Lighter-Than-Air Systems
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Lecture - 92
Char Dham Yatra – Part II

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Now, where does all this lead to? Does it really make economic sense? That is what the next few slides will tell you. So here are the three contenders. You have a luxury car, this is a Cielo which was at that time very luxury car, but now it is not available. Daewoo was a company which made this car. And then you have this Skyship 600-B and then you have Tata Sumo

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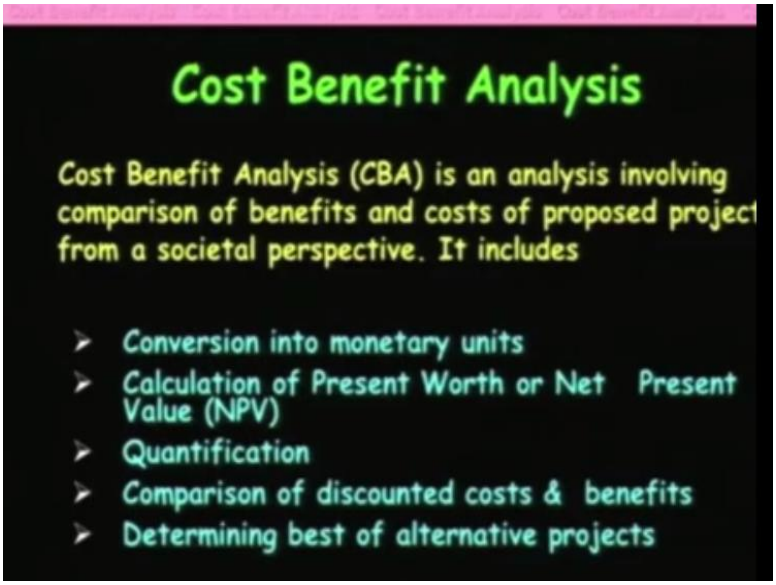

So, when you do a cost benefit analysis in transportation, essentially what you do is you look at the various costs and the various benefits. And you try to get a monetary value of the benefit, remove it from the costs. The net cost can then be compared. Now, what you do is you convert everything into monetary units. It is not very easy. Things like cost of fuel, the charges to be paid to the drivers, etc., you can work out.

But how do you look at things like you have saved so many hours, what is the money equivalent of that? This is called as value of travel time saving, value of travel time. Now, value of travel time is a huge research area in transportation. Let us say if I asked you what would be the value of 1 hour reduction in your travel time when you go from a place to another place?

Let us say you are doing this yatra or if you do not go to this yatra because many of you might say I do not want to do this yatra, why are you asking to do this yatra. Let us say from wherever your hometown is to IIT Bombay you travel today by a mode of transport say train, it costs so much. Suppose I give you some other alternative, which saves you 3 hours of time. So, let us say the journey is 10 hours and you reach there 3 hours early.

What would you put as the value of the saving? In short what is the value of 3 hours of your travel time? Think about it and I want a number from you. So many rupees is the value of my travel time. I also want you to think and tell me on what factors does this number depend? First of all will it be the same number for you and for me? It may not be. So what does it depend on? Why will it be less for me and more for you or vice versa?

So, does somebody have any number? How many rupees per hour? Yes, let us get a number. **"Professor – student conversation starts."** Yeah, let us have number. 1000. 1000 rupees per hour, on what basis do you get this number? Time I will spent with my family. So, but how do you say 1000, why not 500? Why not 1500? 500 seems very less. Yeah, so that means what you are saying is 1000 rupees is the ballpark, so 500 is less than, 1500 is more.

Once you fix the number then you can say more or less, but how do you get this number? There has to be some way of giving the logic. If you cannot have the number tell me on what basis will this number depend? May be go to our parents. So, what do you do with this 3 hour saved? So, as you said these 3 hours I will give it more to my family. **"Professor – student conversation ends."**

So he has valued as 1000 rupees per hour that is a questionable thing. We do not know. It could be too high, too less, but one thing is what do you do with that time? Now if you are welloff fellow you have nothing to do you will say 3 hours more what is the big difference? So many of us take an indirect journey. We take a flight ticket or we go to Mumbai to Bangalore we say direct flight or Mumbai-Delhi is an example.

You take a direct flight. It costs so much. There in another flight which is via some city to our halt and it is much lower, you say no problem. How does it make a big difference for me? Because that money saving is more important to you than reaching in 2 hours. Suppose it takes 4 hours to go to Delhi instead of 2 hours, it should not be a big deal unless you have something so important there that even 2 hours you cannot wait, correct.

So, there is a huge body of research on value of travel time savings. It is different for air travel, it is different for pedestrian travel, it is different for road travel, bus travel. When you design a metro in a city like for example we have this metro which connects from Ghatkopar to Versova, so how many people will travel from that particular place to that particular place? Today they travel via Andheri and then take an auto. How much will they save?

One important aspect is what will be the time saving. Then you look at comfort. You look at connectivity. So, whatever method you use that is a matter of debate and there is a huge, I mean when I teach air transportation I take two classes on only VOT estimation. So, we will discuss about it offline. But it is important that this value of travel time saving should be considered to get a proper comparison. So, now let us look at the assumptions that we made in this study because these assumptions will have to be considered by you.

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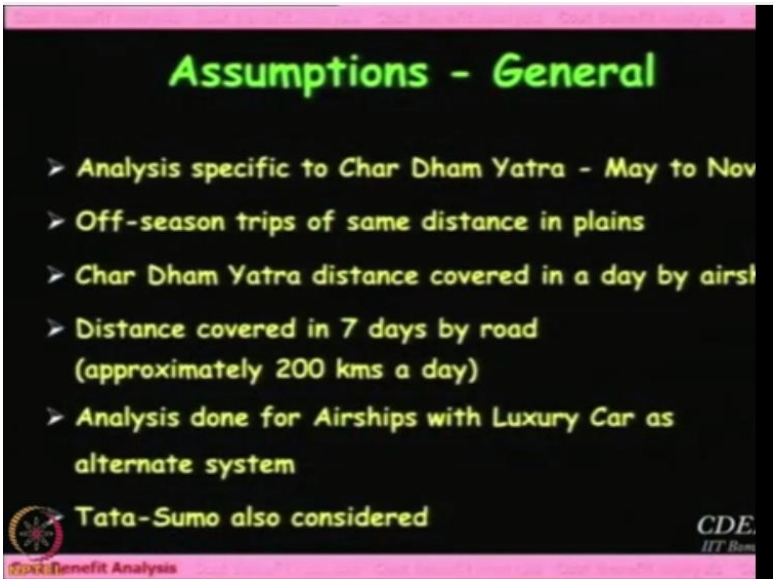

So, first thing is that this analysis is specific to only Char Dham Yatra. You cannot use it for Mumbai to Shirdi kind of travel also. No, that is a different market and different analysis wil be there for that, for Char Dham Yatra which happens only from May to November. But the airship and the vehicles that are purchased they will not remain idle from December to May. Maybe in December you will have a maintenance, one month maintenance.

But January February, March, April you will not say no, there is no passenger coming, so just keep sitting. Nobody can keep or afford to keep transportation systems idling. So, we assume that they offseason will be used in some other areas for example January to March or April it could be the Golden Triangle circuit, Jaipur, Jodhpur, Delhi that area lot of people come. So, we are not assuming that the total cost will be recovered only on these months.

As I mentioned distance to travel by road is 7 days because you are going to travel around 200 kilometers per day which is a lot in hills actually. A typical average speed in a hilly area, I have traveled myself extensively at least in the Kumaon area is not more than 30 kilometers per hour that is the average you get if you do not stop. But after every 3 hours you would like to stop for a cup of tea, for a snack or just to rest just to stretch your limbs.

So practically it only comes to 20-25 kilometers per hour, for 200 kilometers per hour means 10 hours in a day you are traveling on the road that is a lot, but that is the upper limit. Now, basically we are competing now between airship and luxury car because travel by airships will not come very cheap, it will be expensive. So who are the people who will take it? People who

are hiring a luxury car today for that particular route and then in between we bring in also SUV or Tata Sumo, this is what common people will take.

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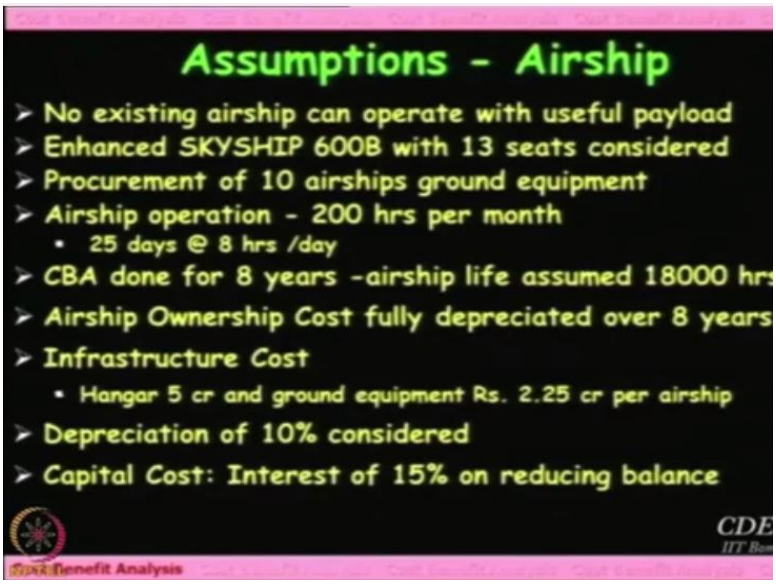

So, as I said no existing airship can do this route, so we make an assumption that an enhanced version of Skyship 600 with 13 seats. Unfortunately, we do not at that point of time, this was done in 2002. So at that point in time, we did not have so much knowledge about airships, Nobody at that time, at least none of us at that time knew what it will cost to make an airship to meet this requirement. So we had to make some assumptions.

One can challenge them. Today we are in a much better condition. So if we are transporting 130 people per day and each airship can take 13 people then 10 airships required. And each airship will come with the ground support equipment. And 200 hours per month is what we fly the airship, 25 days, so we do not fly every day. We leave few days for bad weather or break and 8 hours a day is what, you can do within 7 hours, so it is 8 hours a day is the total time.

The cost benefit analysis was done for 8 years. So, we assumed that the airship life is 1800 hours, so after 8 years the airship is now going to be completely depreciated, right. Now, regarding infrastructure we said okay let us invest 5 crore rupees in building the hangar at Haridwar and for every airship apart from the initial cost they will be 2.25 crores for the support equipment, the mast, etc.

These numbers are not assumptions, these have come from actual quotation. So, today one might say 5 crores is too less for building a hangar, but at that time, we made some inquiries

and got this number for building a hangar of the size that a Skyship 600 needs. Similarly, depriciation of 10% and to buy these airships one has to take a loan and that loan will not come free, so we assumed 15% interest on reducing balance for taking that particular loan.

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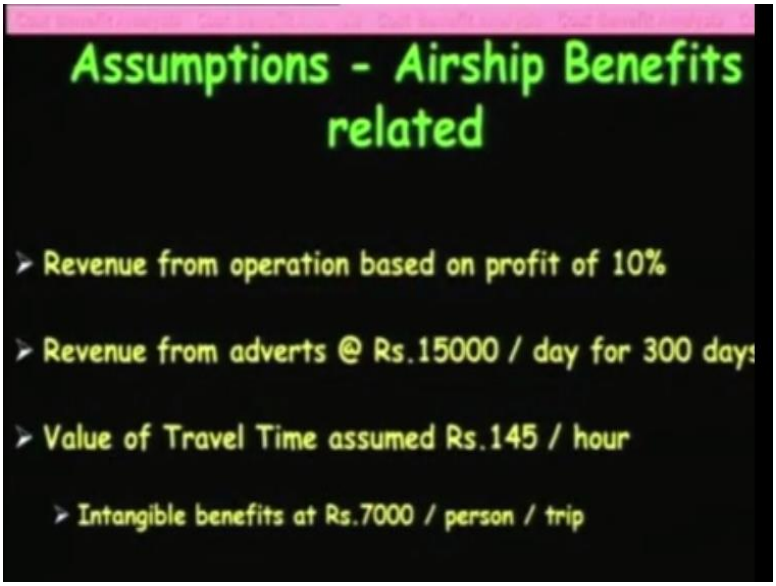

Then this was the cost side. Now, the benefits or the income side. So, we are assuming that this company which operates airships would definitely like to operate with a 10% profit. Nothing wrong in that because this profit is what is the attraction to the investor and a part of it will be invested back in the business, right. So, airship is going to fly with a huge envelope, much bigger than cars or trucks, so you can paint it with something.

We assume that you can charge this amount per day for revenue towards advertisement. Then by some calculation procedure, we got the value of travel time as rupees 145 per hour as against 1000 hours of my friend. The travel time benefit was considered to be only 145 rupees per hour and therefore, the intangible benefit per person per trip is going to be rupees 7000.

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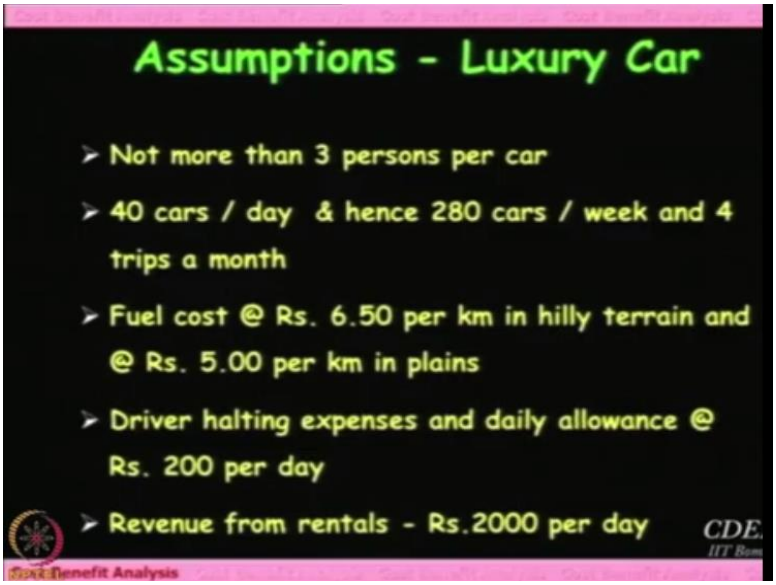

Luxury car, 2-3 people in the car plus driver, 40 cars per day. Hence 280 cars per week and 4 trips a month because each trip takes 11 days. So, you can do cyclically and you will be able to do this way. Now at that time the fuel cost per kilometer was worked out to 6.5 rupees per kilometer and plain area was 5 rupees per kilometer and we gave driver rupees 200 per day plus we got some revenue from rentals also.

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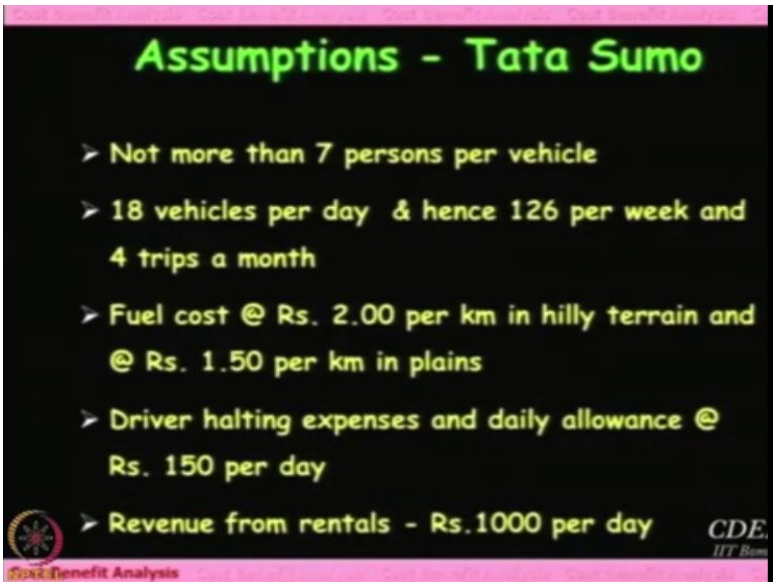

Similarly, Tata Sumo. Now here you can put more people. So, we travel regularly with the Innova and we go 6-7 people. So, it becomes tight with 6 people, but in hills you will find that people travel in these vehicles with approximately 8 people in the vehicle. So, we took 7 people. So, 18 vehicles per day, 126 vehicles per week, 4 trips a month . Fuel costs are lower per person, per kilometer fuel costs are much lower and driver also gets less money. Revenue also is lower.

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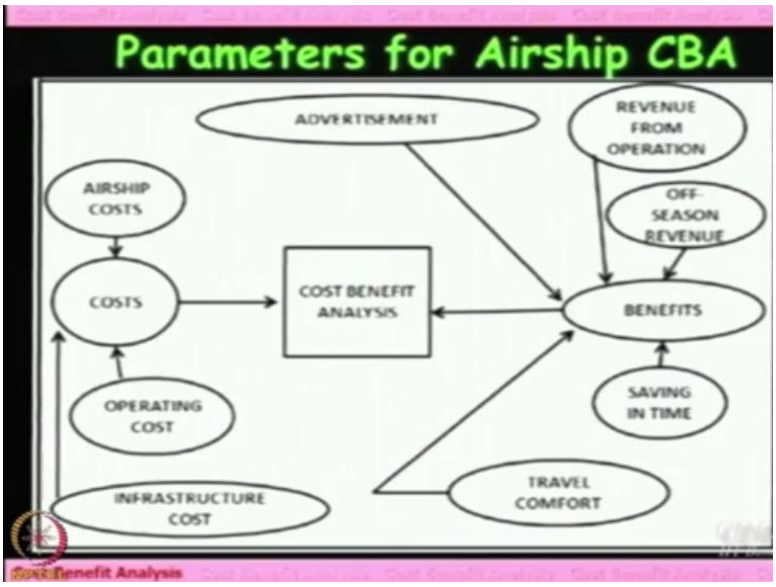

So, this is the general map for doing the cost benefit analysis. So, the costs are the cost of the airship and then the operating cost and then the cost of the infrastructure. The benefits or the income will be the advertisement, travel comfort, hence some premium, savings in time hence a value of travel time, off season revenue when you apply it to some other place and revenue from operation are the fare that we charge

So, you take these numbers, take them projected to a particular year and then you can get a comparison. So, this is the actual data which we got from the US airship Skyship 600-B. This is in US dollars. So the cost of the airship is 5 million. Utilization, pilots, ground crew, insurance, fuel, maintenance, support, ticketing, depreciation, blah, blah, blah the fare comes to 2.3 dollars per kilometer.

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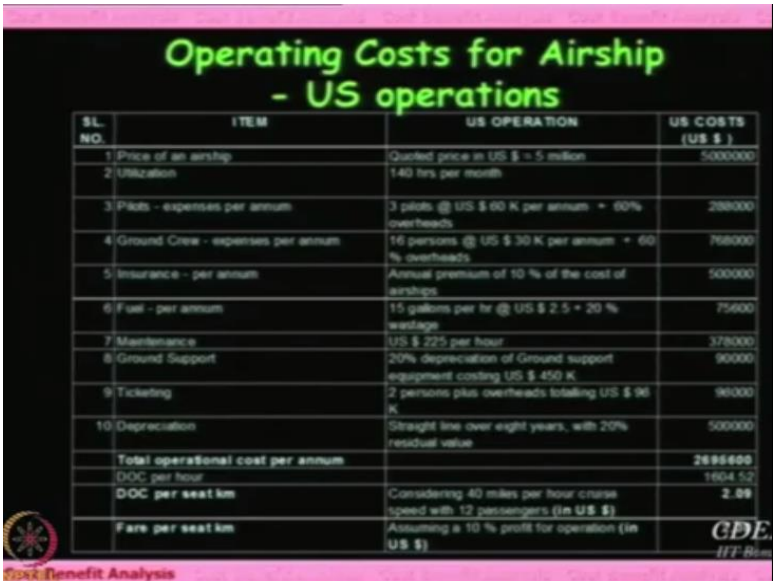

When you operate this airship in an American scenario with 10% profit it will cost operator 2 dollars and 30 cents per kilometer.

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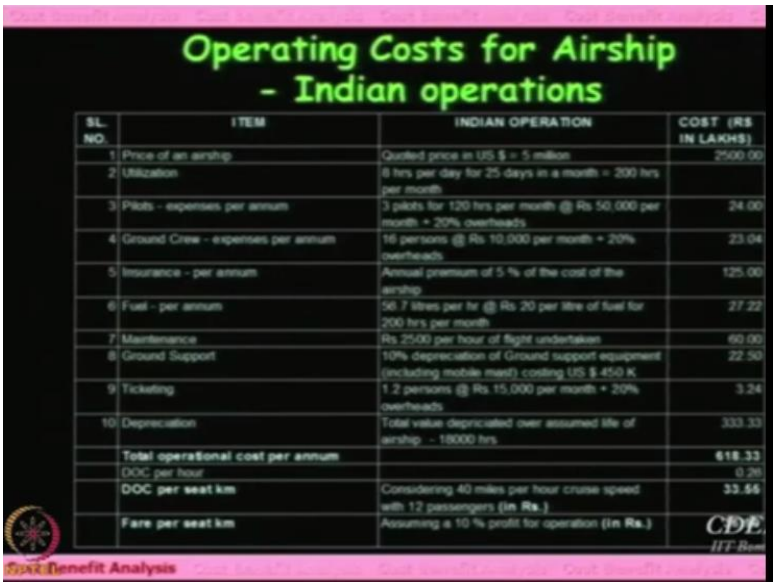

Now, we bring it down to the Indian conditions. So, the cost is the same 5 million dollars, but converted into lakhs . Utilization also is very similar. So, at some places looking at the cost of manpower, etc., in India again we got the fare of rupees 36.9 or 37 rupees per kilometer. Per kilometer travel per passenger you have to pay 40 bucks if you travel by airship.

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Airship Related Parameters

No	Parameter	Value
1	Passenger Capacity	13
2	Operating Speed	80 kmph
3	Fuel Consumption	12 gallons per hour
4	Acquisition Cost	USD 6.00 million
5	Annual Insurance Premium	2.0 % of Hull Cost
6	Annual Maintenance & Spares	6.2% of Hull Cost
7	Annual Depreciation	10% of Hull Cost
8	Annual Cabin & Ground Crew Cost	USD 0.4 million
9	Maximum permissible monthly utilization	200 Hrs
10	Airship Operational Life	18000 hrs
11	Hangar Cost	$1.12 m
12	Ground Support Equipment cost	$ 0.5 m
13	Revenue from operation	25% of operating cost

So, then this is the initial data about the airships. I have already mentioned to you a few numbers like the number of capacity, then consumption of fuel 6 million, 1 million more because this is going to be further improved upon. The basic airship is 5 million, but the enhanced airship is 6 million because there are enhancements to allow it to operate at higher altitude.

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Annual Operating Cost Comparison

Breakup of Annual Operating Costs (in 1000 USD)

No.	Item	SUV	Luxury Car	Airship
1	Vehicle Cost	12.00	20.00	6000.00
2	Support Equipment	0.00	0.00	2000.00
2	System Acquisition	12.00	20.00	8000.00
4	Insurance Premium	0.24	0.40	160.00
5	Fuel	3.00	3.00	118.78
6	Maintenance & Spares	1.00	1.75	372.06
7	Crew	2.00	2.70	400.00
8	Hull & G S infrastructure	1.20	2.00	800.00
9	Annual DOC	7.44	9.85	1850.84
10	DOC per seat per trip	0.0367	0.1132	0.7119

Then here is the breakdown of the annual operating costs. I will not spend too much time. These are numbers which you can see at leisure. We have spreadsheets which contain all these calculations. Look at the DOC per seat per trip. So, in an SUV or in a public transportation system you are going to have something like, now this is 1000 US dollars. So, if I multiply this by 1000 I get 36.7.

So, a passenger pays around 36 or 37 dollars for a trip without any profit, etc. This is the expenditure that is done. On the luxury car 113 dollars more than what is spent because there are 7 people, there are 3 people here, so the operating costs are divided by 3 and by 7 there. For the airship it is going to be 712 dollars, 711.9. So you will spend a lot of money.

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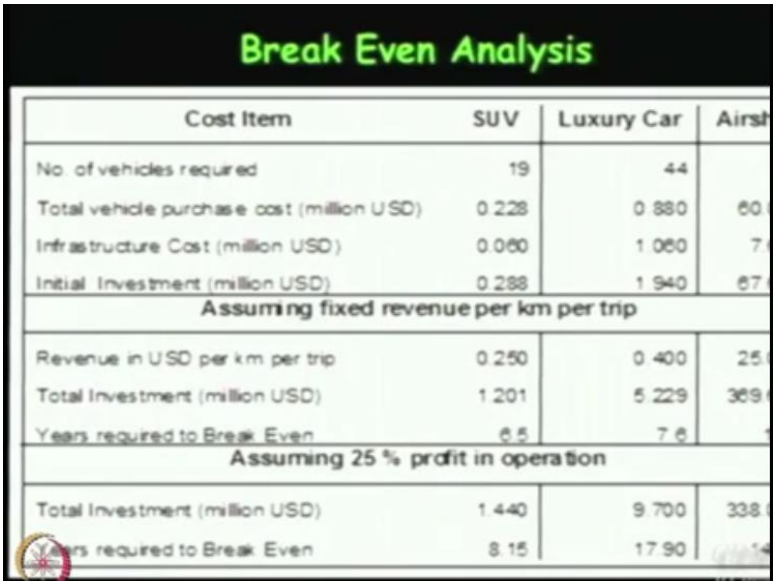

Cost Item	SUV	Luxury Car	Airsh
No. of vehicles required	19	44	
Total vehicle purchase cost (million USD)	0.228	0.880	60
Infrastructure Cost (million USD)	0.060	1.060	7
Initial Investment (million USD)	0.288	1.940	67
Assuming fixed revenue per km per trip			
Revenue in USD per km per trip	0.250	0.400	25
Total Investment (million USD)	1.201	5.229	369
Years required to Break Even	6.5	7.6	
Assuming 25 % profit in operation			
Total Investment (million USD)	1.440	9.700	338
ars required to Break Even	8.15	17.90	

But if you look at the revenue if you look at the investment, etc., you find that to break even in the SUV you require just 8 years. So somebody puts money, buys SUVs, runs this business, everything goes well, in 8 years you recover the full money assuming very little profit. For luxury car you need 18 years, for airship you need 14.61 years.

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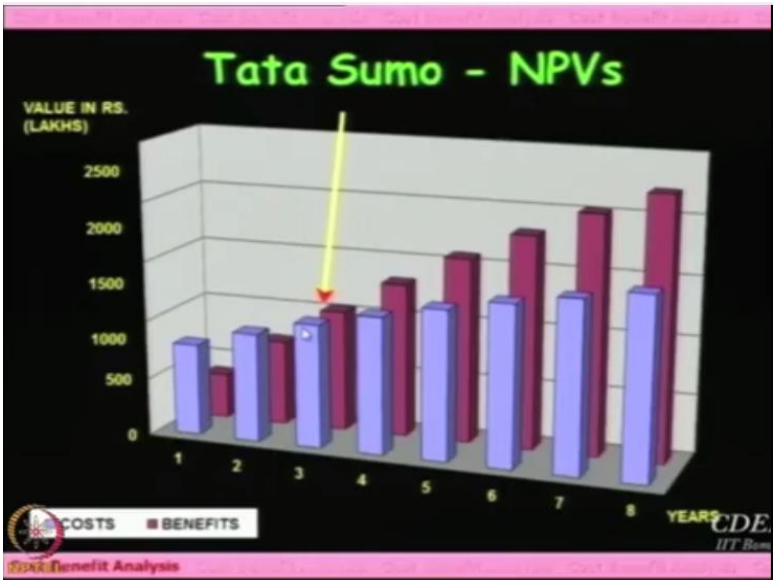

But in this analysis, this is purely on the basis of the no benefit for travel time and no advertisement, etc., basic. So, this is in lakh rupees. So, if I change the numbers slightly and if

I bring in little bit of other numbers it so happens that you can break even in just 3 years instead of 8 years. This particular graph comes with the additional revenue.

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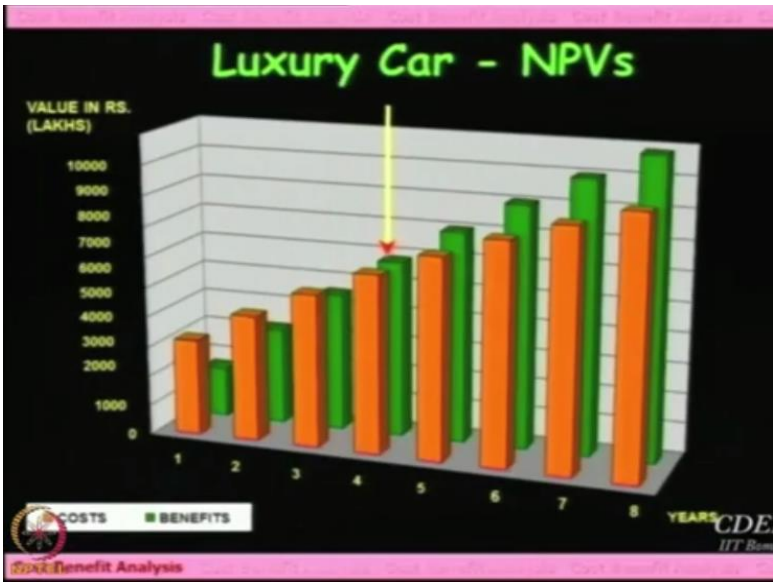

With luxury car you need one more year.

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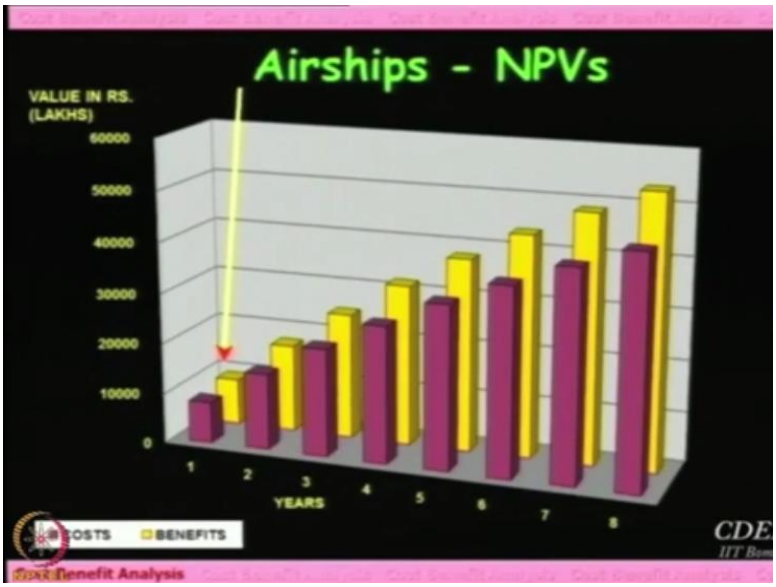

With airship you can do it in the first year itself because you can earn a lot of money in airships with other facilities like advertisement on the balloon and you can charge a premium for travel time saving and comfort.

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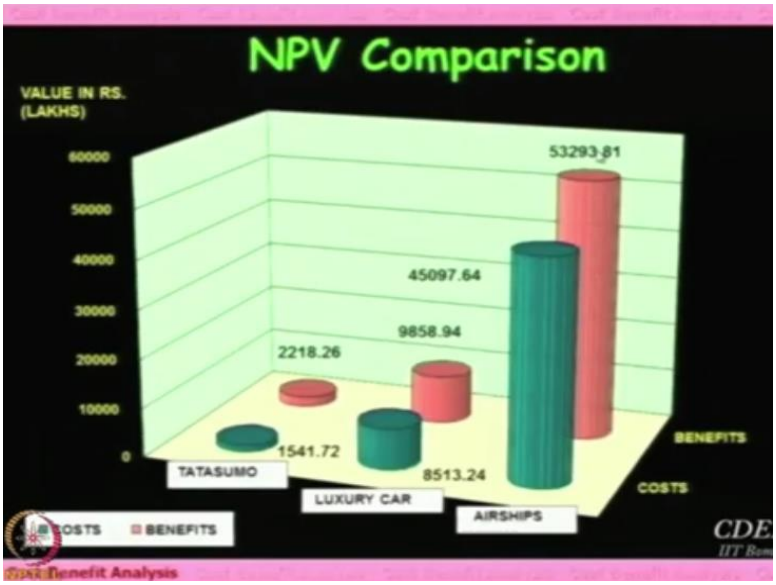

So, if you look at the net present value comparison, now what do you mean by net present value? The investment happens over years. You have to bring it back to today keeping in mind the possible inflation that is called as NPV or net present value. So for Tata Sumo the costs are very low, the benefits are also not very high, but they are more than the costs. For luxury car, it is a larger number. For airships, there is a very huge cost, but also a very huge benefit.

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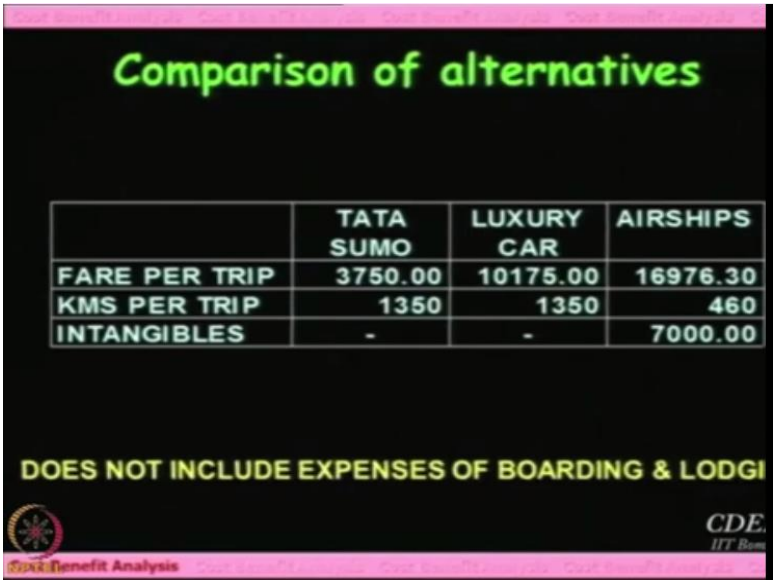

So summing up the numbers in rupees: So the fare that you will pay per passenger in Tata Sumo is around 3750 rupees, luxury car 10,000, airships 17,000 rupees. And if I assume that 7000 rupees per trip I am happy to pay for the comfort and the time saving you are becoming equalivalent to a luxury car.

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So, then we did some sensitivity analysis. What happens suppose we say no revenue from advertisement and intangibles are less, then the air ships will take much years, 8 years for you to recover.

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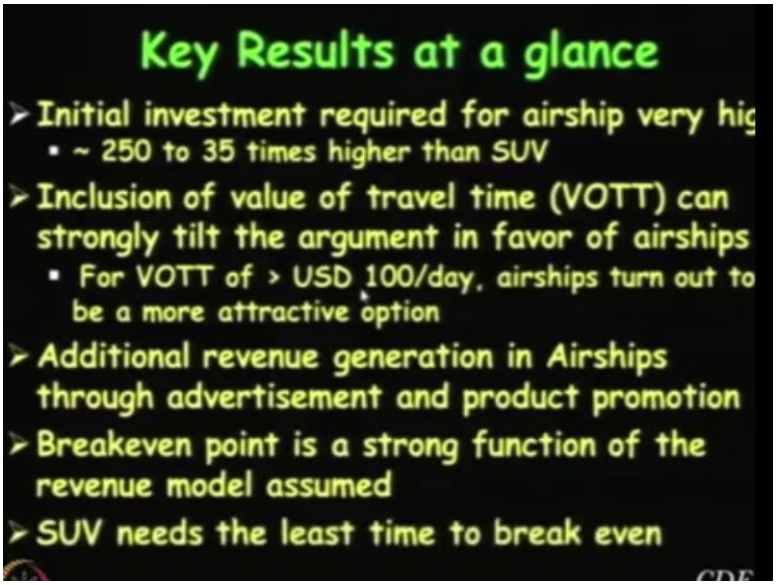

So, basically what it means is that the investment required when you want to operate airships is very high. So, it is 250 times higher than compared to the SUVs and 35 times higher than compared to luxury car. So, that means you need very deep pockets to take this risk. But if you include value of travel time, there can be a very strong argument. So, if 100 US dollars, 6000 rupees per day is what you value as one day, then airships become attractive.

Additional revenue can be also obtained using advertisement and product promotion. And the breakeven point whether it is 1 year or 8 years or 6 years is a very strong function of the

assumptions obviously. So, do not get swayed by 1 year and 8 years and all that, as I said these numbers can change drastically with the change in the assumptions. Basic point is that investment may be needed of a high magnitude, but the returns are also of very high magnitude.

So, therefore a risk taker can invest. And SUV needs the least time to breakeven but also the revenues are very less. So, investment in SUV is the most conservative option. Investment in the airship will be a very bold option. So, in conclusion for Char Dham Yatra assuming that an airship can be made by improving something like Skyship 600-B to handle the altitudes, a very big assumption, then it is feasible.

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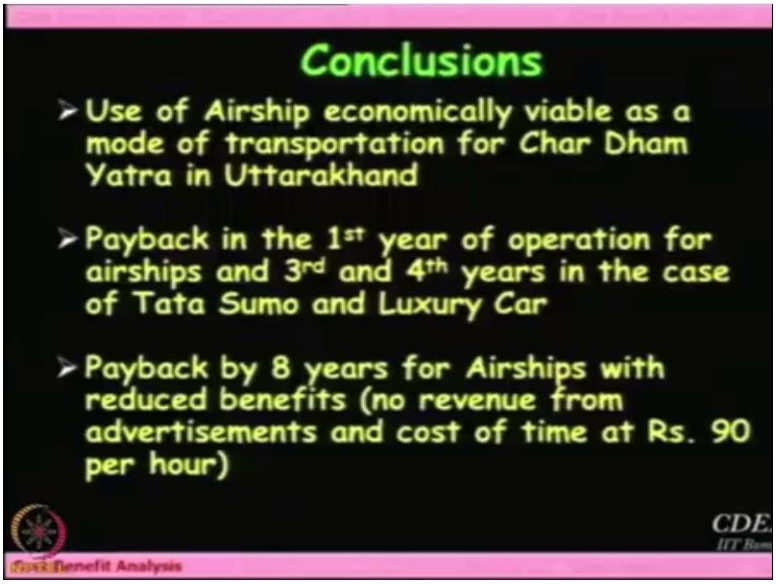

Payback can come in the first year only for the airships and third year for the Tata Sumo and fourth year in luxury car. This is assuming that you earn a good amount of revenue from advertisement. And if you assume that there is no revenue from an advertisement and if you assume 90 rupees per hour only as the value of travel time, it takes 8 years for you to recover.

So, in a transportation system especially when the investment comes in a large part from the government or from some other investor, if the recovery of your revenue in the worst case scenario happens in 8 years and in the best case scenario in 1 year, it is a very good case for investment.

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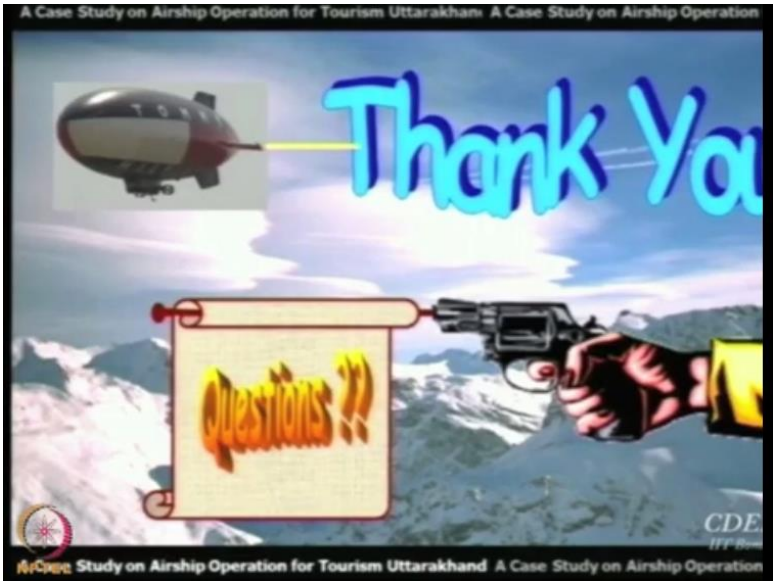

So, this particular study was presented by me to Dr. Kalam when I met him in the year 2001. In fact, I am wrong, the study was done in the year 2000 and in 2001 we got the data. And in 2001 March, I had gone to New Delhi with Professor Sahne who was that time working in our department. We both met Dr. Kalam because we were proposing a project for study of use of airships in Uttaranchal.

So this is the case study I presented and at many places it got presented, the numbers of course can be questioned. I am not saying that I would put my 1 rupee or 100 rupees in this venture based on these numbers. But we did this study essentially to satisfy ourselves whether this is a area worth getting into or not. But common perception people have is airships are very expensive, you will take so many years, you will never be able to recover though numbers of course we have answered.