Infrastructure Planning and Management
Flexibility and Options on Projects Part-1

So we are literally getting into the last few sessions in this class, so when I was looking at the schedule today essentially what we have there are a couple of more concepts that we want to that I want to talk about we will talk about one of them today one of them tomorrow and after that essentially we will have over the next couple of weeks we will have a couple of guest lectures just coming in and talking about how people are actually resolving infrastructure problems will have (())(00:39) come back and do another talk on the kind of human centric design urban design that they do stakeholder management all of that and we will also have some case studies.

So through poor water supply Delhi Airport etcetera which the object of these case up until now and we present case studies we have presented them with a view toward saying here is the challenge to try to understand what the nature of the challenges rate this project has had a you know a social environmental issue what is that issue where does it came from etcetera we have not really I mean although we have made some suggestions we have not really looked at how do we solve the problem how would we have re-engineered this project differently.

So but going forward these two classes I think we might have one of them next week and one of them later I will sort of send out an email on that the idea is we will be presenting cases which have had problems, but now knowing that everything that we know the idea is that when we present we come up with here is what we should have done differently here is how we should have structured this project so that these problems would not have arises in the place, so between a couple of guest lectures a couple of what I call forensic analysis cases and essentially a couple of sessions today and tomorrow on a couple new concepts we are more or less done with the class there is one final that there are a couple of deliverable from your site.

So I will talk about it now one is of course the final module we will also have you know a submission at the end of tight so that is when we are done actually technically after tomorrows class you should be able to actually title that submission, so you can get working on that I will announce a deadline but there is also a term paper all, now let me briefly talk about the term paper the term paper is very open it right all that is expected is that you pick a topic that has some relevance to infrastructure and you write an article you write what we call an analytical article about it which means you problematize it they say here is an issue and then you offer a solution which is driven based on some data, so this is the criteria.

So to give you an example you might say I want to sort of write a paper on the climate change impacts of all climate change impacts on infrastructure, so that is topic that you are interested in addressing climate change perception now you might problematize it by saying for instance that you know climate change is likely to cause it is very unclear as to the kind of damage that climate change is likely to cause infrastructure, we do not really have one specific number in mind,.

So you have problematize it you say this is problem and the you sort of say okay here is what I think the cost to infrastructure due to climate will be and you come to that answer using some kind of data so you have secondary data that is available if you have the time and energy go ahead and talk to people collect data maybe even run some simulation whatever all but the point is you pick any topic that is related infrastructure you want to talk about roads talk about roads you want to talk about real estate talk about real estate you want to talk about political risk talk about political restore talk about stakeholder management anything related to infrastructure pick whatever you like all problematize it say here is an issue with regard to that and here is a solution and the solution is not something that you just throw out of thin air.

So you cannot very useful to say infrastructure projects have a lot of time and cost overruns and I believe that the solution is better stakeholder management end of story, so I mean the you still problematize it you have said there are cost and time overruns but I expect you to in a data driven manner tell me a little bit about what you could do about these cost and time overruns, so maybe you have some statistics that you have collected and you found out that the major factor between you know for say time overruns is delays in land acquisition and here are some idea that people have put forth with regard to how you might acquire land better some of which we have discussed in the class some of which we not this is a been applied at Guatemala successfully that has been applied in Nicaragua successfully.

So you have some data driven approaches and you sort of say ok this is the solution so that is all that is expected the overall word limit including table of contents appendices references is expected to be 5000 word or if you are writing 12 point Time New Roman fonts it is 10 page try not to go over ten pages typically we expect people to do about 8 to 10 pages with regard to their term paper so do not give me 25 thousand word books I am looking so try to be succinct in the analysis, so again very simple pick a topic regards to infrastructure problematize it propose a solution and in between there has to be some data driving what you are saying could be your own data that you have collected or you have gone to website and you know collated a database or it could be data that other people have and there are lots of NGO's and other who have data up there on the web.

So feel free to use all of it obviously site saying that you pulled the data from this site and then when you do the analysis on that data here is what you get but if you can do go out and conduct a few interviews if you know practitioner in the field if you want to supplement you data your idea if any questions at the moment on term papers yeah no no so it can be interview data so you might interview 10 people or you might come up with transcript of interview in you could do in fact this was not done for a term paper but a student did this for a dual degree project some time ago.

So I am not on linked in so I would not know but I think you can create groups on linked in which are thematic and he actually created this group on infrastructure and you know posed a few question and just organically a bunch of people join and started responding to what this fellow had to say it sort of became a discussion group and you know wonderful data came out of it so it was almost it was to be the most painless way of collecting data rather than going on banging peoples doors trying to get an appointment interview etcetera and he was able to cream bases on their linked in profile.

So you could say that this fellow worked intro for 10 years, so let us me just cut off you know and only look at responses from people who have worked for a minimum number of years so there is some credibility, so very quickly so you can use those kinds of method to collect data and it can be qualitative as well absolutely no harm in qualitative data great good question any other question on the term paper and this is not the only opportunity, so if you guys have question then next class whatever you want to raise them we can always clarify them but I hope sort of it is relatively clear in terms of what was being expected great all right.

So today we are going to talk about something that has been very closed to sort of the lot of the research that I have been doing over the few years and it is a little bit different from, so we have talked about ways in which we can manage stakeholders we have talked about ways in which the government can respond better a new public management we looked at the Cambodia example of how government organizations are actually able to develop effective infrastructure but there is one apart from people aright that you can manage better one of the things that you can manage also is the contract on or the agreements that go into developing an infrastructure project and todays discussion is about what are those agreements look like and what can we do about them specific.

We are looking at you know rigidity of agreements versus flexibility of agreement so let us have the next group who is presenting

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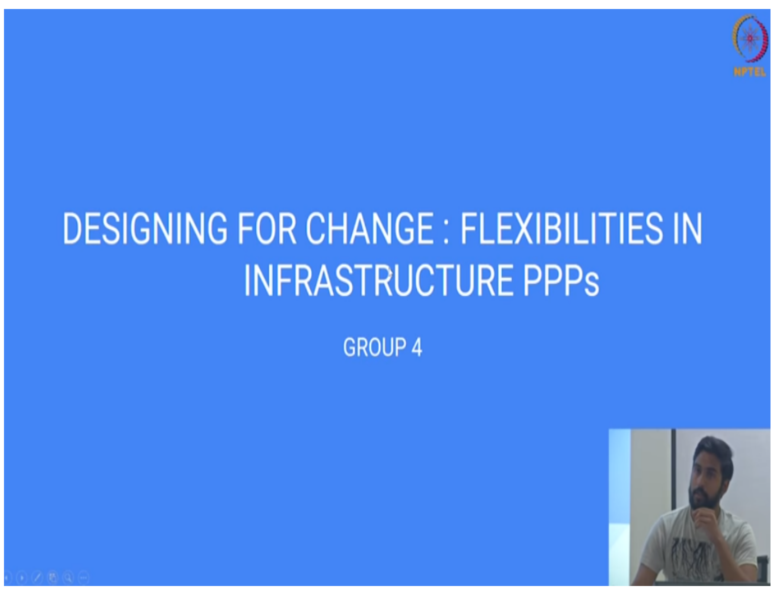

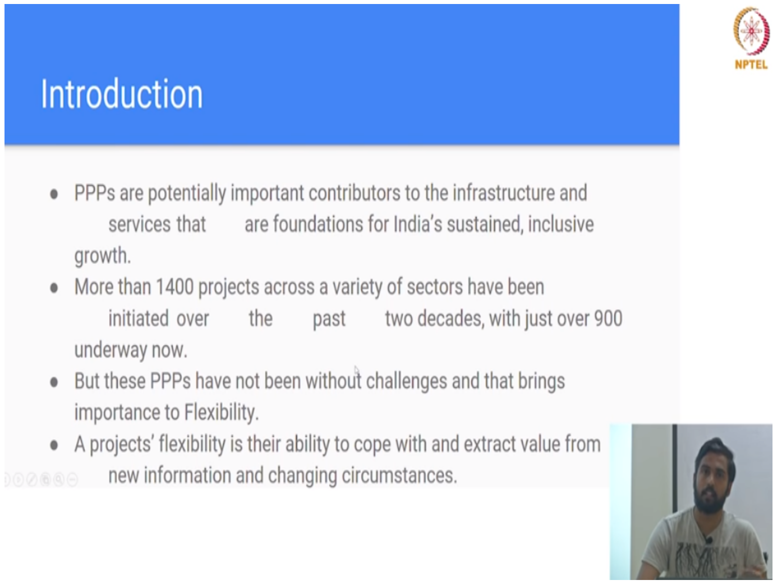

So we will be presenting about the designing for change the flexibilities that can be created in a infrastructure pm, so PPM's are potentially on of the most important contributors to infrastructure that we have been discussing in this throughout the course, now currently there are more than 1400 project that have been doing around in a variety of a variety of sector and only 900 of them are being 100 of them are currently being complete being underway but these PPP's have not been without challenges and that been of many challenges which are faced during the process of PPP during the contract making or during the implementation and the maintenance as well.

So that big so to avoid this problem and to tackle these there comes the importance of flexibility a projects like flexibility the ability to cope with the width and extract value from new information and changing circumstance that can be some new technical innovations or some political changes or that may be any number of factors that may happens during the run period of PPP.

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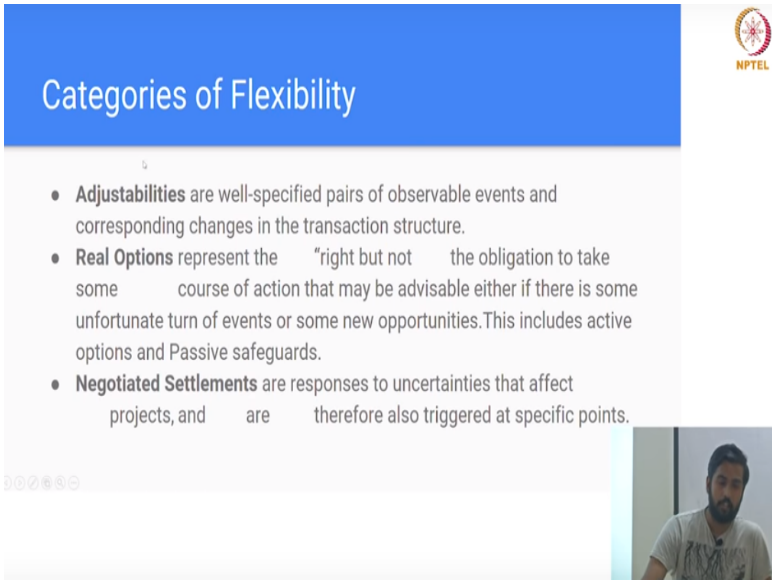

Categories of flexibility include I just first wing that disability these are special well specified pairs of observable events such as that they happens to be like two diverse condition that may be possible and we say that if this happens than we will be performing this particular action and if the second category of event happen then we will be taking this set of action to tackle then this second another one is the real option here most of the power given to single party mostly the developer.

We are in the contract specifies that in case the contractor have a power to assert a certain condition or take some action during the project but it is not mandatory or they do not have to like it is right but they do not have the obligation to do it then the negotiated settlement these are the settlements where in both the public and the private sector developer the come together and they may conduct a discussion where in the end for any certain issue that is being raised and the they come to agreement finalized it depending on the discussion and then implement that to the PPP the for avoiding the problem.

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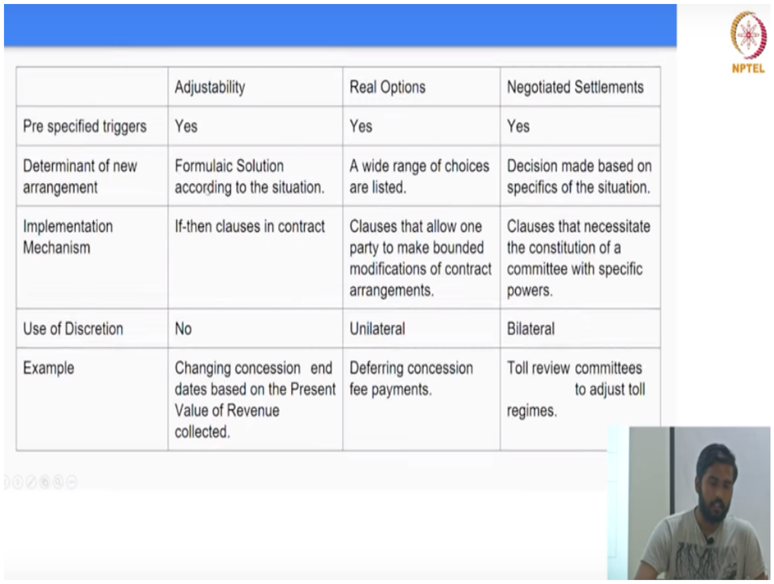

	Adjustability	Real Options	Negotiated Settlements
Pre specified triggers	Yes	Yes	Yes
Determinant of new arrangement	Formulaic Solution according to the situation.	A wide range of choices are listed.	Decision made based on specifics of the situation.
Implementation Mechanism	If-then clauses in contract	Clauses that allow one party to make bounded modifications of contract arrangements.	Clauses that necessitate the constitution of a committee with specific powers.
Use of Discretion	No	Unilateral	Bilateral
Example	Changing concession end dates based on the Present Value of Revenue collected.	Deferring concession fee payments.	Toll review committees to adjust toll regimes.

Then this is the different kind of judgment, we can understand the difference between a disability rear option and the negotiated settlement pre-specified triggers all three of them need proof specified triggers like the what the condition are in case of a disability or the other two as well then the determinant of the new arrangement as I told in a disability or a set formulaic solution is already approved that if the certain condition happens then we are going to do this that is finally fixed in real options there are a variety of options that are provided and we will be choosing among the thing and the developer mostly chooses one of the calling options and then finally the settler negotiated settlements discussion based on the specifics here in negotiated settlements most of the cases adjustability and real options are not a viable option those are the kind of set of problems.

Wherein become we would not be able to predict the perfect like what is going to happens and set a specific tackling a solution in the present itself for the future, so here the discussions need to be made at the specific point where it when the issue occurs then the implementation mechanism adjustability is the clauses what happens and what we do for it in real options of clause of one party to make bounded modification for the content which is mostly the developer he changes the contract according to the situation that is being arise but still it is a bit bounder it is not completely open that the developer cannot do anything there is a set of rules that are in place then the negotiated a committee is being situated and with specific power to may change the rule or change the contract and the use of discretion adjustability it is fixed like there is mostly no changes in real options there is a unilateral changes.

The developer who is undertaking the project he has complete power to change the project though in bounds and in negotiated settlement it is bilateral where in both the developer and the public sector they meet together from a community and discuss and come to a conclusion example can in adjustability can be like setting changing the concession end dates back based on the present value of revenue collected like this can be said during the initial starting of the project itself that at a certain present value of the revenue will be changing the concession end if we might shifted closer or we might push it further and in real options deferring the concession fee payments the developer according to the condition that being at that particular moment he might do this changes.

And finally in the negotiated settlements if there is some problem with the toll regime like there is a to increase toll regime or there I am not able reduce it and some of the situation that have caused this were not predicted earlier a negotiation can be made between the developer and the public and they can come to a certain decision.

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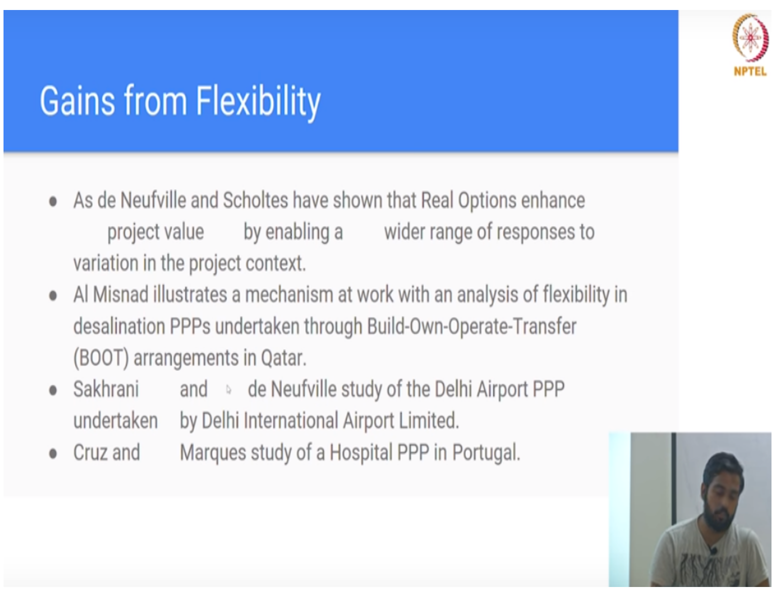

Then some of the examples of the gains from the flexibility as they now fill and short have shown that real options and of projects value by enabling a wider range of responsibility responses to variation in the project context here what the example was that the example was here of a parking garage where in there was option to build a three story a six story where in the three story was like they know that it is going to be needed but of six story was a prediction that they might need it.

So the power that was given to the developer was as in you can build a three story right now and later on if the demand increases you have an option to build the six story as well but the problem here was that the building a six story at a single time will be much cheaper than building three story right now and modifying it to six story later on I will (())(13:43) let us do some mechanism at work in analysis of flexibility in desalination paper is undertaken through build own operate transfer arrangement in Qatar here the developer either provide a fixed number of maximum quantity of water that is in clover or a minimum number that minimum quantity that they have to provide.

And later on according to their wish if they are able to provide it and if the demand is increased then they can provide more and the same was also for the government where in the government might pay a fixed cost to the developer according to the quantity that is been taken of in the developer takes of the entire risk at a higher increase in profit then Sokka Rani and Danial also store made a study of Delhi airport will be undertaken by Delhi international airport limited here there the developer was given an option to increase the number of runways if the demand increases if the airport works better than the developer had an option to increase the runways the space was already provided and that was an option for that developer then Cruz and Marcus study off hospital PPP in Portugal.

Here what they followed was that the government paid for all the categories of the emergencies in a hospital and the patient or the citizens who were going there they were charged to less extremely less this proved to be a very good example as the profits were also like 2.5 times more than the usual other PPP’s that were being followed other places.

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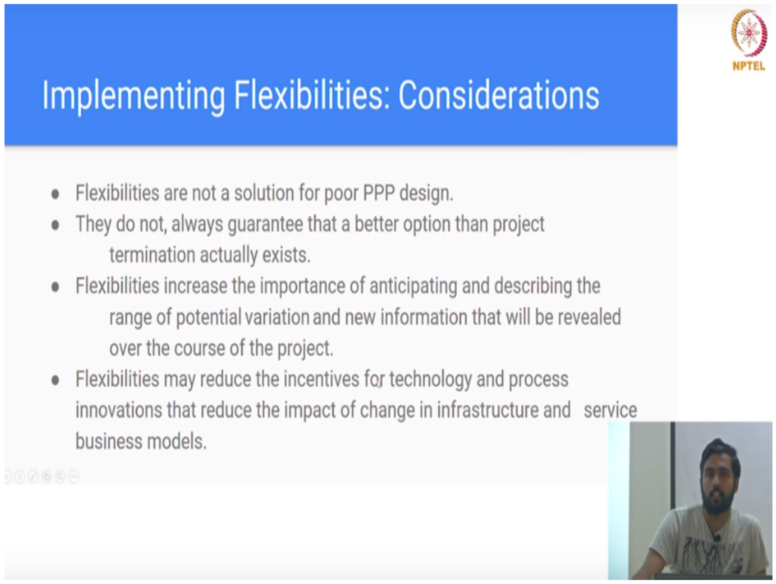

Then there comes a while implementing flexibilities we need to take few consideration the flexibilities are not all solution for poor PPP design we can be kind always like a substitute use flexibility to like make improve a poor PPP design it is just like we are making some fail safes to prove later on the PPP design has to be good we cannot just.

Let say that okay the PPP is poor but we have few flexibilities measure in place, so we do not have to worry about it we cannot do that they do not always guarantee that a better option than project termination the will exist, we need to take consider we need to take in possibility that there may be project termination might be better than using any of these flexibility options then flexibility increase the importance of anticipating describing the range of potential variation and the new information that may be revealed.

So you need to be able to kind of predict the future like what may happen what may be the issue that will be facing later on flexibility may reduce the incentive for technology as we are fixing in the contract few conditions forward to avoid this things they may reduce the incentive to technology and process innovations that might avoid this problems in future that might cause damages later on.

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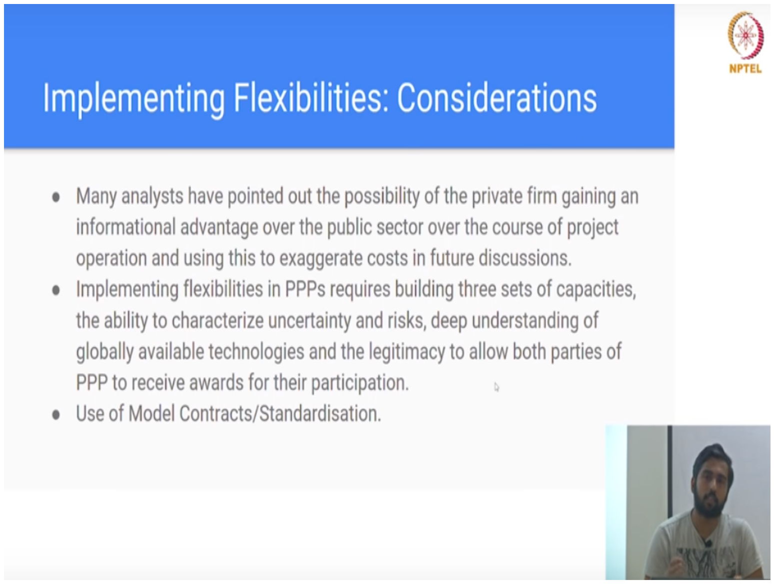

Then many analyst have pointed that the possibility of a private firm gaining information advantage, so the private is the one who is handing PPP completely, so the analyst have said that they might have a gain better they may have a better knowledge about the project and they can exaggerate about the cost in future discussion during the future discussion during the negotiation with the public sector.

If they do not have the base all the information required they might be at an advantage and might cost the public sector then implementing flexibility in a PPP is required building or three sets of capacities the ability to characterize uncertainty and risk deep understanding of globally available technologies and the legitimacy to allow both parties of PPP to receive award for the participation like the first point basically being that we should be able to know what uncertainty what are the risk that might come in future then and deep understanding of globally available technologies.

So if you do not know about what are the alternatives that have been possible we might have a bad deal of the flexibility option that we have made might cause advantage to some other company and we the public sector might be in loss and the legitimacy to allow both parties of PPP to receive awards for their participation these three points these three sets of capacities are currently we in India there is a problem for this fee and that is one of the reason why implementing flexibility is a bit of problem in India the use of model contract or standardization.

So there may be an option of standardization or customization in standardization the fixed set of rules are placed which might help in like all the developers shave to follow set of rules but later on they might also be a problem that if one of the project phase falls as standardization has been happens all the projects following the same rules might also collapse on might feel and then in customization there we have an option of experimenting and like changing arranging the reduce it reduces the risk as we basically divide it among different project and all of them have different approaches and not a simple one set standard but also there is an arbitrary point in this customization method.

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So making finally making flexibility work in India earlier the public sector took up on a lot of risk as there was not much of interest to attract the early partners they change but later on currently in mid-2000's they started being more aggressive as the demand was increasing like many partner wanted to get into the PPP this shift was accompanied by default delays and request for open ended mega renegotiation of project as the circumstance change so this as the government started being more aggressive they were being us the default and delays and we started increasing as the risk was more pushed to more towards the developers.

And so this brings into importance of flexibility which we need but bringing flexibility in India PPP's will not be easy as the same challenges that have always affected PPP is to plan ahead in detail for many scenarios which is not the such advantage advances are not currently possible in

India for various in also plays a major role in flexibility, so this is a bit of problem in India then Flexibility can also be open more possibilities for opportunistic behavior and adverse incentive in PPP.

So that developer might try to look for more making it the more opportunity more advantageous for him and might like there might be a damage for the government but still the flexibilities will of course play a essential role in the future, so we need to like work on how we will be able to incorporate flexibility in India Nitin will.

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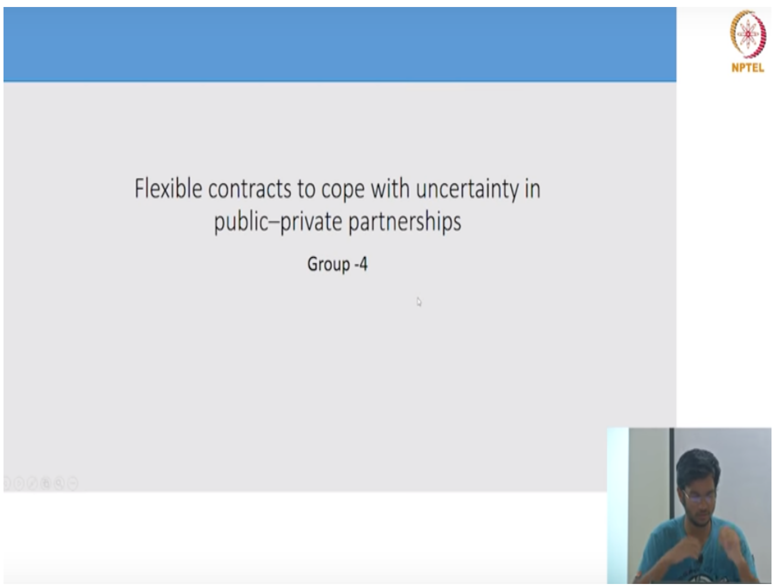

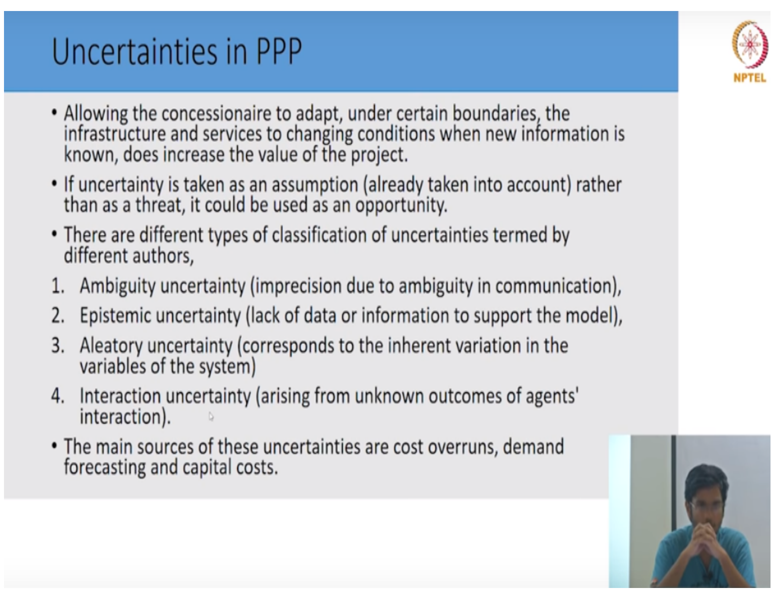

So we are going to discuss about flexible contract to cope with uncertainty in pubic private partnership it is a research paper from university of Lisbon this paper addresses the concept of contract flexibility as well as the several possibilities of incorporation in PP development so uncertainty in PPP, PPP's are based on contracts which base case scenario is drawn from the predefined for cast and assumption on the main across macroeconomic variable leading to demand forecast and cost estimate.

So this is the forecast have proven to be less accurate and unpredictability is very high coming to like even the years like the running period of those projects are more than 10 years allowing the concessionaire to adapt as under certain boundaries will surely increase the value of the project and lessen the cost and lessen the risk to if uncertain is taken as an assumption rather than as treat it could be used as an opportunity.

So there are different authors how do you classify different are it is uncertainty in PPP there are different type of classification one is like ambiguity uncertainty this is impressed imprecision due to ambiguity in communication and epistemic uncertainty is lack of data or information to support the model Aleatory uncertainty is corresponding to the inherent variation in the variable of system and interaction uncertainties arising from the unknown and outcomes agents.

So the this paper represent that main sources of these uncertainties are cost over runs demand and forecasting and capital cost, cost over runs are mainly due to the delay in execution and construction of project however recent study showed that increase in private sector participation in project has on time delivery of project by bundling several series of project eye to eye cycle approach coming to the demand recent studies again shows that there is an overestimate demand in the large project most of the road and water projects are mainly negotiated due to optimism in forecast this may lead to losses in further time.

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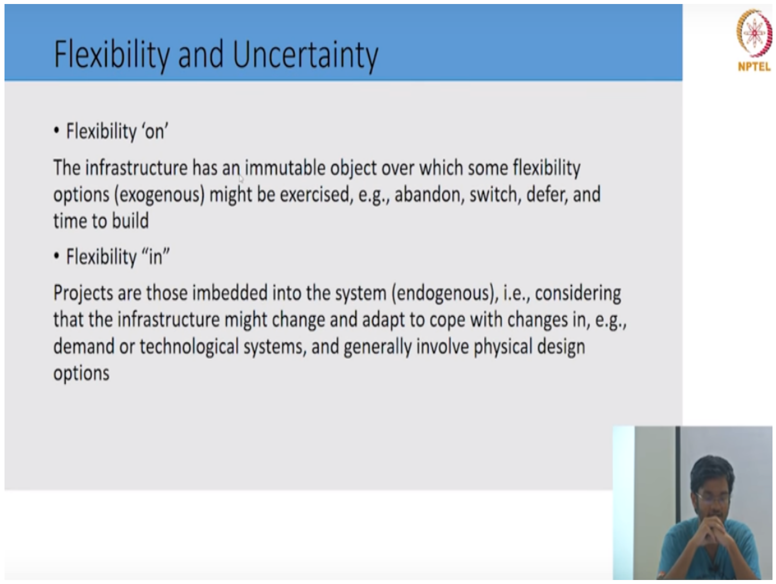

So coming to the relation between flexibility and uncertainty the flexibility on project, flexibility has two types of implementation on project one is flexibility on the project this means infrastructure as immutable object over with some flexibility such as abandon or differ our to time to bill the another one is flexibility in the project which are embedded in the system and it is endogenous, so we can adapt to changes in such as technology will condition so if there is any technological developments the project can implement right way with instead of following the old traditional condition, so this can again increase the productivity of the project.

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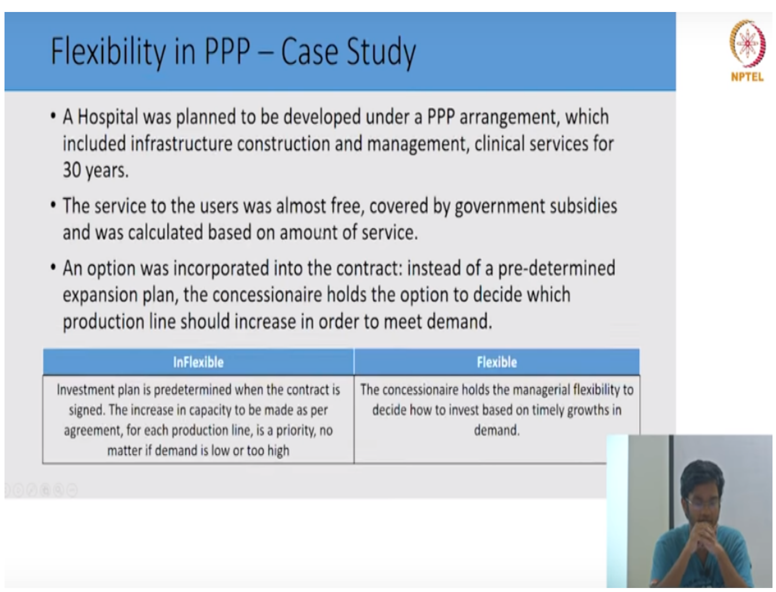

And the paper also represent a case study of a hospital health care like the hospital has planned to be developed under a PPP arrangement which included infrastructure construction management clinical service for 30 years healthcare is one of the most uncertain project both in demand and supply because we are not able to create how is the health condition of the patients furthering or than coming years and also technology condition there may be some technology developments, so which may can compete with the existing PPP.

So this project was like this case study was carefully taken so the volatility is very high for this project the service here was almost free and covered by the government subsidies and all scales calculated on the basis of amount of service done by the consciousness so for the model consider that the new re-numeration is based on level of service provided meaning that each treatment grantor pays the conception on the service basis in this contract and option was such that instead of a pre-determined expansion plan the concessionaire holds the option to decide whether the production line to be increased or not after some certain period of time.

So here is difference putting in flexible and flexible contracts investment plan is pre-determined in and contract assign the increasing capacities we made as per agreement which is in priority and it does not depend on the mat demand if it is too high or very low arising flexible the concessioner holds of manager flexibility or like to some authority, so to decide where to invest and how much to invest based on the timely growths in demand.

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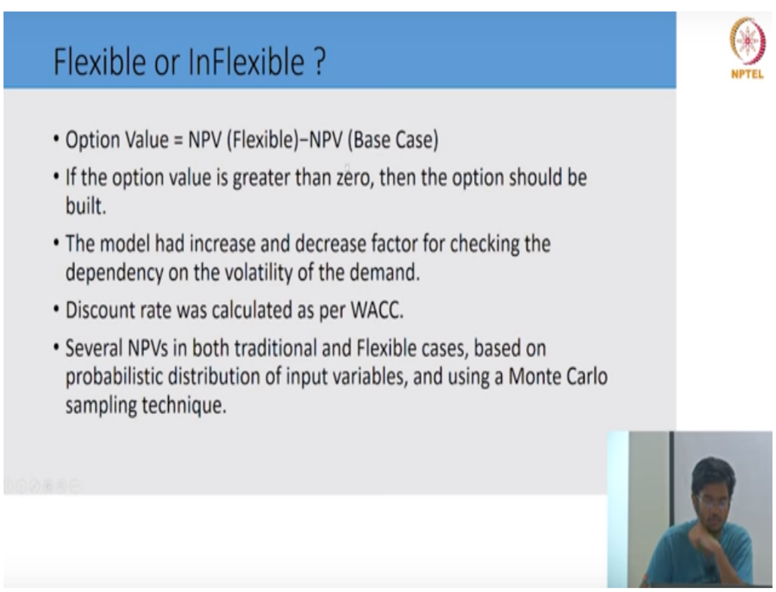

And coming to the choice whether to take flexible or in flexible in PPP's, now there is another term call option value which defines the net present value of flexible net present of value of based case which means the inflexible case if the option value is greater than zero then the option should the option of flexible should be built however there are some actual exception this is such as dam where the design is very complicated and changing the design such that after the construction is a very like highly impossible and in this paper the model has to determine the comparison with flexible and inflexible case a model was created which has increase and decrease factors for checking the dependency and volatility of the department.

We are discount rate was a calculated as per W say in cash flow and they assume that there are some probability distribution in the construction cost itself, so there are several NPV calculated both in traditional and flexible cases based on the probability distribution of input variable and using a Monte Carlo sampling technique they found out the work from a distribution of both flexible and inflexible case.

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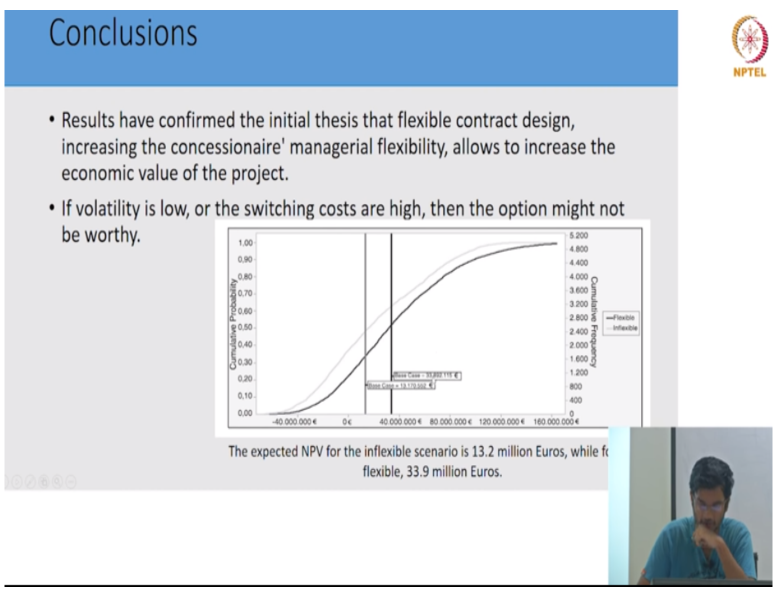

So here is the conclusion a result from this thesis the flexible contract design has increased the concessional manager flexibility and also increased the economic value of the project however these economic benefits can be higher or lower according to the volatility assume if the degree of uncertainty higher one benefits of using flexibility is also higher however if the volatility is lower or non-existent both flexible and inflexible contracts are equivalent and you can see from the graph that for every cumulative probability the flexible case is always a yielding higher NPV than the inflexible case when the expected value of for the hospital project was 33 point 9 million euros for inflexible case whereas for inflexible it was only for thirteen point one seven and.

So as I mention that volatility is low the switching cost are high then option using flexibility might not be worthy, so thanks to both of you for very detailed presentation so the mechanics that Nitin just presented well I will talk about them little bit more but this is not something that you know you can just leave it is one of those things where you have open up an excel spreadsheet and do which is exactly the purpose of the other class that I want to do evening where essentially when we have that.

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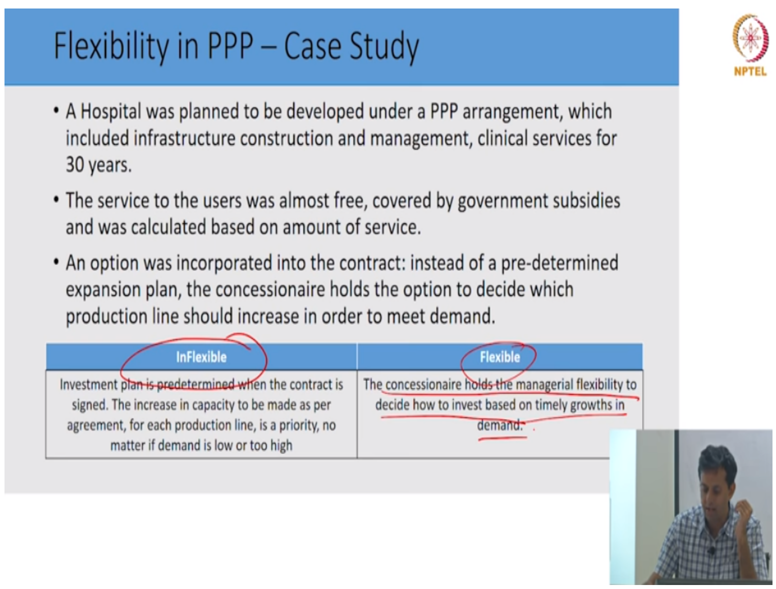

We will do exactly what you see here you have go the inflexible case where essentially you have in this case you have a predetermined agreement about expansion irrespective of whether there is enough demand or not right at this could this applies for a hospital here it could apply for a road elsewhere it is almost like saying I am going to build the two lane road and then I want you to expand it to a four lane road right in six years why do I want you to expand it to a four lane road what is the logic behind that.

So the assumption is over a period of time demand will pick up and I want you to sort of expand it but that is an assumption, so for all I know what demand might pick up within the third year itself or it might take 12-15 years demand might never pick up right, so the inflexible option is to say let us go ahead and expand near sixth part of your contract the flexible option is to say look the concessionaire holds the managerial flexibility to decide how to invest based on timely growths endeavor in other word all I want you to do is make sure that the congestion level remains below or something.

So you know have the ability to decide when to expect so maybe it is in year three maybe it is in year five maybe it is eight maybe it is year never expand maybe it is build the four lane right up front because you feel there is so much demand so there is flexibility but how do we actually compare these we will have to sort of look at the cash flow on for both sides what happens if investment comes in now comes in later there are obviously number of different scenario these are all probability based because the potential for me to hit that traffic in year six this is certain probability associated with it.

So there is a possibly some other probability associated with hitting it in the first four years in the last ten years and therefore you have techniques like Monte Carlo you had Monte Carlo somewhere on these slide no how did you just mention that may be just.

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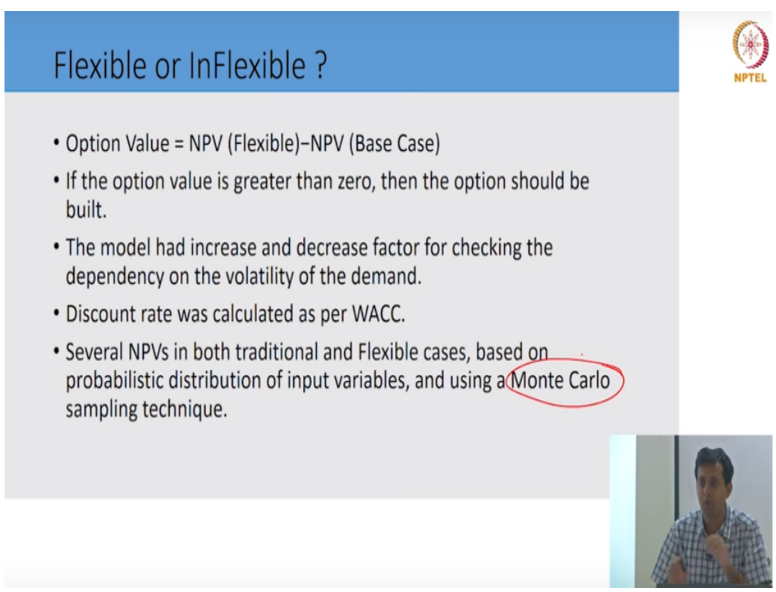

Here we go you have probabilistic techniques like Monte Carlo analysis that you have to use to figure out how to model because there is no determinacy in any of these right it is all hypothetical scenarios, so I need to use some probability statistics Monte Carlo kind of approaches to be able to model these scenario and then decide what work best.

So we will talk a little bit about this, so we will actually do a hands on exercise we will open up excel spreadsheet at some point I have a very similar one which I have borrowed from MIT similar sort of in a question that we can actually start working on all right, but we will get back to so thanks but let us sort of get back to this.

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So both presenters spoke about flexibilities on project, so simple fundamental question why do we need flexibility in a project in an infrastructure project why do we need flexibility okay and why will it not say relevant for a long time if there is no flexibility, so yeah so there could be changes in demand there could be changes in technology good yeah, so absolutely any other additions to that changes in preferences, so what you guys are getting at is the state of the world does not remain constant the state of the world keeps changing and therefore in order for the project to say relevant the project needs to keep changing as well that is just logic that is just common sense right it does not take a rocket scientist to figure that out and therefore I need to have some amount of flexibility on a project particularly if the duration of the project is very long if I am going to do a project for a very short period of time.

So for instance you do not know you know cell phones for instance people tend to seem to tend to use for about a year or laptops even a year or a couple of year and then you sort of end up changing etcetera, so I might be given for designing a for specific set of uses without necessarily putting in a lot of flexibility because I know that couple of years you are going to shift anyway and that technology will change you will have a completely different port.

So this particular for need not necessarily adapt because of the nature of that kind of technology on the other hand when you look at a bridge or a road or a power plant these not things that you are going to redesign every two years as demands change these are things that are new ideally the cost are so high that when you put them in you want them to run for minimum 30 years at least that those are concessions period for public private partnerships but if you look at the design life of the asset it is probably 50-70 years I mean 30 year the contract you are awarding but you want the asset to be relevant 50-70 years and over that time period the number of things that can changes with regards to the world are very-very high.

So I do not know I have done hypothetical thought exercise in the class but you know typically what is the duration of a public private partnership contract concession what is the most common 3 years roughly 20 years 30 years let us say 30 years for now most of these contracts they give t for 30 years now let us say I write an inflexible I do something inflexible I come up with a project design and I come with a project contract that is not flexible what does that mean, that is mean in 2018 I am writing something which should hold in 2048.

So in other word I am saying I can predict the state of the world in 2014, so I am writing an agreement all, so let us just reverse that instead of going plus 30 year let us go minus 30 years let us go 2018 not to 2014 let us go 2018 to 1988 all first thing is unfortunately none of you were born in 1988 all of you are post 1988, so first of all you sis not even exist but have you existed it and I did you would have seen the world that was very-very different, so this thing that sort of rules our lives called the internet and all of that just did not exist there is no such thing called email there were no mobile phone nothing.

So sir travel was exorbitantly expensive and so just the way in which we communicated we transported the energy requirement that we had etcetera but very-very different and if you had to predict 2018 and 1988 but virtually impossible because society today is fundamentally different those technologies that we take for granted today you know were hardly I mean obviously were still there but you could not really envisage where they were this was still something that you saw in Star Trek or Star Wars or whatever not something that you thought would happen anytime soon.

So just put yourself in the shoes of a decision maker in 1988 trying to predict what the world would have been like him 2080 most likely they would have gotten it completely wrong that is exactly what we are asking everyone to do today put yourself in 2018 and predict all 2048 so the point is the world changes.