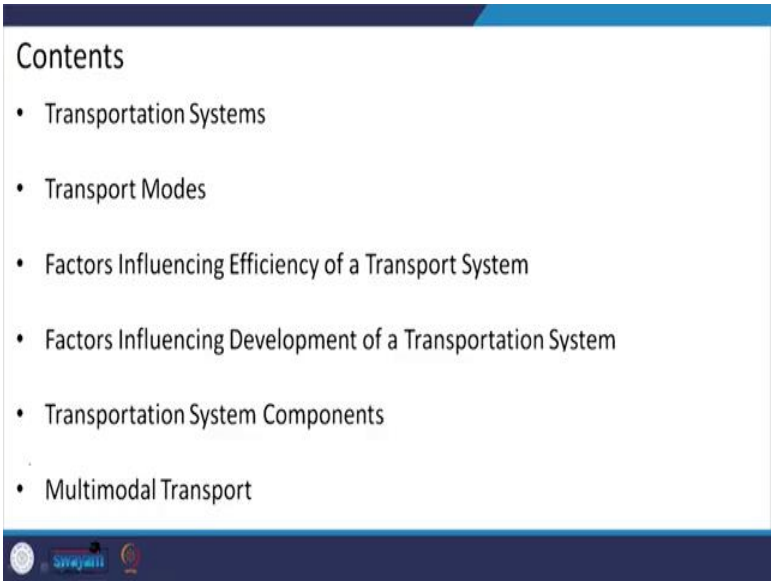
Sustainable Transportation Systems
Professor Bhola Ram Gurjar
Department of Civil Engineering
Indian Institute of Technology, Roorkee
Lecture - 02
Introduction to Transportation Systems - II

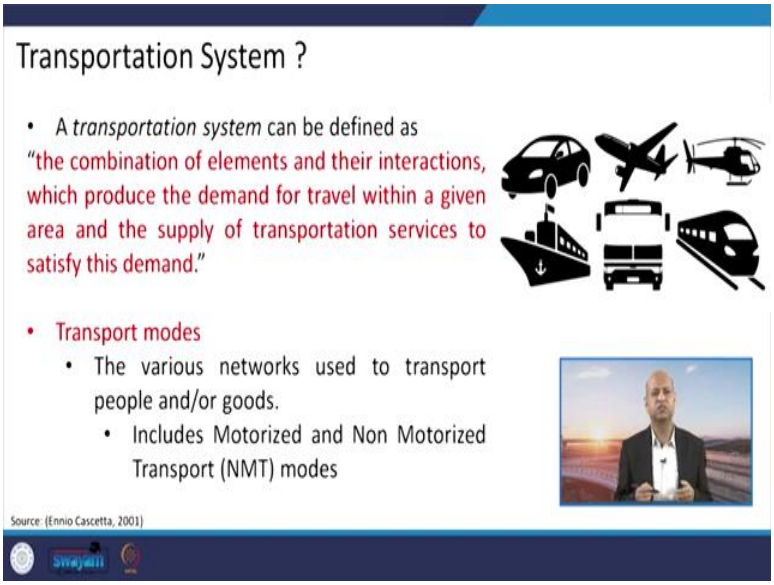
Hello friends, welcome again to the introductory lectures of transportation systems which is part of Sustainable Transportation Systems course.

(Refer Slide Time: 0:37)



Today we will discuss about like, what is transportation system after all and what are different transport modes, which can be integrated and then what are different factors which can influence the efficiency of a transportation system and those factors which influence the development of a particular transportation system. So, both things means, it is the efficiency of a particular transportation system and development of in totality of the transportation systems and different components of the transportation system and multimodal transport those kinds of things we will discuss today.

(Refer Slide Time: 1:49)



So, what is transportation system after all, basically, when we integrate different transportation modes, then the use transportation system emerges, like we can walk to a particular station then we can take bus, we can go to a destination, then we can have another kind of like non-motorized transport to reach a particular place, then we can go to railway station, we can have train, then we can go to airport, those kinds of things means different kinds of transportation modes are there. And that networking is very, very important, which can have linkages between all kind of transportation modes whether it is non-motorized transportation or motorized transportation.

(Refer Slide Time: 2:01)

So, when we talk about different transport modes then in our mind we will visualize that railways or buses, etc. And when we talk about railways then like surface railways or elevated railways, when on the pillars and light rail transit systems or underground tubes, like metros also.

(Refer Slide Time: 2:22)

When we talk about like road transport, then in our mind the picture is there of bicycles or two wheelers like motorcycles, scooters, three wheelers or heavy vehicles or private cars or public buses, etc.

(Refer Slide Time: 2:39)

Similarly, when we think about air transport, then helicopters or commercial aircrafts, private jets are also there, these people can have, then air ships, blimps or hot air balloons, which are still used for metrological observations, those things come into mind.

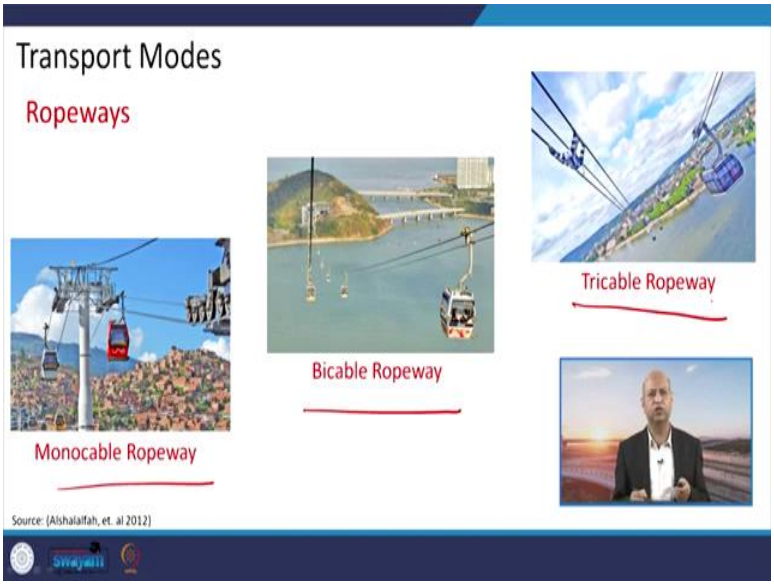
(Refer Slide Time: 2:58)

And when we talk about what to transport, then like inland water transport IWT or international water transport means from one country to another, like ships and cargoes all those kinds of ferry boats, small boats, cruise ships, cargo ships, submarines, even warships, all those are there in terms of water transport.

(Refer Slide Time: 3:20)

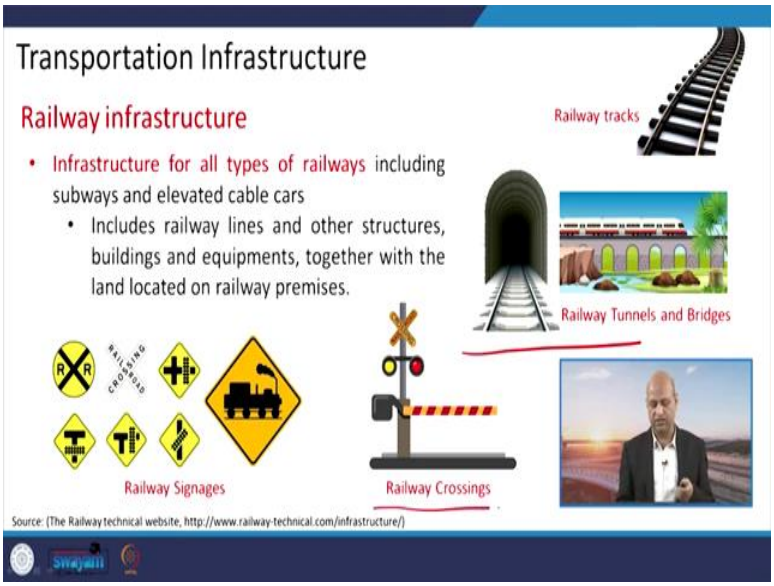
Well, then pipelines, these are the modern way of transportation there were open canals were there for transportation of water and goods, but now oils as well as water within the pipe, one can transport from one place to another, like for refineries, oils are transported by these pipes. And nowadays, people are also talking that if we can use bigger or larger size of pipes, and not only water or oils, but we can put some airtight containers and within those containers something, some goods can also be there. So, floating with the oil or water those things can also be transported from one place to another. So, these are the ideas people are trying to incorporate in those systems.

(Refer Slide Time: 4:07)



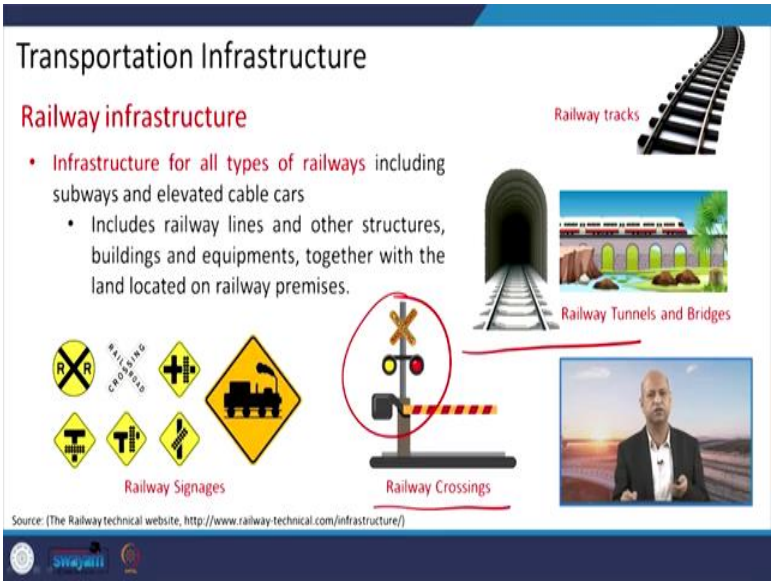
Well, when we talk about ropeways then like a monocable ropeway or bicable ropeway, tricable ropeway depending upon the situation, topography or hilly areas, those kind of things need to be taken into account to decide which kind of ropeway we have to use.

(Refer Slide Time: 4:28)



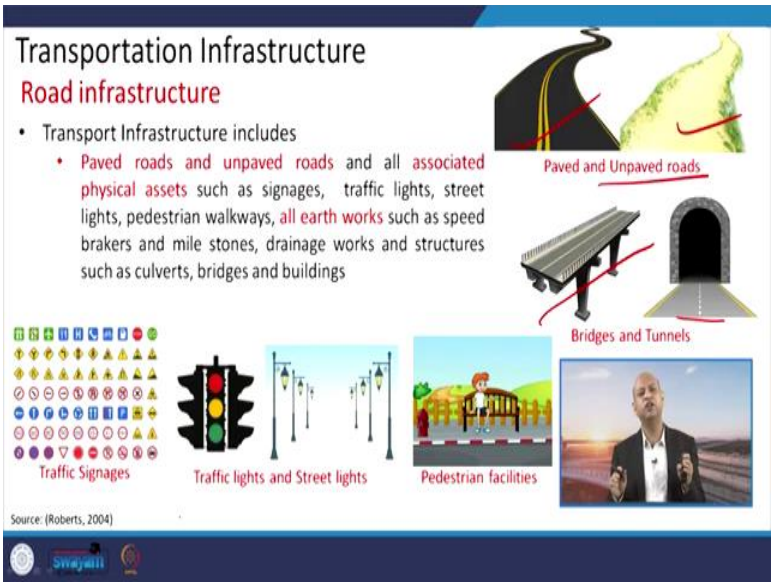
When we talk about railways, then we think about like railway stations and then the railway tunnels or bridges depending upon again, which part we are thinking about railway crossings, those signages and all these systems have to be there.

(Refer Slide Time: 4:52)



When we talk about the infrastructure means like rail infrastructure railway stations or these signals or tunnels when we are trying to reach from one point to another in hilly areas, so shortest distance can be through tunnels.

(Refer Slide Time: 5:05)

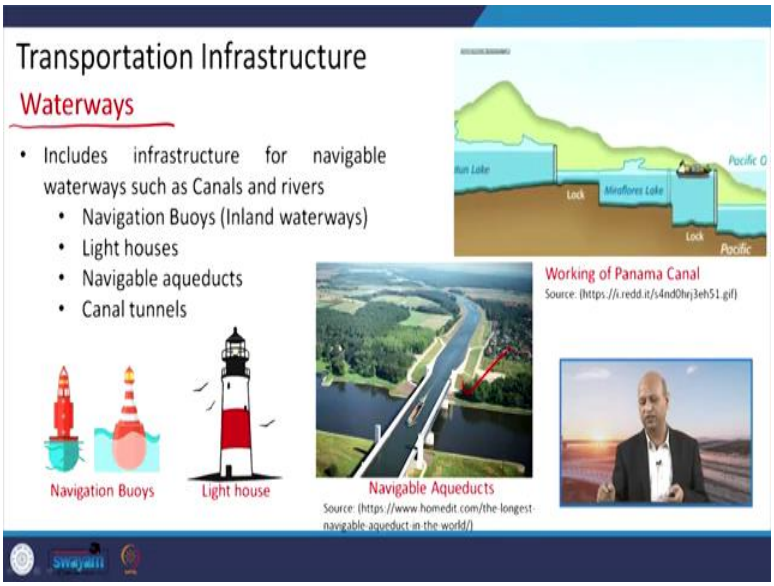


And when we talk about road infrastructure again tunnel maybe they are like railway track, bridges may also be there, then there can be unpaved roads or paved roads depending upon the terrain and traffic lights have to be there because any kind of infrastructure, any kind of

transportation mode has a particular type of infrastructure without that infrastructure, we cannot run that particular transport mode.

Like when we talk about road transportation, then road infrastructure means, you should also have the petrol pump because gasoline and diesel you will need to drive your cars or vehicles, so those kinds of things. Now, we are talking about electric vehicles. So, for that we have to have charging stations. So, whatever transportation mode, you think about you have to think about their infrastructure also.

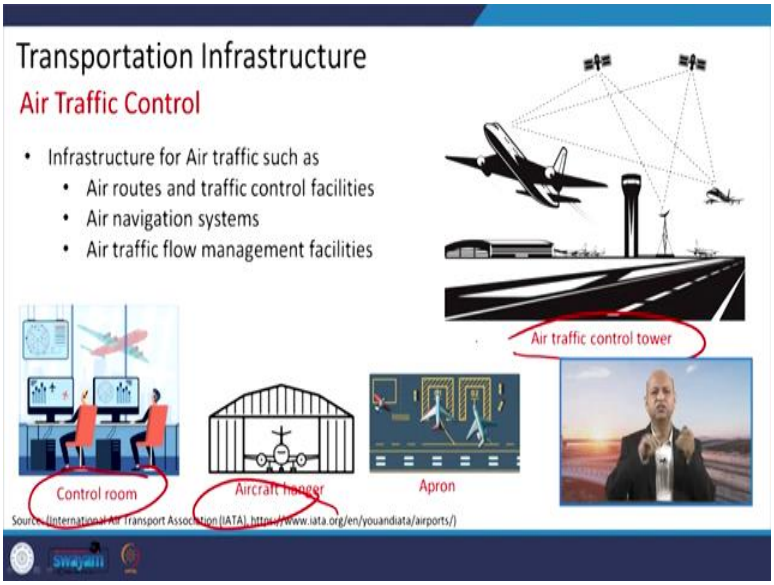
(Refer Slide Time: 5:54)



Well, in transportation infrastructure in terms of waterways, you can have these aqueducts when you are passing through a river, then aqueducts have to be there for taking canal above the river or this is one example of this Panama Canal, that when elevation difference is much more than how these kind of locking system and raising the water level and the ship going up to this level and then down again. So, these kinds of artifacts, wonderful technological wonders have been created by human beings.

And then lighthouses for like ships these were before like now, we have these satellite related communication systems or IT, but earlier these were the artifacts which were used for seeing where is the destination for a particular ship or where is the place where we will land.

(Refer Slide Time: 6:53)



Air traffic control, when we talk about then again, you have to have the control room which will communicate with the pilot, and then navigation system, all those and hangars where aircrafts are repaired or they are kept when they are on the ground. So, those kind of air traffic control tower, all these infrastructure have to be into place otherwise, we cannot have the proper functioning of air system.

(Refer Slide Time: 7:25)

When we talk about multimodal connectivity, then terminals and stations have to be in place properly like if you are talking about bus stand then it can be connected with the railway station

through like over bridge, etc. that position should be nearer to the railway station. Similarly, last mile connectivity has to be incorporated properly because if you want to reach to your home or office, so, how will you reach, there may be some rickshaw or some three wheelers, those kinds of facilities has to be there plus these kind of the signages should be there like you need to know when the next train is coming and how much I have to wait those kinds of infrastructure system has to be there.

(Refer Slide Time: 8:10)

In ports and seaports like docking facilities where we will do container loading or cranes will be there for loading and unloading and then docking facilities where ships will be there, they will rest. So, those kind of draft must be there.

(Refer Slide Time: 8:30)

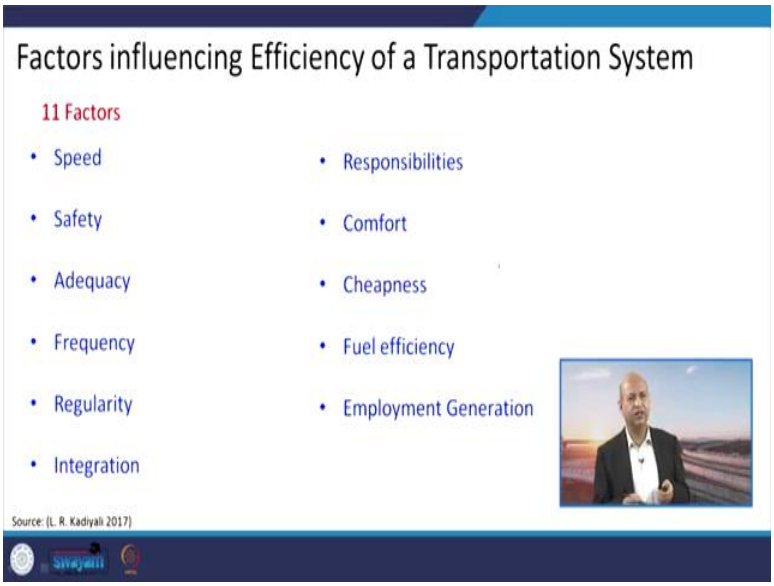
And when we talk about cycling infrastructure then again you will need parking space where safely you can park your bicycle and go for shopping, etc., then you can come again or means even you can use your bicycle when you go to the office, when you are traveling through bus or train.

So, you can take your bicycle to the bus stand, you can park there, if there is a good parking facility, when you come back you can take your bicycle to your home. So, those facilities we have to provide. Then bike paths should be separate and dedicated one so that safely one can use the bicycle, otherwise people will not feel incentive and motivated to use the bicycles.

(Refer Slide Time: 9:11)

Living streets means where again you have to make them like a calm streets, where not motorized vehicles are allowed, only walking or bicycles are allowed on those particular places like recreation places, parks or children playing grounds, those kinds of things. And there may be like these kind of things where one can rest for a while.

(Refer Slide Time: 9:38)

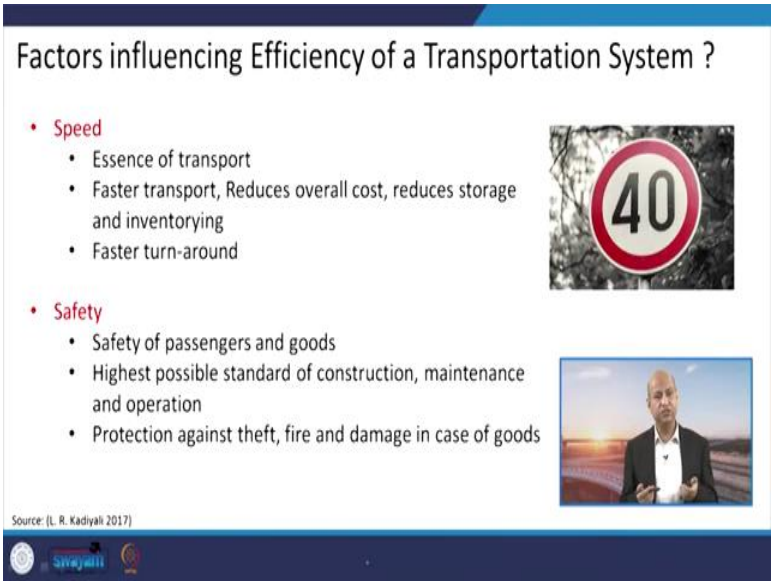


So, in nutshell we can say that the influencing parameters or factors, which determine or influence the transportation systems are like speed, safety, adequacy or frequency, then regularity, integration of one mode to another, then responsibility to hold something. Similarly, it

should be economic, it should be cheap, it should be economically viable, comfort level should be good, fuel efficiency must be there, otherwise it would be very expensive to use more fuel, employment generation it should be linked to because like you might have heard that now government has Kisan Rails. So, from farmers produce particular place to another state one can transfer those things.

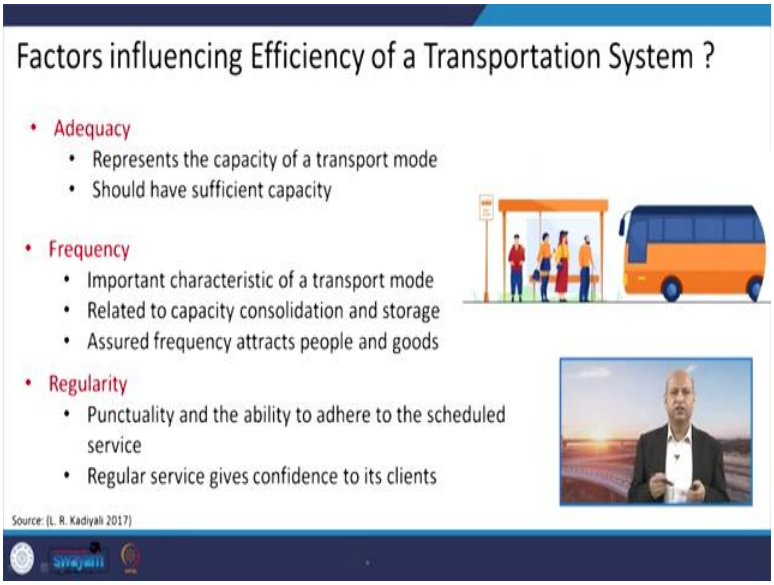
So, there are several factors which can influence this transportation system. So, now we will go one by one. Speed, speed very important, some countries believe that high speed better economy, you can have expressways like we are accustomed to higher limits of the speed, but in those countries, they have like limits you cannot drive your car lower than this speed. So, those are the expressways. So, speed is very important to travel from one place to another, if speed is, means speed can be held very good or high speed transportation systems are there then in very less amount of time one can travel or goods can be transported very easily or efficiently.

(Refer Slide Time: 11:17)



Then safety issues, because if infrastructure is not in good shape, and if there are not good signages there may be accidents. So, to avoid that safety issue are also very important, some those kinds of facilities must be there.

(Refer Slide Time: 11:35)



Then adequacy means, the capacity should be adequate, it is not like people are making crowd and there is no place for sitting or comfortable journey. So, adequacy is very important aspect in that sense, otherwise, it will be very difficult to travel, it will be very tiring and very uncomfortable.

Frequency means suppose, you want to use public transportation system and if you know that my office hour like my work ends at 5:30 or 6 PM and if there is a bus at 6:10 and if I miss it, then I can get at 6:30 or so, then if it is a good frequency at that time, then you will have motivation to use the public transportation system. Otherwise, if you feel that, okay, if I miss one bus and if it will come after two hours or so, then you will feel that I should have my own vehicle. So, frequency is very important in that sense.

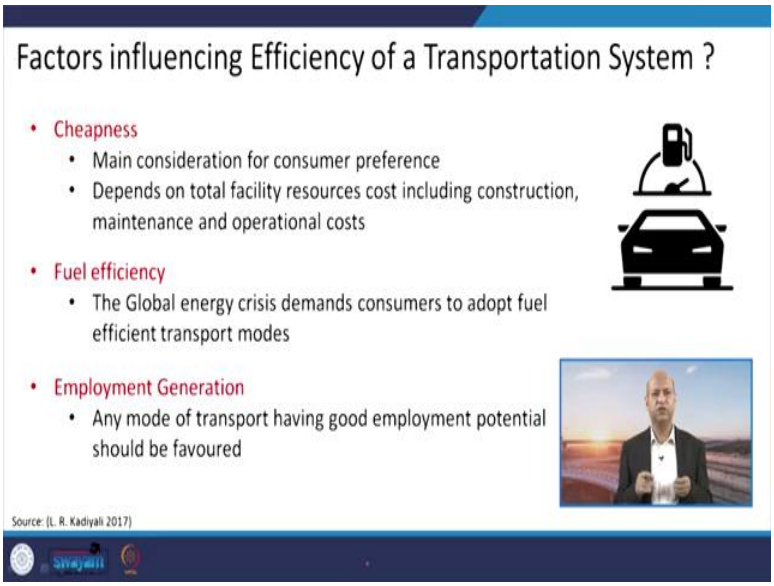
And then regularity also, punctuality means on time it is there then only you have this incentive that you use those public transportation systems or those kind of things. Then integration because if you are traveling from your workplace to home, and if it is not only single type of transportation system, but there are multiple like you have to travel by train and then by bus, and maybe by walking or rickshaw or something like that.

So, the integration must be very good in that, because when you leave one type of transportation system or mode and you go for other mode, then it should be available there, you should not be

waiting for hours there otherwise you will lose so much productive hours. So, integration is very important.

And then the responsibility like if something happens, then the system should be there, which can handle it, if you lose something then or something damage happens then you can properly lodge your complaint and that should be addressed timely. Comfort, of course, comfort level is very important. If you get tired during the traveling then it is not a fun, then you will feel that I should have my own vehicle rather than using the public transport system.

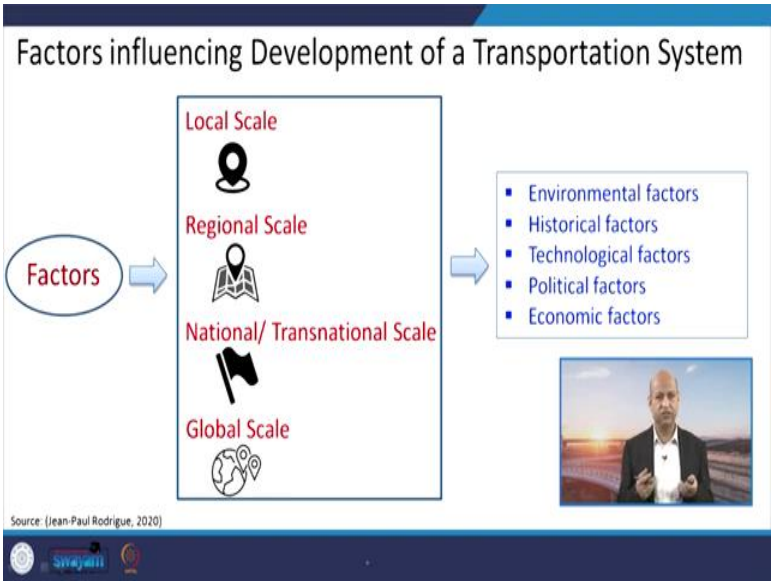
(Refer Slide Time: 14:13)



Cheapness means economically viable, it should be in a wearable to your pocket, it should not charge much, otherwise you will feel again my lot of salary is going in the transportation that is not a good thing. So, the economic viability is very important. And fuel efficiency is important again, in terms of economic factor, because if more fuel is being burned, then more expensive will be the journey. So, efficiency must be taken into account.

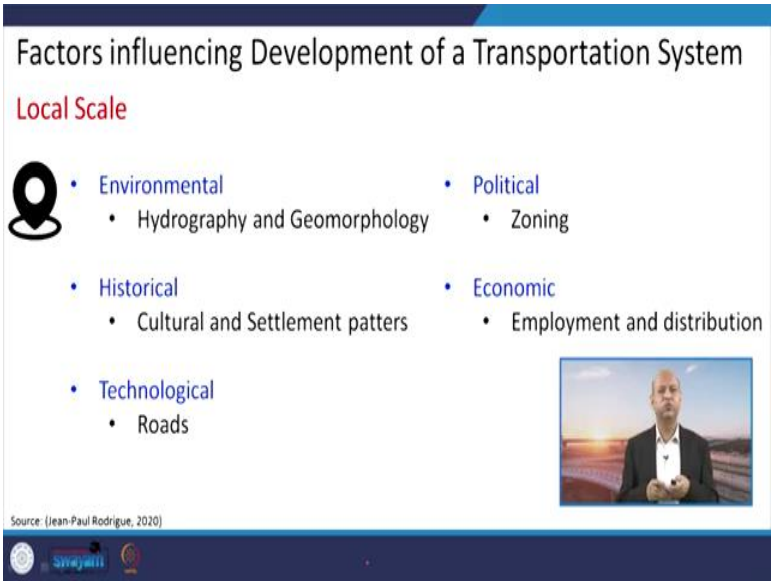
And of course, as I said, like there is now new Kisan trains. So, employment generation means if transportation modes is not only making to travel, but also creating or helping in employment or selling your things efficiently, then nothing like that it will really boost your economy as well as it will help you to use it properly.

(Refer Slide Time: 14:58)



Then, what are different factors which influence transport system at different scales like local or regional scale or national and transnational or international you can say and then globally scale. So, those factors are basically like environmental factors or historical factors are also there, but that can be overcome by new policies and political factors can be there, economic factors can be there, all those factors influence the transportation systems or modes.

(Refer Slide Time: 15:32)



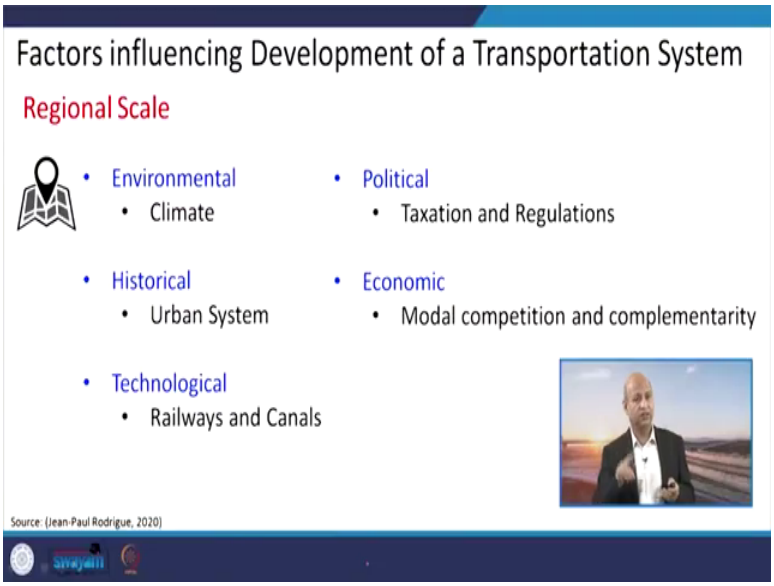
So, on local level if we look into like environmental aspects then like hydrography or geomorphology those are the important issues, means like if there is a rain, then it should not be

flooding the roads otherwise you cannot travel conveniently. So, those aspects should be taken into account so that floodwater goes away very quickly.

Historical, cultural and settlement patterns can also decide some way because if there are places which are visited very frequently then a transportation mode must be there, then technological means roads of bituminous kind or cement concrete or other different materials. So, those technological aspects are also important.

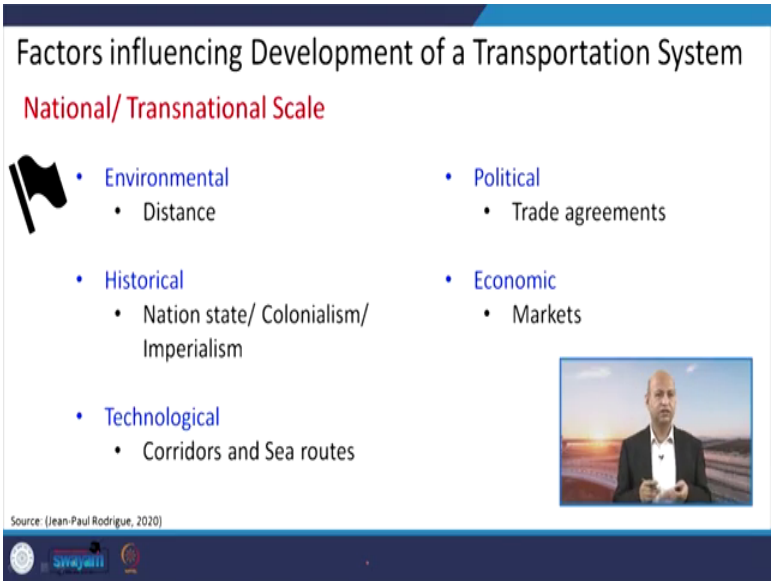
And then zoning means industrial zones or commercial zones or residential different kind of zoning may be there and there may be some conflict of interest but if public transportation like those organizations are managed properly, then they can handle those things nicely. Economic factors are also because employment and distribution of things should be linked with the transportation as I said if it is not adding into your economic activities, then people will not feel motivated or incentive to use those particular transportation means.

(Refer Slide Time: 17:06)



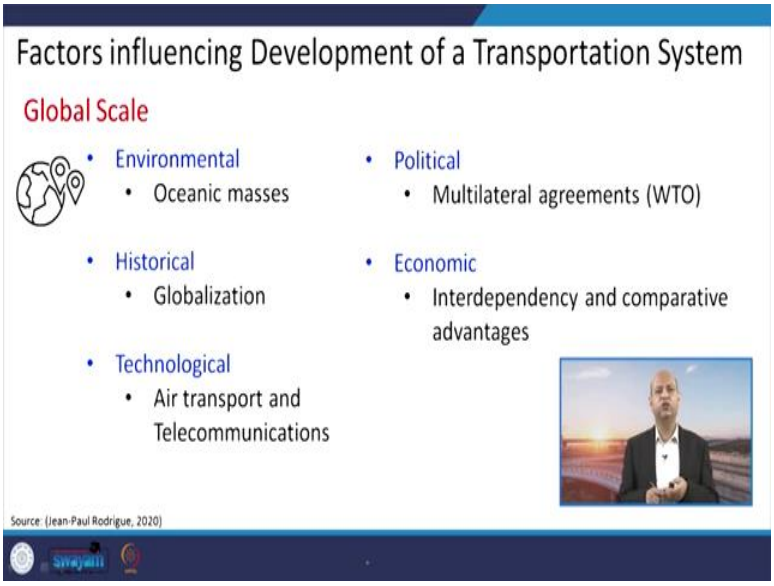
If we talk about regional scale then the climatic factors are more important and historically urban systems technologically means railways or canals, those are for regional transportation those are more economical you can say. So, these taxation and regulations political because in regions from one organization to other organization, you link then these issues are there. So, there should be proper arrangement to address those issues.

(Refer Slide Time: 17:37)



Then national and transnational so distances are more. So, again, different corridors or sea routes are to be managed properly, and there should be trade agreements, otherwise, you cannot travel from one place to another or you cannot ship your goods, if you do not have proper agreements. So, all those issues come into picture and economic factor is that there should be market otherwise, if there is no market, there is no fun in transporting your goods there, it will not be sold and you will you will not earn profit or it will not be economically viable.

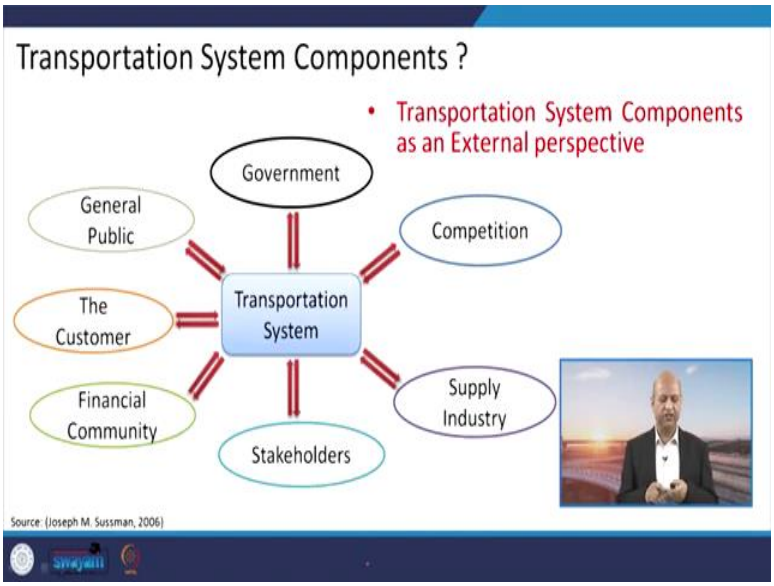
(Refer Slide Time: 18:12)



Similarly, if we talk about global scale, so environmental factors becomes global in a scale like oceanic masses, so proper arrangement of those treaties, etcetera, and historical means globalization because of technological regions. Now, this the whole globe is becoming one village as you people, we talk about those.

Then technological like air transport or telecommunications, they are helping us in global scale factors managing these transportation systems. Then political because multilateral agreements are necessary for intercontinental and international businesses. So, like WTO organization is there, World Trade Organization all those. Economic interdependency and cooperative comparative advantages and cooperation must be there for addressing those issues.

(Refer Slide Time: 19:10)



Then, if we talk about like the different components in nutshell, so government's role is there of course, and means, this transportation system is linked for all those components. So, government will be there for different policy matters, regulations, etc., general public, which is kind of a stakeholder which is there, then the customers are there to use those public transportation system and other infrastructure.

Then financial community who can give loan if we want to have a big transportation system then sometimes loans are needed for buying vehicles and buses and all those things. And then supply industry means timely those if we have a particular network then supply industry should be able to supply us those particular vehicle, fleets, etc.

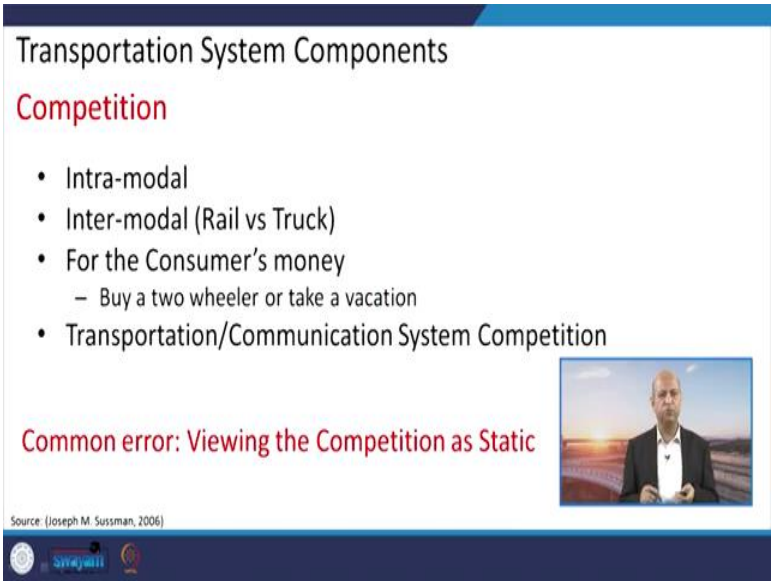
And competition must be fair means it should not be like we are favoring a particular mode over the other then it will not work because integration will not be proper and the other mode may be suffer, it can have losses and then ultimately the public or masses will be at loser end.

(Refer Slide Time: 20:32)

So, how this government plays role as you can see these taxes, then safety regulations or user fee, they can be decided by the government because otherwise suppose private players are there and if there are no regulations one can charge any much and that is not good. So, there may, there should be some regulations that only this must the cost then this much of percentage you can have your gain and you can decide the price.

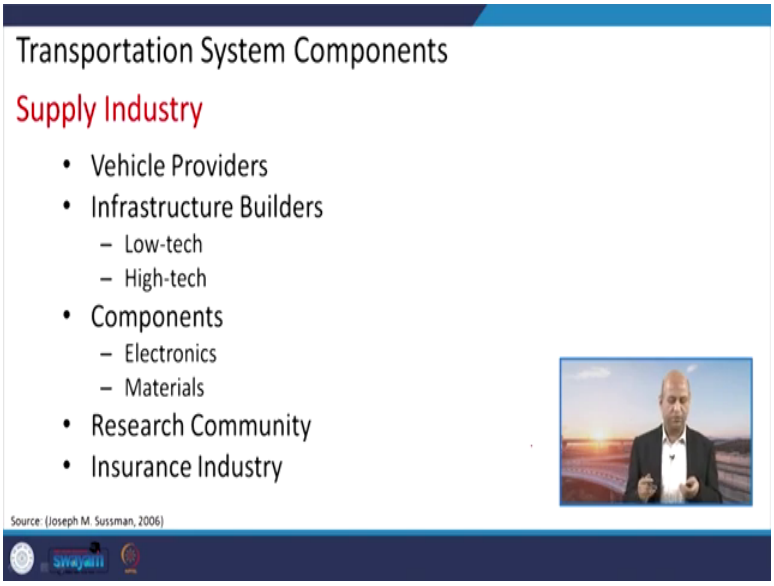
Then entry and exit from the market and monopolies all those issues are government regulated ones, so that the fair playing field can be ensured. So, rules, compliance and standards and all those things are there for this particular system.

(Refer Slide Time: 21:24)



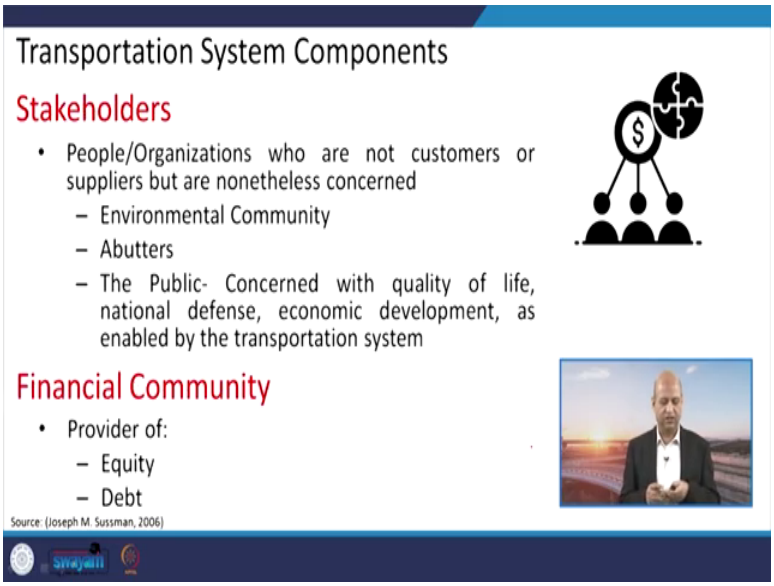
Then if we talk about competition then intra-modal or inter-modal like rail versus road transportation systems or these waterways or those and then means, like communication system, which can competition can be enhanced by using those particular components. So, people the common error or common mistake people make that competition is the static but it, with the time it is dynamic, sometimes which is very profitable transport mode, it can be at the losing end also. So, we have to be innovative and vigilant about those issues.

(Refer Slide Time: 22:04)



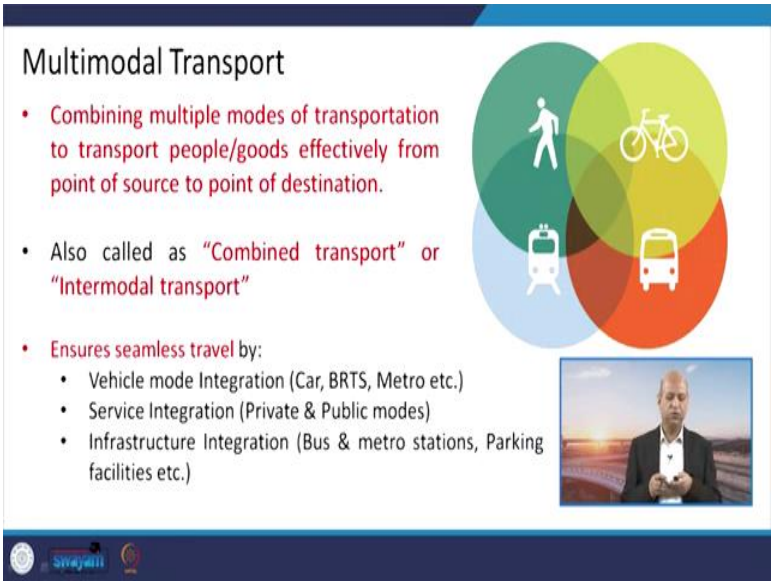
Then supply industry like infrastructure builders, low tech, high tech, and electronic components, all those things must be available in time, just in time like this Japanese technique. So, those are the issues then insurance industries are also there, if something happens then there should be a particular way of handling those things.

(Refer Slide Time: 22:27)



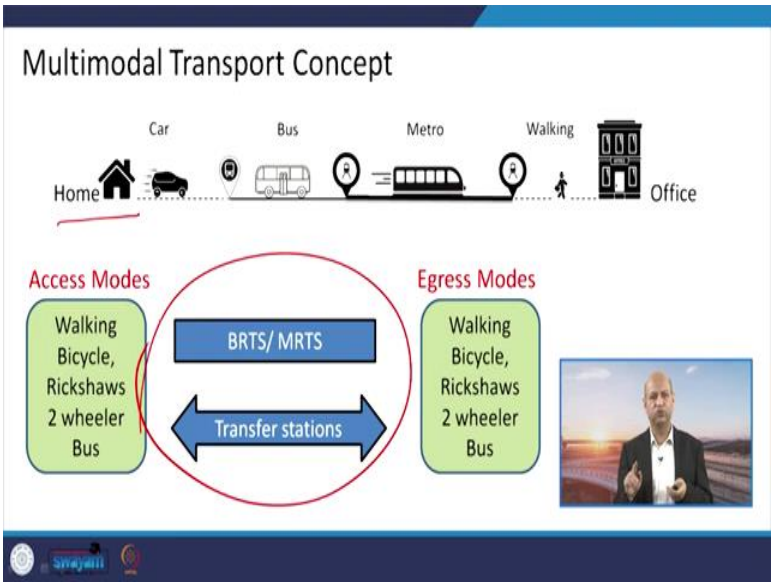
Similarly, like stakeholders which are of different nature like environmental community, they can ask for issues which are related to the environment, if something is being damaged, some environmental components are being harmed then those issues must be addressed properly and financial community like through equity or debt, how can we generate resources to support our system all those things, we have to look into.

(Refer Slide Time: 22:54)



Then multimodal transport because there are road, there are railways, there are air traffic, there are these waterways, etc. So, all those things and then walking also, all those things has to be integrated properly. As I said earlier, if suppose, you are traveling through train and if you are not finding some rickshaw to go from a train station to your house, then again it is a problem.

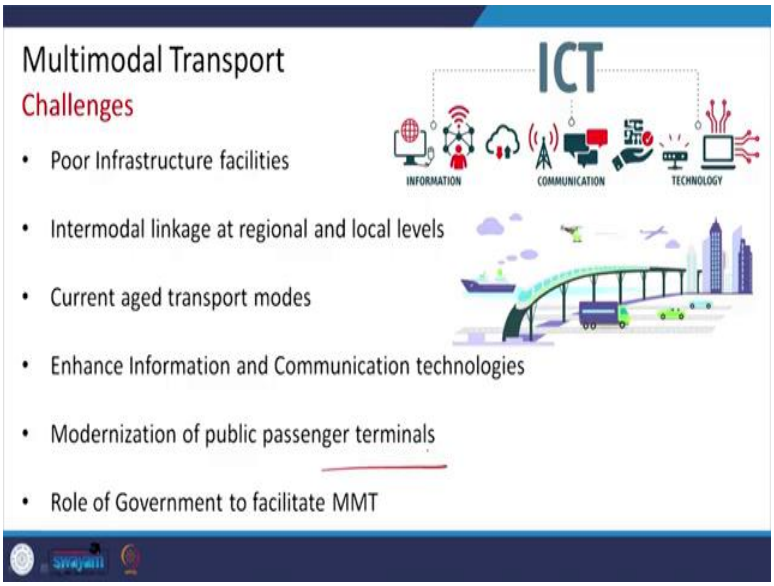
(Refer Slide Time: 23:27)



So, multimodal integration should be proper as it is shown very beautifully in this picture like from home if you start your journey, so by car you can go and at bus terminal, you can park your car there, you can use metro then you can work and office. Similarly, you can come back, then

take your car and again, means traveling some like 80 kilometers, 100 kilometers or so. So, those kind of multimodal transportation systems can be useful. Similarly, like from one end to another end, so those issues has to be handled properly. So, that there is no gap between one transportation modes usage to another transportation modes usage.

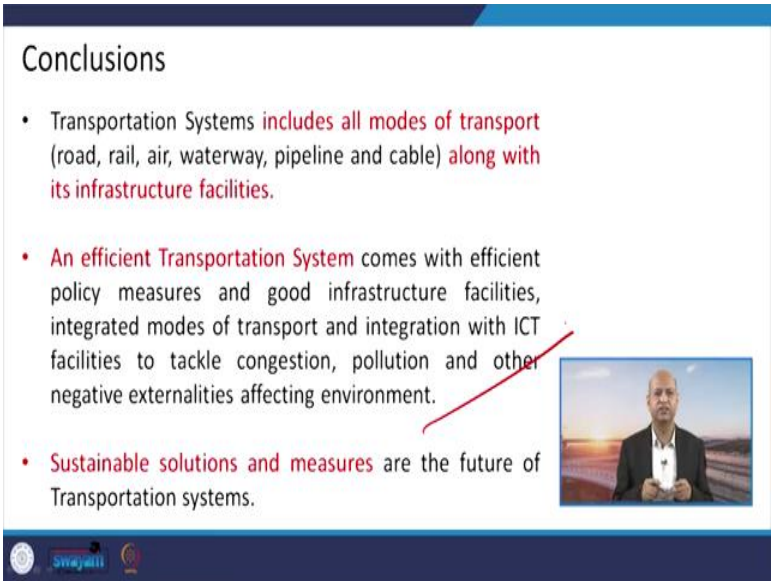
(Refer Slide Time: 24:09)



And these are some challenges for multimodal transportation system like if one particular mode has poor infrastructure then you can have in one mode good journey comfortable journey, but in another mode you are finding it very difficult. So, those infrastructure challenges must be addressed in time.

Then intermodal linkages which I am trying to repeat again and again that those must be integrated properly. Then, you can have these modernization of public passenger terminals, because if there is no good waiting area and people are not finding it place as a comfortable for thermal comfort as well as other comfort parameters, then again public will feel discouraged to use those particular transportation systems.

(Refer Slide Time: 25:16)



So, now we can conclude that any transportation system can include all modes only then we can have the journey towards sustainable transportation system, because road, rail, air, waterways, pipeline or cable, all these infrastructure facilities has to be there, if you want to interconnect with each other in a efficient and effective way.

Well, there are some issues related to like congestion related to pollution that we will see in later lectures, but they have to be addressed and so that sustainable solutions and measures can be incorporated to achieve the sustainable transportation system. So, I hope you have enjoyed this particular lecture about different modes of the transportation and the infrastructure and how to integrate them, how to put them in place, so that we can have a journey towards sustainable transportation system.

(Refer Slide Time: 26:00)

These are the references which you can go through to have additional knowledge about a particular part of the lecture. Thank you for your kind attention, and we will continue these lectures towards the journey of sustainable transportation system. Thanks again.