the feedback arrow is again shown to socio-economic environment, just to indicate that it is a cyclic process, because continuously the demand will grow. So, you take some intervention to provide some relief. Then you again need to evaluate then after some time again the demand will be more. So, you again need to do something. So, it is actually a cyclic process and a continuous process.

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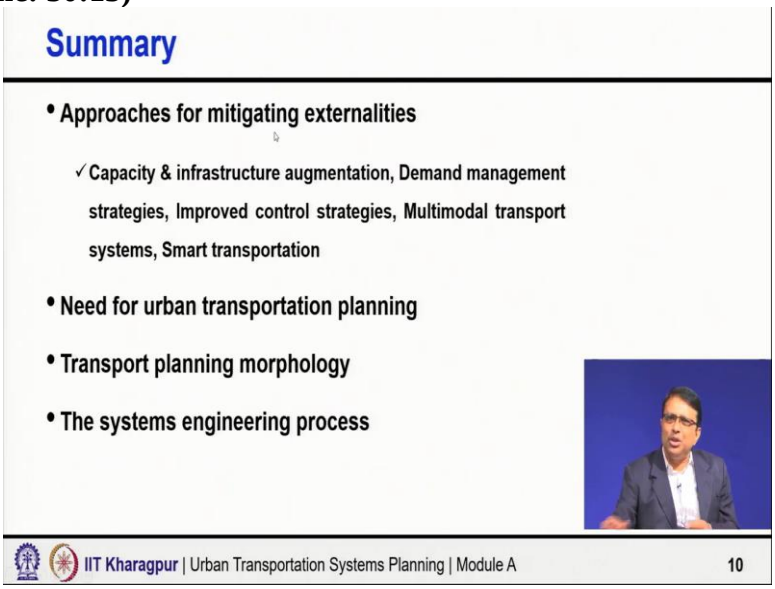

So, we stop here today and you know, we will continue in the next class. So to summarize that we said different approaches for mitigation. Then we talked about the need for transportation planning. We introduced the transport planning, morphology and system engineering process. Thank you so much.