Infrastructure Planning and Management
Economic Risk in Infrastructure - Part 1

So just very quickly last class we just talked about risk and construction, we looked at two projects the project from health as well as from the Montréal Olympics where the projects were severely delayed and this is not an uncommon occurrence in large infrastructure projects, many projects are delayed and the delay is not by a month or two, sometimes the delay is by several years, sometimes the cost shoots up by large amounts and when you look at the cash flows of a project the capital cost of a project are the highest cost on that balance sheet on that spreadsheet. And so if the cost on the project uh spiral out and if the time duration of the project gets longer right which means your revenues are going to come in further and further in the future, which means if you discount them to today's network they are going to be worth less and less, you end up with economics of the project being completely warped.

And in many cases projects are on paper look wonderful and financially stable, by the time they run into these overruns cost and time overruns primarily due to issues in the construction phase they just sort of spiral out of control rights. So those are important resistance those risks could be with regards to land acquisition, it could be regards to material unavailability, weather conditions and we really need to invest in better construction planning techniques right, that is where things like building information, modeling and all of that study in the construction management plays an important role. While maybe not as high ticket the operations and maintenance are also obviously critical to the functioning of the assets.

So for instance take for example the functioning of the metro rail system that you built in Chennai or wherever. And obviously for the infrastructure to work trains have to be running periodically, there are number of things that can stop trains from running periodically. For instance there could be snags in the tracks; some of them are mechanical electrical systems might not be working properly, your tunnel ventilation fans might have to be replaced so anytime there is operation and maintenance issue couple of things happen. If you particularly if you do not predict it and catch it in time, essentially what happens is you have to stop the infrastructure right. And if you have to stop the running of that infrastructure then that is loss of revenue loss of value, et cetera, so it is very important to also think about risk in operation and maintenance.

Typically when you build metro rail for example, you probably know a tunnel ventilation fan can last for N number of years right or you know this kind of signaling in telecommunication system will last for this long and therefore I must replace it perhaps 3 months before it is scheduled to die right, so there are certainly these maintenance schedules that you can uh come up with, but the point is that these need not be the equipments that we are talking about could fail even earlier right. It is like if you buy a car possibly people will tell you that the car could run for about 10 years that is the average life of a car, but your particular car for whatever reason you might be running it far more, it might breakdown 4 or 5 years right.

And at that point you need to also have what we call we need to have the preventive maintenance systems right where essentially you are looking at and saying I am going to prevent the loss of any economic revenue generating activities by replacing or maintaining assets before they fail right, you also have to look at what we call predictive maintenance right. You actually have instrumented your devices, they can give you early warning signals that these have to be replaced all of that so that much before a failure right you actually start replacing the assets otherwise you are left with what people call corrective maintenance. Corrective maintenance means after the fact after something has failed you start maintaining it, all right.

So maintenance is also important in terms of there are risks that things could fail ahead of time that good then stop the project temporarily that could lead to loss of revenue all of that and got invest in better decision systems to improve maintenance. If you take the case of a highway right, we know that from time to time you will have to resurface the highway, there is sort of you know there is maintenance or often you have what you call minor maintenance which are repair works that are carried out on an annual basis and then there is once in 5 years perhaps there is a major maintenance where you bring a milling machine, you take off the top layer of the road you really (())()4:21) and so on right so there are those.

The point is when you do this you are obviously going to be constraining the capacity of the road right. What you do not want to do is eliminate uh the ability for people to use that road, you do not want to take all 6 lanes at the same time, do milling and basically say for this month this road is closed right that is economically not the best solution, socially also probably not the best solution because people are relying on that mode of transport. As you have seen in many roads here essentially what you do is you do it lane by lane right, so you

close off one lane to traffic uh, you do your repairs and maintenance works on those lanes and then of course you keep moving lane to lane.

So the speed with which you are able to do this uh this renovation is critical because the moment you start restricting lanes clearly traffic congestion is likely to build up provided it is a highway that is being used popularly right. So there are metrics like meantime between failures right or the meantime to replace that people often keep in mind and try to optimize so that you actually operate and maintain the infrastructure because let us face it. Construction might take 3 years, 4 years, 5 years right, the asset is going to be there for next 30-35 years right, so whether it is an airport, metro, railway, a port, road whatever, there is maintenance that needs to be done on an ongoing basis.

Often whenever you do maintenance, you are going to affect the capacity of that infrastructure right which means you are going to reduce the potential for earning revenue right so then it becomes important for you to sort of think about how do I minimise the disruption to my revenue streams or my value streams as a result of working on that infrastructure right, whether it is shutting down a runway for maintenance, whether it is shutting down a lane because if we do not do it properly again your cash flow gets affected and it might not have the same impact as a problem in construction phase does because construction costs are much higher than operation and maintenance cost, you can still have all kinds of (())()6:12).

And you never know when these failures are going to come from for instance, in a road there may be an accident on the road because of the accident on the road the medium has actually been damaged right which you now have to replace because if you do not replace it that there is possibility of more accidents for a particular lane is now non-functional right. So it does not say that this is all very nicely predictable but again that is where the technology can help uh whether it is satellite imagery, drone technology, building information model whatever it is, trying to figure out if we can predict issues with you know with assets and do maintenance as far as possible ahead of time right and the old prevention is better than cure philosophy works here as well.

So for instance, there are certain sections of the road that are likely to be accident prone right for whatever reason there are curves, the visibility is not high, the mountainous section, you know accidents are likely to happen, because accidents are likely to happen your operation and maintenance cost in those sections are likely to be higher right, so it is up to the

developer to make investments to reduce the probability of doing that so investment could range from better quality reflectors which tell you about curves coming far ahead of time to just sign boards right that tells you about that the curve is coming in that sort of warning you know “speed thrills but kills” you know all these kinds of I saw a particularly hilarious one in when I was driving from Coorg to Mysore which said “better to be Mister late than to be late Mister” I thought that it is pretty funny.

All of these sorts of files that you can put in, in some cases people even put graphic pictures right of road accidents just to deter people from riding so whatever the strategy is, we talk about safety stats but all of this is very important because if you just sort of build the asset and let it run then you might have maintenance issues, you might have accident related issues, all of it reduces the throughput of the infrastructure that you have built all of which reduce the bottom line, and you know if your 14 percent might suddenly become 11 percent right and that might not be what you are expecting.

So operation and maintenance is also something to think about carefully, if not for any other reason but for the fact that 50 years for the life of the infrastructure only 5 years is construction right, the remaining 30, 40, 45 whatever years you have is operations and maintenance and therefore that is a function that really needs to be though through risk need to be managed ok alright. So we will move on now to next set of pretty big risk which are economic risk right. So we will have group A coming forward or if all of you are coming forward, come over and present your views on the, so you are not going to present the case study you are presenting the Flyvbjerg reading and you are presenting the economic hitman right ok.

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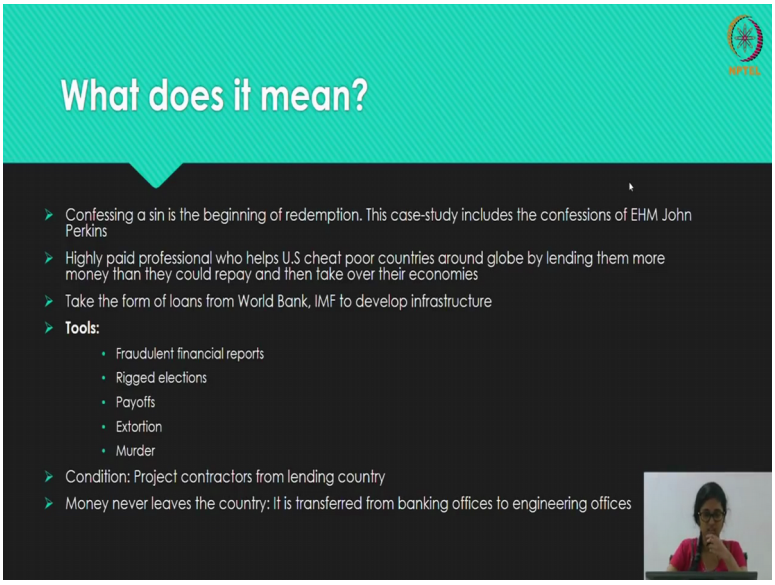

Confessing sin is the beginning of redemption, so today we are going to discuss the confessions of John Perkins, who is an economic hit man. So economic hit men are highly paid professionals who help full countries like US to cheat poor countries by lending them more money that they can repay and then take over their economies, so what are the tools they use? Fraudulent financial reports, rigged elections, payoffs, extortions and murders. So they put a condition that the contractors must be hailing from the lending country itself so the money basically never leaves the lending country, it is just transferred from banking offices to engineering offices.

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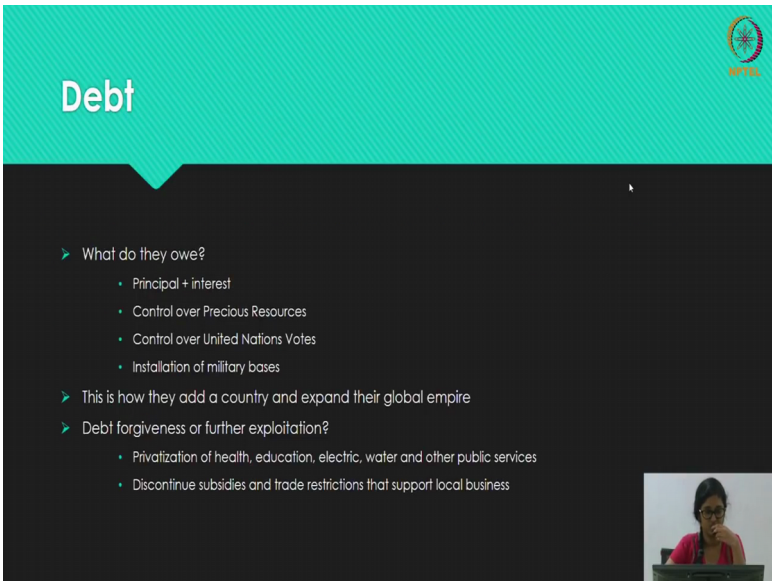

So what do the countries who take the debt off them, so they do not owe only the principal and interest, they also take over their resources and they have control over the votes in United Nations, this is how they add a country and expand their global umpire. So sometimes in the name of debt forgiveness they further exploit these countries by asking them to privatise their health, education and water centres and they ask to discontinue the subsidies and trade restrictions that support the local businesses.

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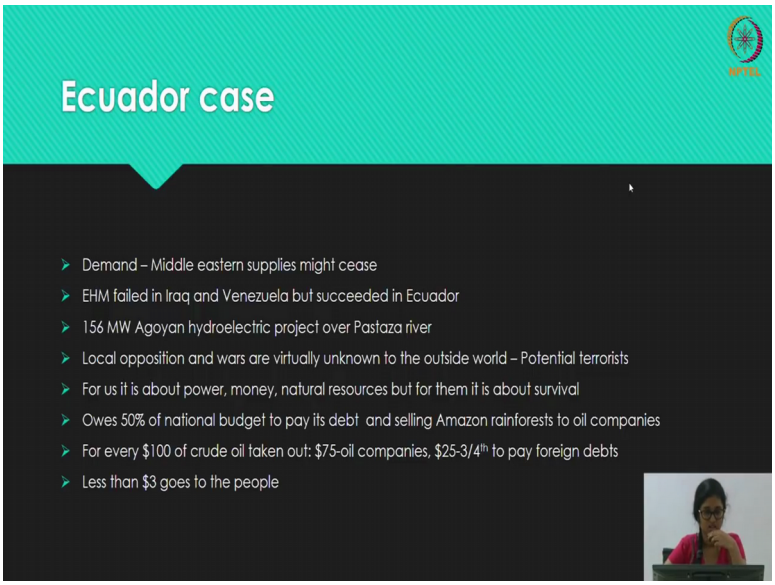

So this is the Ecuador case, in Ecuador case they took a debt to build a hydroelectric project over the Pastaza river, so what did the US really want? What they wanted was there was a risk that the oil supplies may seize from Middle East countries so they wanted oil, they tried to get it from Iraq and Venezuela but because of political opposition they could not succeed so but they succeeded in Ecuador. There was local opposition but it was not really known to the world, so over the 50 percent of the national budget of Ecuador goes to paying the debt and they also exploited the natural resources like Amazon Forest, they took oil from them and they do not get anything in return so most of the money by extracting crude oil like so 75 dollars goes to oil companies, 25 dollars goes to foreign debts, after paying the debt only 3 dollar goes to welfare of the people.

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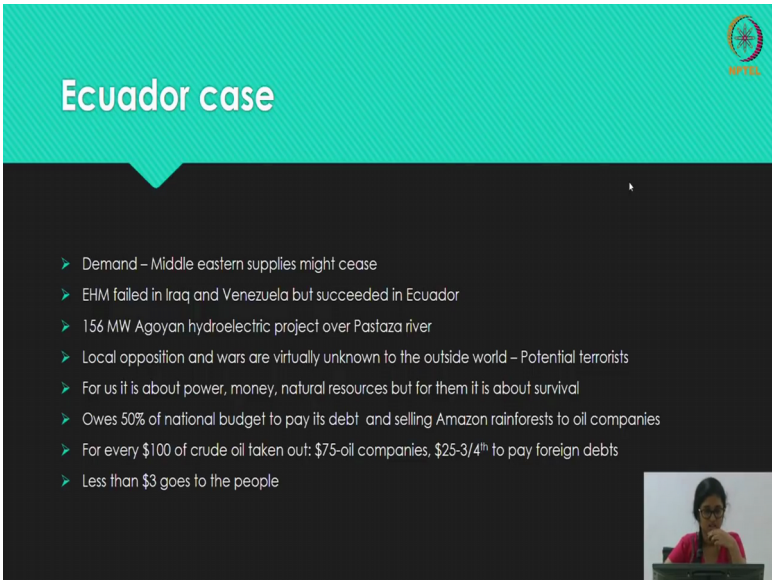

These are the views of John Perkins, so he worked in an international consulting firm for 10 years, there is an erroneous belief that the captains on the industry who drive the system should enjoy a special status so there are lot of income inequalities, only the wealthy people they enjoy the money more. So there was a war so US provided some 87 million dollars to conduct this in Iraq if only half of this money could be provided for diet, sanitation and education, every person in the world could enjoy these benefits. According to him the 9/11 attack was the result of actions of economic Hit men. In the end he says that no country or combination can thrive in the long-term by exploiting others.

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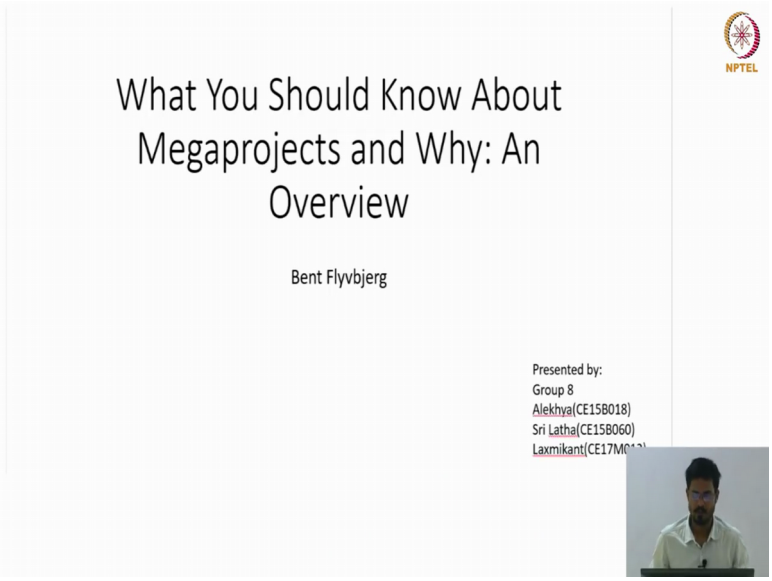

Hello everyone, I am Laxmikant and I am going to present you about Bent Flyvbjerg's views on what should you know about megaprojects and why.

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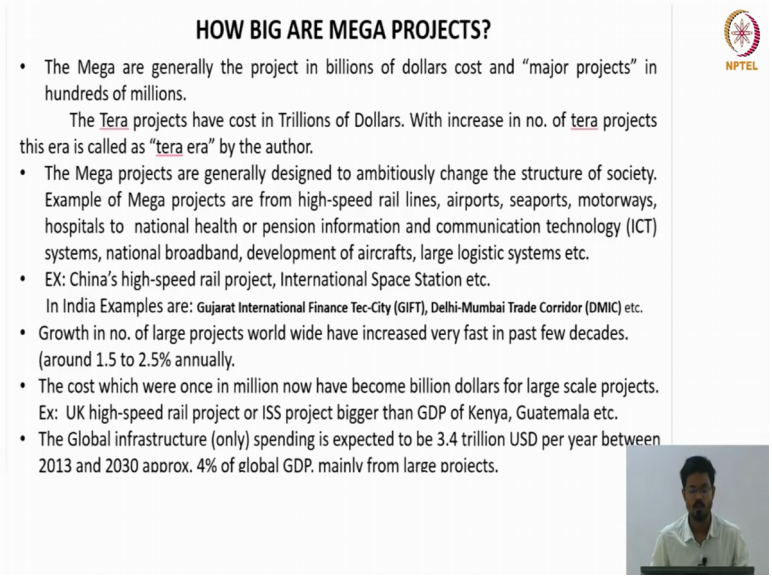

So megaprojects are big projects which are which have the cost in billions, more than 1 billion US dollars, and followed by them are kind of projects which have cost in trillions of dollars. So these kinds of projects these kinds of big projects are increasing in numbers from previous few decades and this is called by the author Bent Flyvbjerg as "Tera era". So megaprojects are generally designed to ambitiously change the structure of society and these projects affects the society and cultural things of a country on a large-scale.

These projects include the highest-speed these projects can be of many types like high-speed rail lines, airports, seaports, waterways and in fact information and communication technology projects, logistics systems like Amazon and other projects in national broadband or Internet connection projects something like that. So example for example China's high-speed rail project, International space Station project, these are some of the biggest projects in the world. In India some megaprojects are Gujarat International Finance Tech city GIFT city and Delhi-Mumbai trade corridor, etc. So a growth in number of large projects have increased very fast in few decades around 1.5 to 2.5 percent annually that is a lot of growth in big projects. The global infrastructure spending also has increased in few decades like from 3.4 trillion US dollar per year have been expected by some companies ok.

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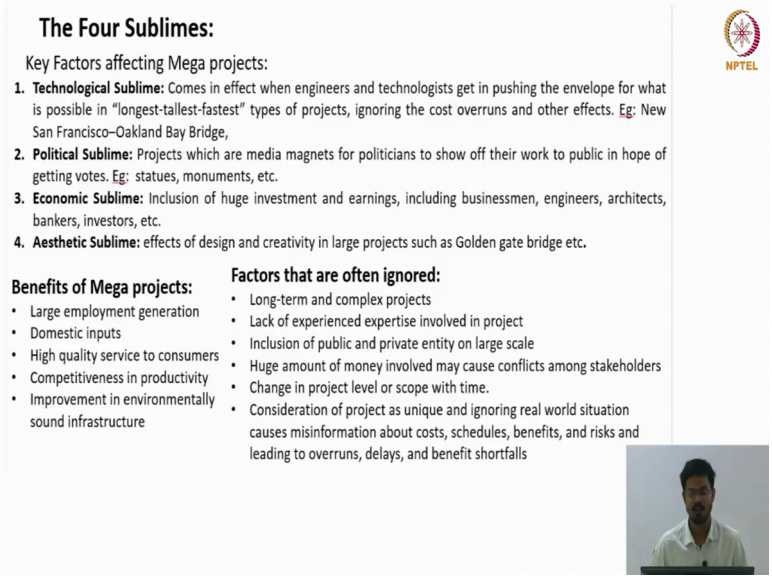

So according to author there are 4 sublimes which affect the megaprojects; our technological sublime comes in effect when engineers and technologists get in pushing the project as tallest, longest or fastest like Burj Khalifa is the tallest building. And in 1930 something around the tallest building in the world was 300 meters, but now Burj Khalifa is over 700 meters so you can see the growth how it has… Technological sublime has affected the growth.

So political sublimes are somewhere when politicians affect the project in terms of their benefits like to show the public that they are doing something and in reality, economic sublime inclusion of huge investment and earning which affects the project on economic level including engineers, architects, and other stakeholders. Aesthetic sublime effects of design and creativity in large projects like golden gate bridge or Sydney's Opera House; these are more of design affected projects. So benefits of megaprojects are large employment generation, domestic inputs are there, less what we say output from other countries, high-quality services to consumers, competitiveness in productivity, improvement in environmentally sound infrastructure.

And factors that are often ignored by this planners and decision-makers in these large projects are long-term and complex projects, these projects are long-term complex projects and a lot of processes are involved in these projects. Lack of experienced expertise involved in this project because number of these projects are not very much but so the expertise is not that much in this project and lot of small-scale project engineers or project managers are involved

in this kind of project. Inclusion of public and private entity on large-scale, huge amount of money is involved so conflicts are likely to happen in this kind of project.

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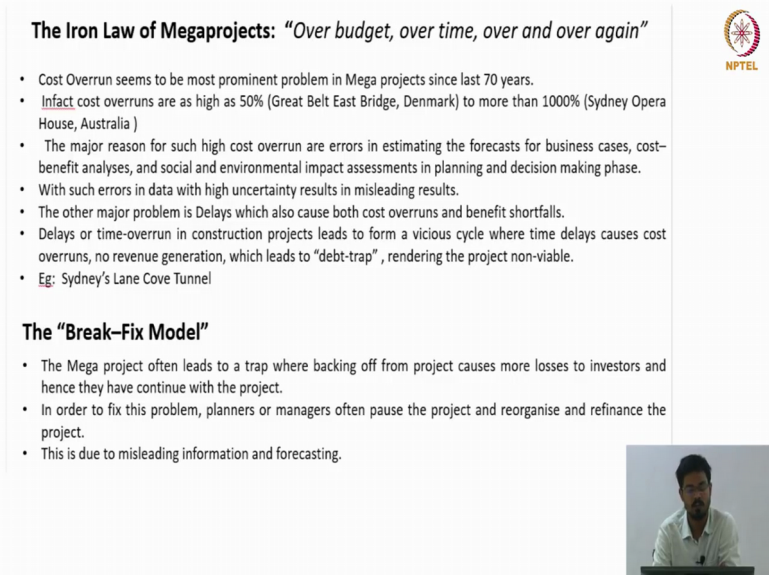

Next the iron law of megaprojects; over budget, over time, over and over again. So what happens is cost overrun seems to be most prominent problem in megaprojects since last 70 years and it has not been reduced very effectively. In fact cost overruns are high as 50 percent to more than 1000 percent in Sydney Opera House we can see more than 1000 percent was the cost overrun in the project. The major reason for such high cost overrun are errors in estimating in forecasting the business and cost benefit analysis, social and environmental impact in planning and decision-making phase. So these errors cause the uncertainty in results and lead the project to failure or not giving us the results as expected.

Time overrun is one another cause of project failure, Time overrun also causes the further cost overrun and kind of creates a "debt trap" which cost the project to become non-viable as there is no revenue generation and (())(18:59) causes cost over. Break fix model, the megaprojects often leads to a trap where backing off project causes more losses to investors then the then leading the debt so they have to continue the project in order to hope of some benefits from that. In order to fix this problem, planners and managers often cause the project and reorganise and refinance the project, this is called fix break fix model, and this is due to misleading information and forecasting in preplanning phase.

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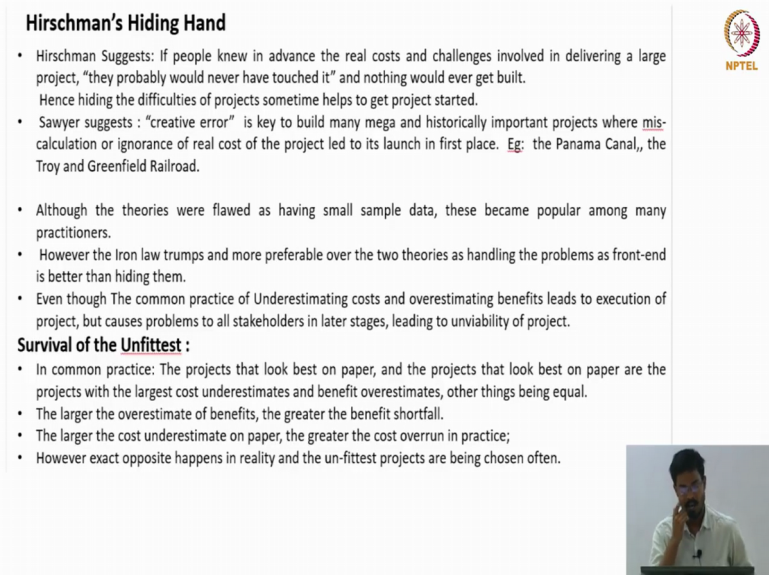

Hirschman's hiding hand, Hirschman's suggest that if people knew in advance the real cost and challenges involved in delivering a large project, they probably would never have touched it so nothing would have ever built. So instead of providing real cost and real information about the cost we should hide some information and let the investors come and the project should be started by self. Sawyer suggests that creative error is to build mega and historically important projects key to build mega and historically important projects where miscalculation and ignorance of real cost of the project led to launch in first place example, Panama canal and Troy and Greenfield railroad where the ignorance of the real cost of the project has been done so that project could be implemented.

However Iron law trumps over these two theories as handling the problem as front-end, front end means before the project implementation preplanning phase handling the problem in preplanning phase is more beneficial than handling it or hiding the problem for the later time. So survival of the unfittest, it is a concept given by the author that in common practice the project what happens is the project that looks best on the paper that project may not be the best in practical thing as suggested earlier that overestimate of benefits and underestimate of cost causes the cost overrun and time overrun both in practice and however, the project that seems to be fit in paper becomes unviable in reality.

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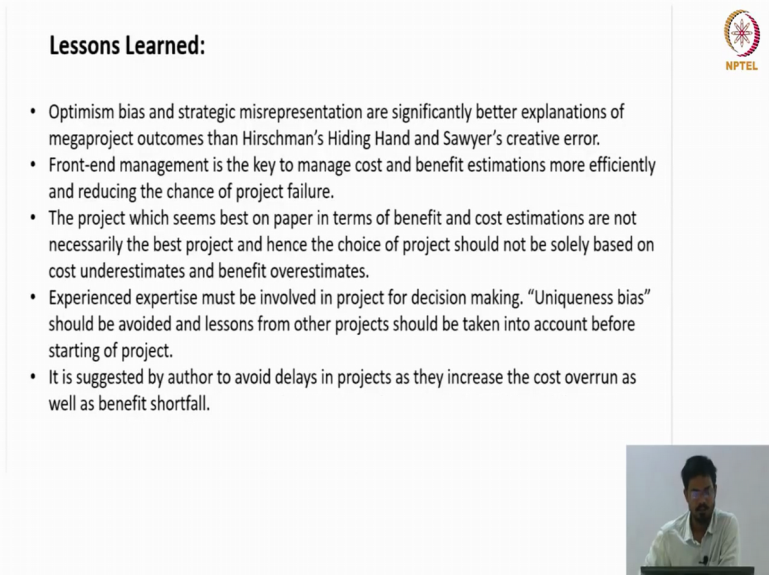

Lessons learned are optimism bias and strategic misinterpretation are significantly better explanation of megaprojects outcomes than Hirschman's hiding hand and Sawyer's creative error. Front-end management is the key to manage cost and benefit estimations more efficiently and reducing the chance of project failure. The project which seems to be best in paper may not be best in practical so cost underestimates and benefits overestimates should not be the sole factors to choose the project. Experienced expertise must be included and it is suggested by authors to avoid time delays as it increases the cost overrun and well as the benefit of shortfall.

Before we get to the case, so today we had 2 papers or 2 articles represented both of which are somewhat controversial ok so we will talk about them one by one and sort of see what we learn from them. The first one was the economic hitman article right or excerpt from the book by John Perkins ok, so what is the key message from that excerpt from the book? Yeah so vested interest that large countries have when they deal with large infrastructure projects right, so essentially so Harsh can you explain a little bit more what you mean by vested interest? Right, so very often what happens is that countries seek aid from other countries and it is not just financially, it is also technical aid right.

So you know any government for instance hires a set of consultants and they might hire consultants from other parts of the world who might have the expertise there. So for instance, you know water, one might look at the countries like the Netherlands right who have done a good job of managing water and therefore when Chennai wants to deal with its potential

flooding problem there is possibly some (())(23:36) saying, let us bring in people from Netherlands to help us right or it could be you know oil you have these countries with oil but without the technical capabilities of leveraging those oils fields, let us start bringing in some of these large American companies and consultants who understand how to projectise these situations so you tend to sort of take assistance from other consultants right.

The expectation is that the consultant is an expert, somewhat neutral who comes and essentially studies the project and gives you the best recommendation right. So the consultant says this is the technology you should adopt because this is the best technology for your soil condition right, this is the number of barrels of oil that you can possibly get out of the ground and therefore this is the kind of price that you should charge for it, this is where you should sell it, so the consultant is expected to be an expert. Theoretically it should have nothing to do with them being American or Australian or Indian or Russia or whatever right, so that person is a technical expert is the expectation, so you bring in the best consultant.

What John Perkins says is the consultants motives are clearly not that altruistic right, so the consultants comes in with ulterior motives. In this case the consultant he says is sort of supported by the US government to uh you know improve in various ways the political economy of the United States. So for instance they may come in and give you recommendations to build projects that may not necessarily need to be built right, but they still give you recommendation. So now that they have recommended that you need to build this project you can start borrowing money right to build the project. Where do you borrow the money from? Perhaps from the banks in the same country so you might go to the United States or you might say okay lend me money for this right.

The project is also designed in a certain way where the technical expertise or the machinery, et cetera might reside with contractors in the US right, so you are in a country somewhere in Latin America you go in and you say look these consultants have recommended I do this project can United States lend me 100 billion dollars, the United States said okay 100 billion dollars get transferred then that money is taken and given to contractors in the US right who will actually perform the task, so the money comes in from the US and it goes back into the US, but now the country here needs to repay the debt because they have taken a loan ok. What happens, the amount of oil that was supposed to be there in the ground is now not there in the ground right, and therefore the revenues that you are generating are probably a fraction of what you wanted to generate and as a result of it you cannot repay the loan right.

Because you cannot repay the loan, you are now further in the debt of in this case the United States right, so they say okay if you cannot repay the loan then here are the things that we can do, can you give us some kind of tax to do this, can you give us right to develop this other oilfield somewhere, so that reminds you a little bit the Arabian nights story of the Arab and the camel and the tent. There is an Arab in the tent, he does not let the camel in, the camel says can I put my nose in right because it is really cold and he says fine then the camel says can I put my years in because it is really cold and the Arab says fine and then slowly slowly slowly the entire body of the camel comes in and the Arab says look there is no place for the two of us and the camel says I am not moving right out you go, so this is essentially what John Perkins talks about.

What do you guys feel? How true do you think it is? One way of doing is to control the infrastructure right in other countries. Now this could essentially be I will give you money to build the infrastructure therefore I have control or it could be Perkins' argument of I am not asking you to use American contractors but I will design the project in such a way that you end up taking American funding and American contractors then sooner or later before you know it you are caught in a trap.

So if you look across geopolitically so Perkins says this is the truth right this is the absolute truth nothing but the truth and you know I do not know I think it is been a while since I read it end to end but I think somewhere in the book or maybe elsewhere in an interview he says he cannot reveal the location that he is right now because now that he has published the book, the moment anyone knows where he is, he will be instantly silenced and so he adds an extra layer of drama to it maybe I do not know I think it might be drama it might actually be the real thing, but he actually is very very clear that consultants who essentially help projectise of the opportunities do not necessarily do it with the right intentions in mind, they do it with the intention to promote in this case the US interest or the Chinese interest or whatever.

What therefore means is the projects starts running, the actual demand for that project is often not as high as the projected demand right that is because I projected the demand extremely high that I have convinced you to borrow all this money and build it and therefore the project runs into you know all kinds of problems and then you will have to think about creative ways of resolving it right, so that John Perkins' view on life that how this works ok. What does Bent Flyvbjerg says the other article that Lakshmikant just presented, what is his view? Does

he subscribe to this view of economic hitman, does he have an alternate explanation, any idea on what does Flyvbjerg say?

He has a couple of things that Flyvbjerg proposes right, one is that he says people are obsessed with these large projects right, they are obsessed with these large projects, engineers like these large projects because they are technological marvels in fact I was in a very interesting meeting which was sort of impart change by the government of Tamil Nadu where pretty senior person said engineers want to build only big things right, so you want to build interlink rivers, you want to build large sewage treatment plants, etc, right and if you want to build small things then you are not an engineer, you are an NGO right because everyone thinks that engineers need to build big things, only NGOs need to do all of this community level sanitation and rural roads and all of that right. So there is this hangup about engineers only wanting to build spaceships to go to the moon, et cetera so that is what we called the technological supply right.

All these engineers are really keen on building big things and therefore that gives a push to mega projects. Politicians also you know the same thing, I would rather build this huge diamond cut the ribbon and make it a big photo opportunity that might help me win the next election rather than you know whatever go and open something small somewhere 5 ML desalination plant, why would I do that versus a 100 million liters a day desalination plant that looks really nice pictures behind me, so there is a political you know sublime then he sort of says then there is sort of the aesthetic sublime of essentially architects and people sort of talking about as Laxmikant was saying looking Burj khalifa I am saying, is not this an architectural wonder right? Is not this an iconic building?

If I draw the shape of Burj khalifa anyone you know even a child today could probably recognize that this is what I am sort of drawing. Sydney Opera House right if I sketch it out, even if I did a very poor job of sketching it you know you would instantly recognize, so there is an appeal in sort of building things that have that worldwide recall. And then what was the, he talked about technological, political and then there is the whole economic sublime where people say look only if you build large projects, are you creating large economic opportunities, right.

So there is no point in building you know getting a few extra buses and making your bus transit system more streamlined, let us build large metro rail right because we are going to create a lot of jobs, imagine that thousands of people who are going to be employed, imagine

that thousands of people whose travel time will be saved, they will be able to go from one end of the city to the another end at very affordable rates and imagine the boost that will give the economy right and none of this is possible when you do a small project right. So small projects do not really give those kinds of you know economic arguments, they do not give you those aesthetic arguments, political arguments, technical arguments right and so because people sort of like projecting themselves, he says people go in for mega projects but these megaprojects obviously are mega costly right.

And one of the things that ends up happening is people do something maybe not exactly what economic hitman do but do what Laxmikant also called strategic misrepresentation right. If I went through the true cost of the facility nobody would approve right so I deliberately go in with a lower cost justified and as the project progresses, more and more cost gets added on but at that point it is too late to withdraw right so we have to go ahead and complete the project and we will see sorts of examples of this later on uh in the class right. The London Olympics being a classic example of the case where London won the Olympics according to the paper where one of my colleagues from Portugal wrote well he now lives in Manchester.

The cost was quoted at about 1 billion pounds I think, and when the project came through when the Olympics actually happened it came out at about 8 or 9 billion pounds right, so 8 or 9X was the cost overrun on that project okay. The other thing he also talks about which is a psychological condition called the, what is the psychological condition? Psychological condition is called what he calls the optimism bias which he says generally people tend to be far more optimistic when the task is in front of you right.

So even though you might know that you know historically it is taken people 10 hours to do this piece of work, when you are gung ho and ready to go, you often think that you can do it in 8 hours right you think it is just the matter of putting in the right kind of effort, putting in the right kind of planning, people in the past did something differently I been they were not motivated, I can do better right is often…

So even you know that most projects takes 6 years to complete, you have no problem committing to 5-year completion thinking that it is all about if I can bring in better technology, etc, all of this can be done, it was not possible earlier and convince yourself and you become quite optimistic. In both these cases what happens is the final economics of the project tend to be very different from initial economics of the project right. So particularly in these large projects the capital costs particularly important, cost overrun tends to be

extremely high right at the start of the project demand tends to be much lower because you tend to have built something very often much bigger than what was necessary at the time right as a result of which you may not make as much revenue.

So both these guys talked about why projects fail from an economic perspective cost perspective and both of them talk about the fact that your initial cost tend to be much higher than what your actual cost tends to be much higher than your initial cost, your actual demand and revenue tends to be much lower right and there are competing explanations right. Perkins says it is all a game, it is a deliberate game played by certain countries to increase their sort of standing in the world right. Flyvbjerg said it does not have anything to do with the kindly uh it has something to do more with policymakers, decision makers, general optimism uh right it is sort of just take of mind or state of being tend to be more optimistic.

We try to strategically misrepresent as a result of which we end up with projects where we convince ourselves that the cost will be X and the demand will be Y and very often the cost are much higher then we expect , the demand is much lower ok and these are the challenges right. So what we will do is where is group 3, come and present so we will talk about the this is Vadodara Halol toll road case right, again very close to not not very close but in India people are familiar with Vadodara or Baroda in Gujarat and there is a road connecting Baroda to Halol. And we look at this project and sort of essentially it is a project that went through certain economical risk right.

So let us sort of understand what happened on this project and then let us try to connect it with Perkins or with you know with Flyvbjerg to see if there is any correlation between what these people say the troubles that this project had. So how do you realise whether there is an economic hitman? It is very difficult because the point is there is also some benefit to the country right. For instance, if somebody is actually putting money into India whether it is the Asian infrastructure investment bank which is essentially a Chinese bank at the moment or the Asian development bank or Jayka whatever, it is all foreign money coming in, there is a benefit to us because it also allows us to build our infrastructure right.

The question is, what level of scrutiny are we doing with regards to the project arrangement. So somebody comes and puts in project report on your desk, are you just accepting it as given or are you saying okay that is an initial input let me also get an another team of experts to cross check some of those assumptions right, so those are the kinds of safeguards that you build to see if the data that you have is correct right because the war rationale behind the

economic hitman is that they are massaging and also what Flyvbjerg says in terms of strategic misrepresentation, optimism, buyers, everything comes down to there are some facts that are put on the table to justify a project those facts are incorrect.

So once you start off a project with incorrect facts in terms of cost and revenue then at certain point of time you as a project certainly lose, somebody else gains ok so then it is up to you to check those facts right, it is up to you to sort of have enough due diligence enough methodological rigour when a project report comes in that says this project is feasible, this is the demand that you are able to actually believe those numbers right so that is the only way you can really determine, so whether it is an economic hitman or not you are not concerned you want your project to go ahead ok. So come over and let us talk about the Vadodara-Halol case.