Urban Services Planning
Professor Debapratim Pandit
Department of Architecture and Regional Planning
Indian Institute of Technology, Kharagpur
Lecture 09
Service Planning Basics : Part IV

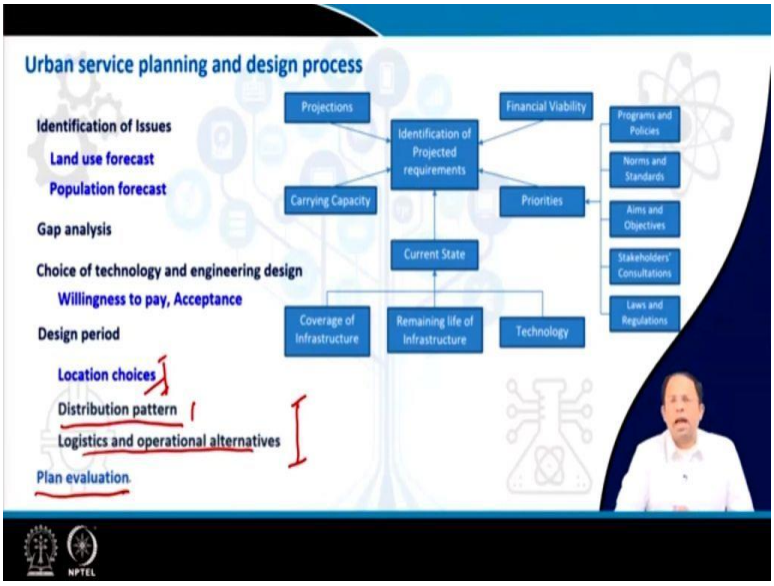
(Refer Slide Time: 00:29)

Welcome back. In Lecture 9, we will talk about service planning basics. And this is Part 4 of the lecture.

(Refer Slide Time: 00:35)

So, in this, the concepts that we will cover are on urban service planning and design process, location choices and location choice based on suitability.

(Refer Slide Time: 00:44)



So, based on what we have learned till now that whenever we have a particular, we have to plan for a particular service, or even for certain kinds of facilities, in that case we have to follow certain steps. We start with different identification of different issues. We have to forecast the population, forecast the land use for that particular area, determine the gap between what is currently presented, what is required or what is expected. Then, what could be the choice in terms of technology and the engineering designs that are available for that particular facility or that particular service?

Then, willingness to pay, an acceptance of that by the people, how to measure that, we have learned about that, and we have also talked about the design period of this kind of projects. Now, once this part is done, the next question is to look for locations or where we should set up these facilities.

For example, we know that whenever we are designing a particular infrastructure facility or a service, it is divided for a different parts of the city. So, we have to first determine the distribution pattern and this is very specific to what kind of infrastructure or facility that we are designing, or what kind of service we are planning.

For example, we are planning for solid waste management collection services like door to door collection services, then the distribution pattern would be based on maybe to certain extent on administrative boundaries, to the kind of housing that is there without road network and so on. Now, when I am talking about setting up a distribution pattern for a police station, then probably we will consider the size of the administrative area, density of that particular area and so on.

So, different distribution patterns based on socio economic characteristics, demographic characteristics, economic characteristics of the area, accordingly, we have to adopt some policies on how should I distribute the services. Now, once that is done, then particularly for service planning like for example, door to door collection, we have to decide on what are the logistics and the operational alternatives.

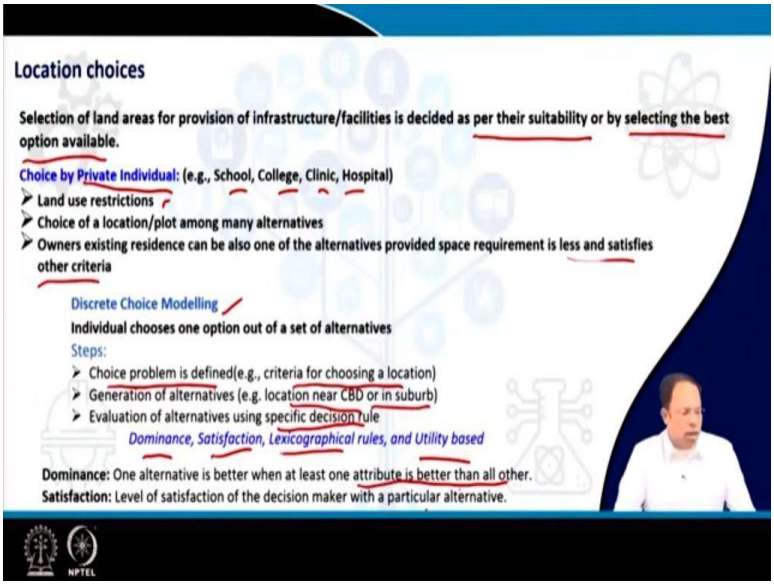
That means I can do door to door collection using wheelbarrows, or I can do using auto rickshaws, or auto rickshaws with a tipper at the back, so that we can collect waste through that, or it could be a mechanical vehicle. It could be a lorry also or a tractor trailer. So what is the logistical, and then what route should this particular vehicle take? So this is the logistic part of it, or the operational part of it, which is also an issue decided.

So, these two are very very, it depends on, it is very very aligned with what kind of service or what kind of facility I am providing. Whereas location choices, even though it is aligned with what kind of service, but there is a general principle through which we can determine location of particular facilities or particular infrastructure that we should provide.

And finally, once this, all these aspects are covered, when we are ready with the or different alternatives and all, then, we have to evaluate that which alternative is better or which alternative which we should we choose. Or for example, in case of a location choice, where the infrastructure we put up in a location, then probably we have to evaluate if that location is suitable or not.

So, what are the final (imp) because of my choice, there is some impacts on the environment, impacts on the surrounding population, so we have to evaluate the impacts. So, that is the plan evaluation process. So, we will first start with the location choices, and then these two we will cover, when we will talk about those individual services in subsequent lectures. And we will also talk about plan evaluation today.

(Refer Slide Time: 04:37)



So, when we talk about location choices, it is selection of land areas from, we are talking about selection of land areas for provision of infrastructure facilities. So, it could be decided in two ways. One is decided as per their suitability of that particular land for this kind of infrastructure provision, or by selecting the best option available.

That means none of the options are very suitable, but those are the only options available to us. So, I have to make a choice to which, to allocate that infrastructure facility to that particular land area or that particular option. So, either we have got we have got limited choices, and we have to choose from that, or it is an open choice and we can select from the entire urban area where I should locate them. So, these are the two ways we can make this choice.

So, for example, let us if I go for certain kinds of facility like a school, or college, or a clinic, or a hospital, and let us assume that the choice is made by a private individual, that means individual is deciding on where to locate this particular facility. So in that case, first comes the land use restrictions.

So, I cannot set up just any kind of facility anywhere. So, that means as per land use regulations or land use restrictions, I am allowed to set up certain kinds of facilities at certain locations. So obviously, that comes first. But after that, still, I have to choose the exact location or the exact plot, where I would have put up this particular facility, so choice of a location among many alternatives.

So why? Because I have got many plots to choose from and I have to choose which one is the best option for this particular facility. And this decision is taken by an individual entrepreneur or individual person who is setting up this particular facility. Now owners, existing residents can be also one of the alternatives provided space requirement is less and satisfies other criteria.

For example, sometimes when a kindergarten school is usually opened up in the neighborhood level, at the at maybe in one of the premises of that particular owner, he may put up this particular facility. It is a small business, or you, if you want to put up a clinic, it could happen below somebody's, in the ground floor of somebody's house. So, all these options are also available. So, this becomes one of the alternatives out of all the alternatives available for a person to choose.

Now, what will affect this particular choice? So, obviously because it is an individual's choice, he will definitely try to see that the choice that he is making will be beneficial for himself for the for the most part. So, first is as per his convenience, as per his affordability, as per his knowledge of that particular location. He will say, he will decide on a certain location.

But, at the same time he will also think of how if I select this particular land, what would be the criteria? Like for example, a school. Even though I have a land 20 kilometers away from the city, I have not set up a school there, because I know that in that case, nobody will come to that school. So, he considers both characteristics of the school, that means a school should be near a residential area, a school should have certain amount of play field.

So, certain kinds of criteria he can consider which is mostly coming from the school itself, that is the characteristics of the school, what a school requires and so on, and the other is based on his own characteristics, his own conveniences and so on. So based on this, he will make a choice, if because it is a choice made by a private individual. So, some characteristics are coming from the inherent characteristics for setting up a school, and the other characteristics are coming based on his choices.

So, this way of choice making, we can call it discrete choice modeling, we, we can solve. We can evaluate these choices via discrete choice modeling, where individual chooses one option of a set of alternatives. So, he has got many alternatives in front of him and he chooses one option out of them.

Now, how we can, if I break it up further into steps, the first step is the choice problem is defined, that is the criteria for choosing a location. That means because it is a school, I will use certain criteria for choosing the location. If it is a hospital, I will choose another set of criteria for choosing the location.

Or, it could be based on some criteria like a financial constraint on my part that I cannot go for a plot which costs more than so much rupees per square foot. So, all these criteria, some based on the characteristics of that particular facility, and some based on my own characteristics or that decision maker's characteristics is considered. So, that is the definition of the choice problem.

The second option is generation of alternatives. Like, the alternative that a person generates based on his knowledge, first of all. That is, if he does not know about alternative, then he will not deny that, plus he may also use some criteria to generate the alternative. For example, the locations near CBD, he will consider or locations in the suburb, he may not consider, or there maybe several criteria which can limit the size of the alternatives which are available.

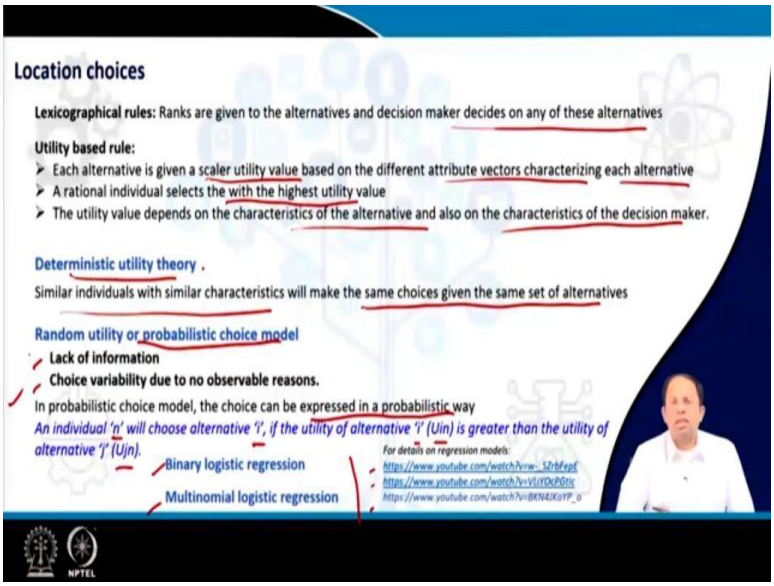
So, that means he can take some decisions on what sort of alternatives he will consider. So, that is the second criteria. So, once this choice problem is defined, and the alternative, some criteria is put in, then comes the actual. We can come out with a final set of alternatives which is in front of him from where he has to choose.

Then, comes the evaluation of the alternatives using a specific decision rule. So that means now in front of him, there are suppose five alternatives, then he should choose one. So, he has to have a certain decision rule using which he will choose this particular alternative. So, what could be the decision rule criteria? There are different ways we can take a decision in this regard.

One is dominance, other is based on satisfaction, other is called lexicographical rules, and finally utility based decision making. Now, let us go one by one for each one of them. Dominance refers to when one alternative is better, when at least one attribute is better than all other. So, that means I am not considering all attributes of that particular choice. But, one alternative out of these five alternatives that we were talking about earlier, has got a very good deal in terms of price.

So, maybe that is the biggest criteria or that is the most important criteria that person will consider, and take a decision based on that. So, this way of decision making is called a dominance. Then comes satisfaction, level of satisfaction of the decision maker with a particular alternative. That means how satisfied he is with that particular alternative, which again, his satisfaction may result from many aspects. But, it is his satisfaction. So that is how he can take a decision on this.

(Refer Slide Time: 11:56)



The third is lexicographical rules, where ranks are given to the alternatives and decision makers decide on any of these alternatives. So, out of these five alternatives based on some criteria, you can generate ranks like 1, 2, 3, 4, 5 in order of choice, and then the decision maker takes a decision should I go for rank number 1, or should I go for rank number 2, so it is up to his decision.

So, then finally comes the utility based rule, which is the most common way of decision making. Usually, that is how we consider. Here each alternative is given a scalar utility value based on the different attribute vector characterizing each alternative, and also the decision maker's characteristics as well. So, the utility value depends on the characteristics of the alternative and also the characteristics of the decision maker.

So this utility value, it is a scalar value, it is a scalar quantity, it is, one value is given, which is based on many criteria. Now, I can give different weights to this criteria, that can, that is

possible. But at the end of the day, we have created a score which represents all these attributes or characteristics which define this particular alternative. And along with that, there could be certain characteristics of the individual which also contributes to this utility value.

Then, the next thing is we consider a rational individual selects the alternative with the highest utility value. So of course, I can generate these utility values for different alternatives and the rational individual will consider the one with the highest utility value. So, that is how this utility rule plays out.

Now, there are two ways, now within utility based rules, utility based decision making, there are again two ways we can do that. One is called deterministic based, one is based on the deterministic utility theory, and the other is based on the probabilistic utility theory, or which we call random utility or probabilistic choice model.

Now, what is deterministic utility theory talks about? That, similar individuals with similar characteristics will make the same choice given the same set of alternatives. That means I create a utility value for each alternative, and if I bring in a person or a group of persons who are of exactly similar characteristics, they will all make the same choice. That means they will all choose the same alternative out of all this alternative, which, based on of course the utility value. So, whichever has got the highest utility value, this group of individuals will choose that particular alternative.

But random utility or probabilistic choice model talks about that, yes, utility is highest. That means that a person should choose that one with the highest utility, but he does not do that every day. So, there are two, that means there are two reasons for it. What is, he wants, he may want variability, that means I do not want to do it every day. I want to do some different alternatives. And also there are many things which we do not know about that particular person, because all persons are not similar. If I bring in multiple person, even though their characteristics are same, but they will take a different decision.

So, that is one and the other is a lack of information. That means, he does not have information about all the alternatives. So his choice, even though it is based on utility, he because, because it does not have information on certain choices, his choice may be different. So, these are the two reasons why a probabilistic choice model is more appropriate, because it tells, gives us the

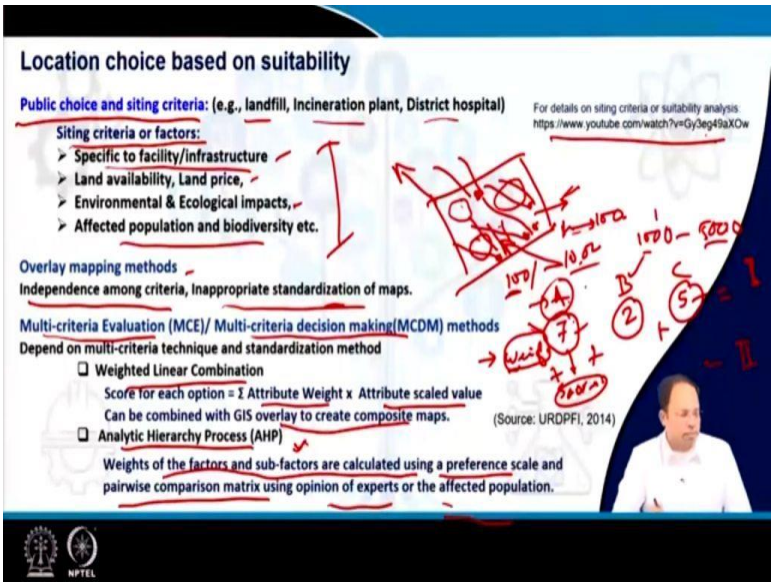
probability that a particular, probability of a particular alternative being chosen by a particular person.

So, in probabilistic choice model, choice is expressed in a probabilistic way. So, we can state like an individual n will choose alternative i, If the utility of alternative i U i n is greater than the utility of alternative j. Any alternative, any other alternative is j, so if it is more than that, he will choose that. So, that is the basic theory, but at the end of the day, we get a probability value, that what is the probability that this person will choose.

So, sometimes he may choose, sometimes he may not. But obviously, if the utility is higher, the probability is will be obviously higher. So, there are two ways to do this. Like we have been discussion during the when we learned about willingness to pay, and the different methods to evaluate willingness to pay. We have learned about binary logistic regression, multiple logistic regression.

So, those kinds of regression has to be applied to determine this utility equations and the weightage of those particular, how do I measure that particular score and how I can get a probability. So, this you can learn, and I have given some links for this lectures which are already there in YouTube, which you can watch. And using this, you can learn these kind of processes that we have, we can choose for determining these choices made by a particular individual.

(Refer Slide Time: 17:13)



Now, there is another way to make choices. As we are talking about different ways rules are there, beyond the utility measures and all. For example, it is a public choice, and siting criteria, of course. Now, public choice means like if I want to set up a landfill, if I want to set up an incineration plant, if I want to set up a district hospital, these decisions are taken by decision makers.

It is not a choice made by the people, because people may not have enough information, and also it is difficult to take everybody's opinion about a location. Because, there are many factors which, it is, the people have no understanding of. So, it is a decision, it is a choice or a decision made by a particular, maybe a group of officials or a group of experts, or maybe that municipal body.

So in that case, first of all, for making these kinds of choices, this group of individuals or this particular body will have some siting criteria or factors. That means where on what criteria we should determine the location of that particular facility. So, first of all, every facility or infrastructure have certain specific criteria, which it requires.

For examples, for a landfill site, the criteria is we should set it up at least 10 kilometers away from a airport or it is 20 kilometers, but in some cases, we can even go for 10 kilometers. So that is one of the criteria. So similarly, there could be other criteria for other aspects. Then, either

criteria could be in case of a incineration plant, for solid waste incineration, we have to set up a plant where it the wind pattern does not blow into the residential area, so, the location should be such.

So, these are the different criteria which is specific to a particular infrastructure. Then, there is land availability and land price. It is not only about this area is suitable, but the land is available there. What is the price of land? If it is affordable or not? Environmental and ecological impacts. If I do it over there, what kind of impacts or environmental effects it will have? So, this is the next one. And what is the affected population and the biodiversity, how it is affected, that also needs to be evaluated.

So, these are the different criteria which we can consider when we decide on where to locate a particular plant. But there has to be some method to do this particular thing, or how do I consider so many criteria together or in sequence, that has to be there. So, the first method is overlay mapping method, which is a very, very simple method. It is a GIS based method and mostly we do that.

What we do is we have, we create a GIS map and we create different layers. For example, if I am locating an incineration plant, I will, in this particular map, we will find the areas which are, like, this is a residential area, this is a residential area, this is a residential area, and let us assume the wind pattern is like this, the dominant wind pattern is like this.

So, that means if I set up an incineration plant over here, the wind will blow into this part. Or, if I set up an incineration plant here, the wind will blow over here. But if I set up a incineration plant over here, it will not affect at least in this particular area. Similarly, if I put it over here, the, it will blow like this, but till the time it reaches over here, its effect will not be there.

So, that means using this map, I can determine which areas are suitable considering the first criteria which is like air, the emission coming from the incineration plant, it should not be moving into some residential neighborhood. So, that is the first criteria.

But similarly, the next criteria could be land availability. Now, we can say that this area, this area, this area is suitable. Now, we will also put another layer over it where I put the land prices.

I may have a certain constraint that beyond this particular land price I cannot afford. So, if that is the case, then some other options will go out of this.

So in this way, I can keep on adding layers and I can reduce the scope of locations where I can particularly put my plan. And eventually, I could come to one single location or maybe a very few locations from where I can, have to choose or make a decision. So, this is what a overlay mapping method looks like. But, there are two problems with it.

All these criteria is considered independently. That means each criteria we are picking at one go considering it, and then we are considering the next criteria. But, there are also interdependence among the criteria, which we are not considering, so that is missing. And the other is inappropriate standardization of maps. That means the maps for different criteria could be of different units, it could be different scale, so sometimes that leads to errors. So, that is inappropriate standardization of maps.

So, these are the two problems that can crop up which we have to be careful about. The other way to do it is to also consider some amount of dependence or some amount of comparison between the criteria, which is known as multi-criteria evaluation MCE, or multi-criteria decision making methods.

So, here what happens, over here we considered multiple criteria, and in most cases, we will determine the weight of each criteria. So, that means if I have Criteria A and have Citeria B, and Criteria C, each of these criteria will have weight. So this is important, I can put weights on a particular scale. This, I can say, this, in a 1 to 10 point scale, this weight of this criteria is 7, weight of this criteria is 2, that is how important is that criteria. And then the weight of this criteria is 5.

So, of course the most important is A, then C, and then B. So, this is one, how important it is and then what is the score for this particular criteria. Now, this criteria is land price. So, if it is land price, then land price could be starting from suppose 100 rupees per square foot to 10,000 rupees per square foot, suppose. Now, what score will I give to 100 and what score will I give to 10,000?

So, if I normalize, then I can say that okay 10,000 gives a normalized score of 100, whereas 100 gets a normalized score of 1. And everything in between get some score as per, we have normal, as per the normalization is done. So, 1 to 100, all the scores are normalized. Similarly, if B is like your effect on the population, how many people are affected by this particular decision? So, in that case also I can say that okay, in one, 1000 people are affected, in the other, 5000 people are affected. So, this is my range of the different options that are there, how much is it is affecting.

So, here also I can normalize and I can put it on a particular scale, and so goes on. So, this score that we generate after normalization, that is the score for that criteria. So, once I have a score for a criteria, and I also have the weight for the criteria, I can multiply these two. And then, I and if I do that, then I will get a particular unique value for each option.

So, in that way, if I got many criteria like A, B, C or the different criteria, I will add this up, and overall I will get a score for this particular alternative which is Alternative i. When there is no alternative, Alternative 1 or then Alternative 2, I can get similarly another score, and it goes on like that. So, we will choose the one which has got the most highest score, or which lowest score as per how you frame the criteria.

So, score for each option is a summation of attribute weight into attribute scale value. So, this is criteria weight or criteria scale value, and can be combined with, this can be also combined with GIS overlay to create composite maps. So, these scores and all also could be made along with a GIS map, which would actually help us to create some, create how the distribution of score happens and all these things.

So, together we can do this and this is called a weighted linear combination. Now, this weight that we are determining, that is we are determining based on some expert opinion or based on the judgment of the researcher. But it is not, this is where people make the biggest mistake. The score and all is based on actual values, and then normalizing those values, we get a particular score. But weight, it is something very subjective.

Sometimes experts decide in different ways, they decide on different kinds of scores. So, that is where we can adopt other kinds of techniques, such as analytical hierarchy process, where weights of factors and sub factors are calculated using a preference scale. We ask them that

between any two factors, we do a pairwise comparison matrix, and from there we can generate these particular weights.

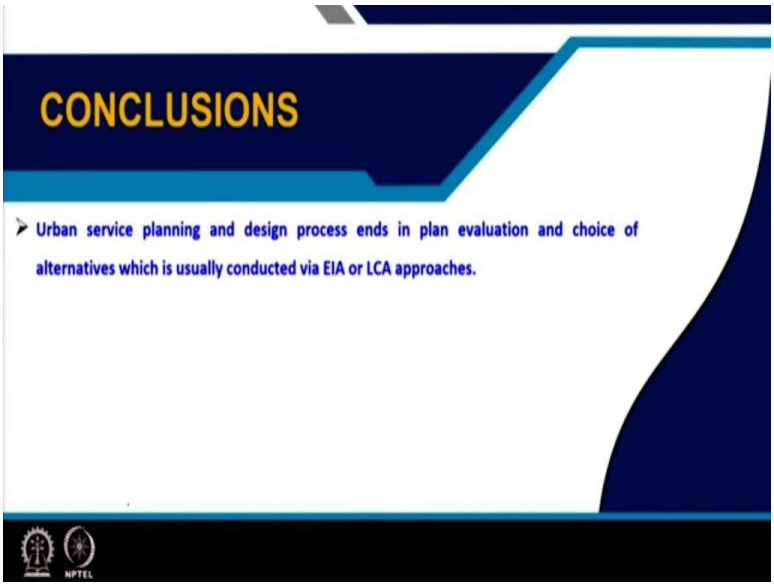
So, if I have got four or five items, then for each pair of items, we ask people about what is their, which one is more important, which is less important, and accordingly, we can get some scores. And then we can combine those to get weights for each of these factors that we are considering. And this could be based on experts opinion, or based on the opinion of the population who are being considered. So, based on this we can also generate weights.

So anyway, so this, as you understand, these two topics are again, could be, it is a long, we cannot put too much explanation for this aspects, because this is two different ways of determining weights. So, if you are more interested to learn about these particular processes, then you can watch this particular lecture where we have explained this in more further details.

(Refer Slide Time: 27:07)

So, these are some of the references you can look at.

(Refer Slide Time: 27:12)



To conclude, urban service planning and design process ends in plan evaluation and choice of alternatives, which is usually conducted via EIA or LCA approaches. Thank you.