Infrastructure Planning and Management
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Introduction to infrastructure and the Transportation Sector Part 1A

Just a quick introduction, about what's infrastructure. The best way to do this, is to ask you. So what is infrastructure? structure, system and I am also going to say enabler. Alright, anyone else want to.? Do we completely agree with what Arjun has said or does someone want to add anything on to this or disagree? Makes life simple, wonderful. Yeah now the thing is, is that something generic that would apply to a variety of things or is that something specific to infrastructure? Value for money, I mean even if I bought an apple, I would want value for money, I don't want an rotten apple for 50 rupees, and I would love a juicy apple for 1 rupee which I can never get. So I think that's something more of a characteristic so I wouldn't, so I am trying to define infrastructure.

So may be I should not put that under the definition. Yeah, sure, go ahead. Essentially so far we have, it could be a physical structure, it could be not necessarily a physical structure, it could be a system. It enables, it facilitates, makes our life simple. Hopefully sustainable, fine. Anyone else want to throw up anything? In some ways, this kind of depends on how you define bringing people together. But one might argue that telecommunication infrastructure actually keeps people apart. So I don't need to come together. I am not quite sure that it brings people together. Some kinds of infrastructure connect. So roads for instance obviously provide connectivity. It's an interesting question.

So I am not quite sure, for instance housing is also infrastructure and it is more of a, I am not quite sure, it might not be a property of all of infrastructure. Although, it does work for several aspects, several kinds of infrastructure. These are all interesting, now I get the feeling though that all of you or many of you, right, yeah (points to someone) sorry, measurement criteria, so it is a criteria for measurement of development right, so that's fine. But is that what infrastructure is? I am trying to get us to define what infrastructure is. Now I think many of you are defining infrastructure or thinking about infrastructure as an asset. It's a thing. It's sort of, I mean it's a building; it's an airport or whatever. It's an asset and that is one way of thinking about it. But, you got a point, yeah (points to someone). All levels.

So the question is how many of us really think of infrastructure as a service? This is something that we really want to think about in terms of how we define infrastructure. So

when I define infrastructure, do I define it as an asset? It is something that I build or do I define it as something that provides this kind of a service.

And you will find that in what you have said, there is a little bit of a mix of both. This makes life simple is certainly more of a service criteria but the physical structure for instance is more of an asset kind of definition. So I think the important thing to understand is that infrastructure is both asset and service. And this is critical.

Because if we think of infrastructure as an asset we will be tasked with building good quality assets, which means you build the fanciest thing that you can build, perhaps the most expensive thing that you can build. But it may not necessarily provide service.

It may not necessarily make life simple. It may not necessarily enable or facilitate. It may not be sustainable and it might not hit all levels of society. And this is fundamentally very important because when you say list some infrastructure we often think roads, bridges, power plants, airports, ports whatever. We think assets and assets of course are key.

But what I want us to do in this course is think of infrastructure as a service. Infrastructure is all about providing you the service to do something that will enable you, make your life easier, make you more productive, make you more wealthy, make you more comfortable. It is all about enabling.

So there are no points for building the most expensive, most complex from an engineering perspective asset if you are not delivering the service. So when we think about infrastructure I think we need to think really more in terms of service. So you guys didn't do the readings but essentially some of the definitions that you can later on look at, there is a brief intro chapter for this session. People talk about infrastructure as something that is public in the sense it is open to everybody, delivers essential services, helps achieve economic as well as social objectives and it is essentially a foundation or a base on which society rests.

You don't have infrastructure then you are in, you are in big trouble.

You are essentially going back to a period in time where you know, human kind was essentially congregated around small settlements and almost completely self-sustaining because you didn't have the means to transport.

You didn't have sort of sources of energy to do things that were technologically advanced etc right, which is obviously a situation we can't even imagine ourselves in now. So it is essentially the base or the backbone on which society rests and there are examples of infrastructure. There are tons.

In this class, because ultimately we are in an engineering institute and I am an engineer by training and all of that, when we talk about infrastructure we will restrict ourselves by and large to what we call physical infrastructure, which means roads, ports, airports, waterways, water and sanitation systems, power, telecom.

We won't really get into things like education, which people also classify as infrastructure. It is you know backbone along which society should rest. So some people call this social infrastructure.

So we may not really get too deep into social infrastructure because in my view it becomes very difficult to define performance parameters around social infrastructure, very tough problem.

If you give me a bridge and you tell me how do I tell in 20 years or in 10 years if this bridge was successfully built or not, I can come up with a number of criteria, right. I can look at the physical characteristics of the bridge. Is there any sag, etc. I can look at the use of that bridge, how many people have used that bridge etc, what was the cost of maintenance and I can come up with the decision.

But when I go to a school and I say, is this a good school or not? Very difficult to answer. What would you say? 100 percent of people passed twelfth standard and so it is a good school? May be but we know that passing twelfth standard does not mean anything. May be these people just memorized everything in the book perfectly, got great grades but did not quite learn.

And therefore on the other hand, because some people failed, is it a bad thing? Or there is a school where the academic performance is mediocre but they do very well in arts and sports. How do we even sort of start judging? So metrics around social infrastructure are much more difficult and so that to me is a second order problem.

Let us first get to the easy stuff and then we will get there. So this class will focus more on the easy part of the difficult stuff, which is the physical infrastructure, by and large, so not on the social infrastructure.

I looked at the Merriam Webster Dictionary some years ago, it said underlying foundation of basic framework of a system or an organization is how they define infrastructure. So it is an underlying backbone but is not just a physical asset. It's tied towards the service that it delivers. And so when we think infrastructure, we need to think service.

So we design infrastructure that provides better service, not infrastructure that is low-cost, that is the way you would think if you were designing an asset. If you are thinking an asset, you would say, let me reduce the cost. Let me put in as many bells and whistles as possible so that, you know it is something that is magnificent that people will comment upon.

All of that relates to the asset. It may not relate to the service. In fact low cost and service might be inversely correlated. It may make more sense to spend more money upfront to provide lasting value, right. So may be a more durable surfacing of the road is more expensive but the road will be in better condition for 10, 15 years

As opposed to reducing the cost of the road today and giving a project plan to government saying, I am going to build you a very cost effective road and finding that you will have to maintain it 5 years down the line. So think about it as service and not as asset.

So this is the kind of stuff we will be talking about in this class, transportation, water sanitation, energy, telecommunication, housing, may be even a little bit of, we are not really going to talk about it but, you know parks and all of that are also a part of physical infrastructure.

So I will leave you guys with one thought, and then we will stop here. So there is this guy called Quieroz, his article is part of that reader and when you guys pick it up you can read it. Quieroz talks about this graph that people in the World Bank came up with a long time ago. The graph is quite simple. On the X axis, you have a measure of infrastructure quality. How do you measure infrastructure? These guys said let us measure it based on the number of kilometers of paved roads that are there in the country.

So if a country has lot of paved roads then the infrastructure is better. If a country has very few paved roads, kachcha roads etc infrastructure is worse. So that is a measure of infrastructure growth. Now some people will say Switzerland is a tiny country. India is a much larger country. So obviously in India there will be more paved roads than in Switzerland.

So how does that work? We divide it by the number of inhabitants or million of inhabitants so we get some normalized figure. So India for its 1.2 billion people, there are so many kilometers of paved roads per million people; and in Singapore, in Switzerland, in Turkey, in whatever.

So the X axis is a measure of the infrastructure of the country. The Y axis is the wealth of the country, which is measured in terms of GNP Gross National Product similar to GDP, Gross Domestic Product.

So this is wealth, this is infrastructure, and what does the graph tell us? Right, the graph tells us that there is actually a wonderful correlation, right. So what we are saying is countries here, have a relatively low wealth, GDP is low, and also relatively low quality of infrastructure. Countries here have relatively high wealth, relatively high quality of infrastructure.

Countries here, medium wealth, medium quality of infrastructure. We really don't find countries here, high wealth no infrastructure,. Or country is here, right superb infrastructure, no wealth.

And if you remember your statistics, there is something called an R squared that tells you the goodness of fit and the R squared is pretty high, 0.76. I mean 1 is perfect correlation, 0.76 is pretty high and this is 98 countries.

I think there are roughly,170, 180 countries in the world I think at the moment, and this was done a little bit earlier. So this was probably about 60 percent of countries in the world.

So the evidence is quite stark. If you want the country to go, you want the country to be strong then one of the levers that you have to change is certainly infrastructure

Doesn't mean, don't focus on education, don't focus on health care but infrastructure is critical to country's growth. There is a lot of evidence. Other people have changed this. They have said why only look at roads? Let us look at the amount of water supplied per capita, right. That is the measure of infrastructure or the amount of energy supplied, you know per capita and you will get very similar graphs irrespective of what you do. I think that the conclusion is relatively inescapable that infrastructure and the wealth of the country are very strongly linked.

At some point if we sort of say what can we do to make India better country etc one of the things we certainly need to focus on and something that the government has had in its sights for a while is infrastructure.

There is only one problem with this graph. What is the problem?
One problem with the interpretation of this graph

(Professor – student conversation starts – student voice not captured)
Professor: So the causality is always a question. Now do countries become rich because they have infrastructure or do rich countries invest in infrastructure?

Because I am rich I have more infrastructure or because I have more infrastructure am I rich, so that becomes very difficult to unpack from this graph. Essentially I have 2 variables; it is very difficult to tell which direction the causality goes in.

There is a bit of truth in both, right. Infrastructure does lead to a greater wealth, so the more roads I have, the more produce can get shipped faster. So there is less cabbages and tomatoes get spoilt on the way because my roads are faster, more things get sold and there is more wealth that is created.

More electricity then more of us can do productive; you know tasks after the sun has set, and our weekend study and therefore the wealth of the country can increase. Better quality water supply, you know we fall ill less often because there is fewer water borne diseases. We are therefore more productive. Wealth increases.

So there is certainly an argument, qualitative argument to be made that if infrastructure is better, wealth can increase. But clearly if you are a very wealthy country you tend to build, you know better Special Economic Zones and facilities. There you attract other companies to come in from all across the world.

There is a little bit, but irrespective of the direction of causality. And there are pros and cons to both. The point is infrastructure and economic growth are linked. And therefore you really need to focus on infrastructure if you are focusing on economic growth, is essentially the lesson here. I think that is all I wanted to sort of talk about today.

Sort of introduce what infrastructure is, get this point home that we are thinking of infrastructure as a service, not as an asset and show that infrastructure and economic growth are intertwined. So if you want the country to develop, among other things infrastructure is key.

And what we are going to talk about is how many of you believe we have wonderful infrastructure in India? Ok, couple of people, alright. How many of you believe we have infrastructure that needs to be improved considerably? Everyone else. So I fall in the majority category as well.

I think we have some good infrastructure but by and large I think our infrastructure across industries are performing terribly. So then the question is why, what can we do about it and that is what we will talk about in the class. So I will stop here.