Geographic Information Systems
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Lecture-60
Limitations of GIS

Hello everyone! and welcome to the last discussion of this course, that is the limitations of GIS. As we know that we have discussed the GIS can do this and that. But one should not oversell the GIS because GIS is one of the platforms which can solve lot of problems. But nothing is universal in this world. So, GIS too is having limitations. And before we close this course, I thought that I will discuss this part.

We must know the limitations of GIS. If we do not know for example, if we know that a car cannot fly, it would be better. Otherwise, if we increase the speed of car so much that we cannot control. So, the same way, we should not propagate that GIS can solve each and every problem of the earth, not at all. GIS is also having limitations. GIS is also not a Universal tool. It is a platform to handle spatial data which is coming from variety of sources.

And it is allowing us to organize in efficient manner, analyses it and then create models, final outputs but these things are having limitations. Another thing is if somebody has to do a small work, an organization for example and they find the solution which is coming or proposed from GIS is expensive then they will not resort. So, one of the things which is said about the limit, among the limitations of GIS, the GIS solutions sometimes are expensive.

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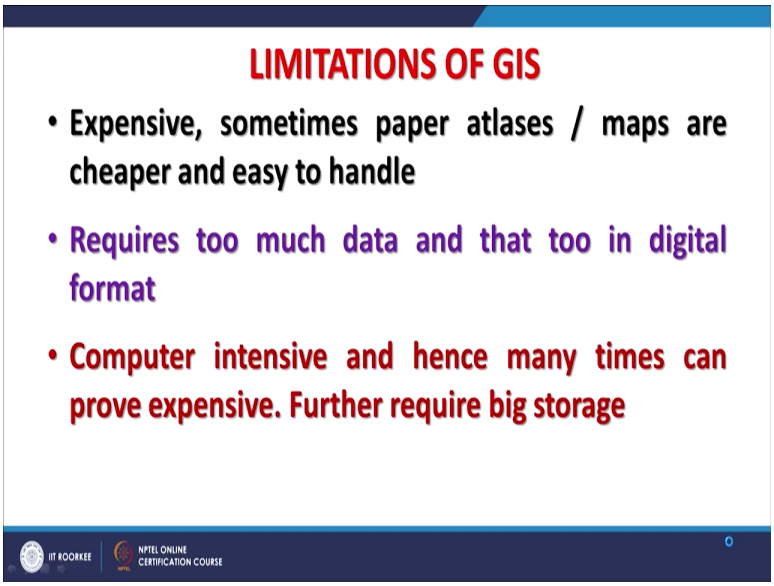

And whereas people find that Atlas or maps or you know online maps are cheaper and easy to handle. So initially, an organization may face this problem that is the expensive. Now sometimes also, it requires too much data. If organisation is just starting using GIS, then everything is required. You require software, you require hardware, you required data. Initially, for a very small map or data output, analysis so that organisation may not support that one.

So, requires too much data some times. And that too in digital format and you know digital things are expensive. For example, a survey of India toposheet if you buy in a print form, may only 100 rupees. But if you buy in a digital form that may cause 30000 rupees. So, there is a large difference between analog product and a digital product because digital product can be copied easily therefore, they have added so much cost.

So, this must be taken care that even if an organization would like to start using GIS for initially small work, then they may face some problem. So, this we can consider under these limitations of the GIS. As you know by definition GIS is a computer-based information system. So, you require computers all that. Now, computers are becoming very common. But on a very standard PC or laptop, you may not be able to run good GIS software.

So, you require like workstation or very expensive, powerful laptop to run good GIS software. So that means, it is computer intensive and ultimate basically cost and many times, it can prove

expensive for an organisation again, I am saying that who require small work to be done initially. Further, we know that it requires big storage. It requires storing of the raw data, it requires storage of process data and final output.

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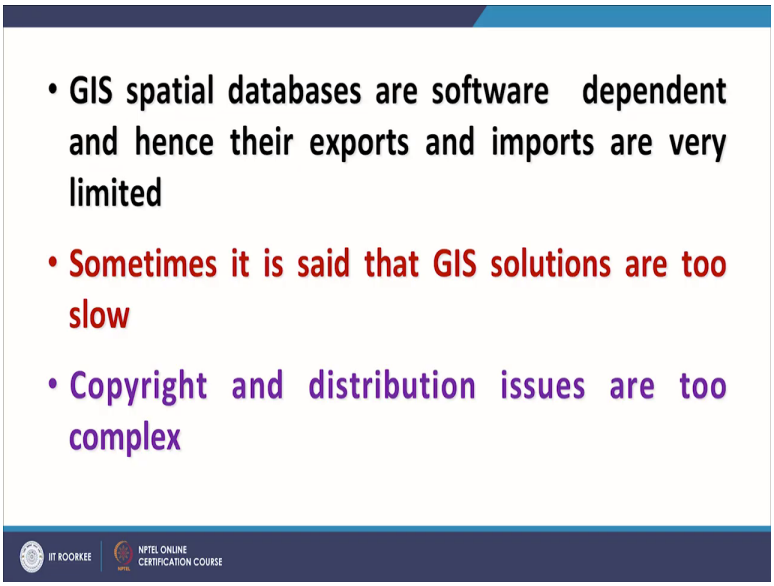

Another problem with GIS faces sometimes is GIS spatial databases are software defendant. That means that I have created a database on a particular GIS platform. Now I want to use the same database on the other GIS software platform and there may be some difficulty. So, converting from one database to another is a challenge therefore that is why it is mentioned that GIS spatial databases are generally software dependent.

And therefore, their exports and imports are very limited. It is not just like that you are having a GIS database in x software; you start tomorrow using in y software. It will not work especially the project which I have created and saved will not work at all with the other software. Sometimes even they do not work with the same company software of having different versions. So, one has to be aware about this limitation of GIS.

Sometimes it is said that the GIS solutions are too slow. Initially yes because if an organisation is just entering in this domain, then for them, it requires a lot of time. They have to arrange hardware, software, person, data then only solutions will start coming so initially sometime the

GIS solutions are too slow. Again, since we are using digital data and nowadays these issues especially about copyright and distribution issues are becoming complex.

Because digital data can be copied from here to there and many times, we may land with these complications so that those issues are also creating in some way, limitations for GIS. Now this is another limitation that if I have created a 3D perspective view which I can rotate on my system but when I create an output as hard output; a hard copy in a form of print out then that flexibility or facilities is gone and then it becomes difficult for decision makers to show.

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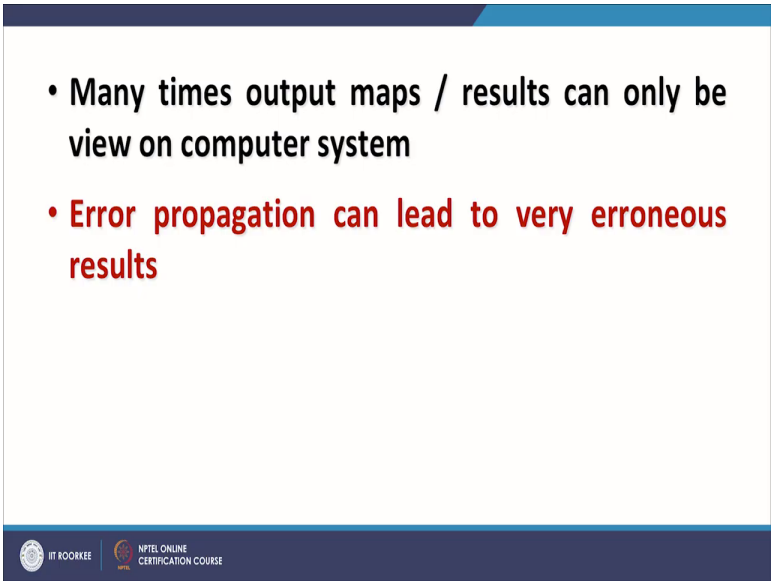

So that means every time the computer system with along with projection system has to be carried. So, many times output maps results can only be viewed on computer system. This part we have just discussed in the previous discussion that errors propagation can lead to erroneous results. So that can also be one of the limitations of GIS. Now, another part which I would like to discuss which I have been mentioning here and there in my previous discussions or lectures about the GIS rules. Again, you will not find in any book as I am going to discuss.

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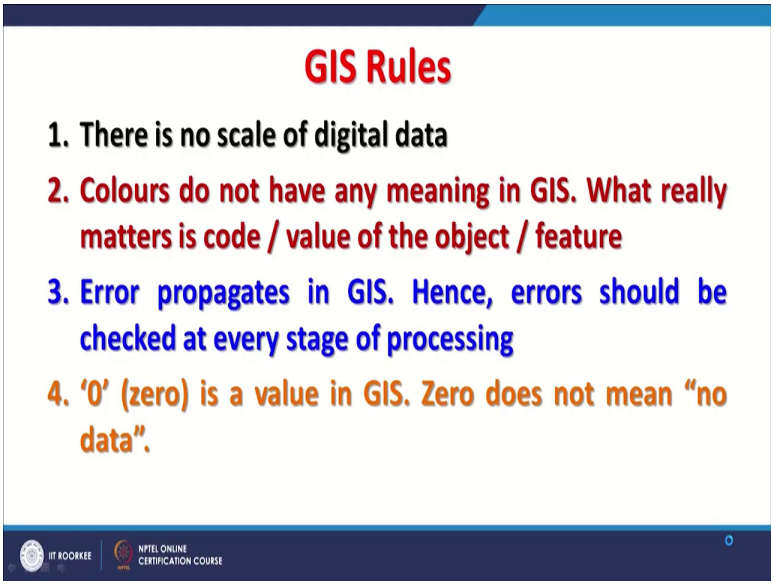

GIS rules; the number one, there is no scale of digital data. Many people recently may not agree with this statement. But what I say as long as the data inside the computer in digital form, there is no scale. But once the data is project or printed on a map, the scale is frozen. Therefore, we say that the digital data do not have any scale, it is absolutely correct. However, the digital data which I am having inside my GIS database may have come from a data source which had the scale or spatial resolution.

But as long as it is inside my computer in form of real digital form, not scanned one then it will not have any scale. So that means the same map I can print on A0 size and same map I can print on A4 size. These two different outputs will have different scales. So, it proves the point that the digital data do not have any scale. Now another point is that colours do not have any meaning in GIS. Generally, we should follow some convention of colours.

I gave the example like for forest; we should use green colour for depicting forest. Sometimes, for agricultural land; we use the light green colour or yellow colour. But using red colour for forest, no one would appreciate. However, colours do not have any meaning; what here the meaning is that the value of the object, feature that matters a lot. Not the colours because colours are only on the screen.

Because they are being used before there is a pallet which is saying that for this value, we should use this colour. So, we must take care about the values rather than colours. Colours; we can change any time but values, we cannot change. Third point we have mentioned many times that error propagates in GIS. Hence errors should be checked at every stage of processing.

After each and every operation in GIS, one should check for errors. If found corrected then go to the next step. Fourth rule of GIS is that the zero is a value in GIS. Zero does not mean no data. And we had a separate complete discussion on a Nodata. So, concept on Nodata came little later though GIS existed before that. So, this zero is a value in GIS and especially in digital elevation models.

Somebody is working in the coastal area; there they may face problem if they do not have this facility of Nodata in their software to handle because zero means it is close to the sea and minus values can also have. But if I do not have any survey points or anything then how I will represent? I cannot represent as zero. I have to have some value which is declared to the system that whenever you encounter this value, just ignore in analysis. So, zero is a value in GIS. Zero does not mean Nodata.

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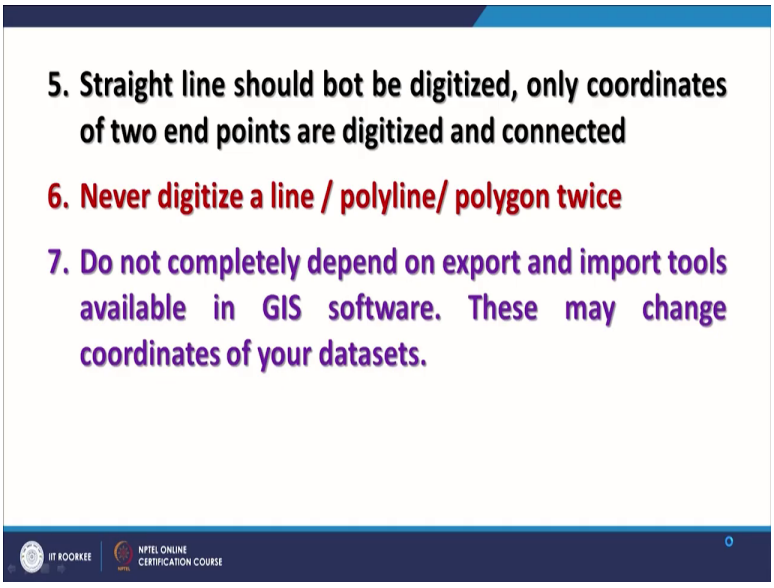

Now the fifth rule of GIS that a straight line should not be digitized. Only coordinates of two endpoints are digitised and connected because if you start digitizing a straight line, you are not

keeping a line segment but you are creating a poly line. And we supposed that should not have been there. So, a straight line should not be digitized. Only coordinates of the straight line; to end members, 2 these nodes should be digitized and connected later on.

The sixth rule never digitises a line, polyline or polygon twice. Because no person can digitize the line 2-3 times in the same way or even 2 times in the same. And therefore, you will introduce errors. So, whenever doing a digitization, take care that you digitize only once. Otherwise, you would create artifacts and ultimately you would end up with some errors. Seventh is, do not completely depend on the export and import tools available in GIS because they may introduce errors.

Conversion from one format to another; there may be introduction of errors because these conversions may not be 100% transparent. And therefore, if I export or import, this may change the coordinates of data set because of the precision setting. So, while doing this thing; exporting data or importing data into GIS, we must take care about that. So, after the export, I should check whether it has correctly exported.

And if I am importing from somewhere, I should again check whether is there any difference between the original because this export-import is doing nothing but the change in format sometimes. So, these are the 7 rules of GIS as mentioned that you will not find in part of any book but very-2 important to remember.

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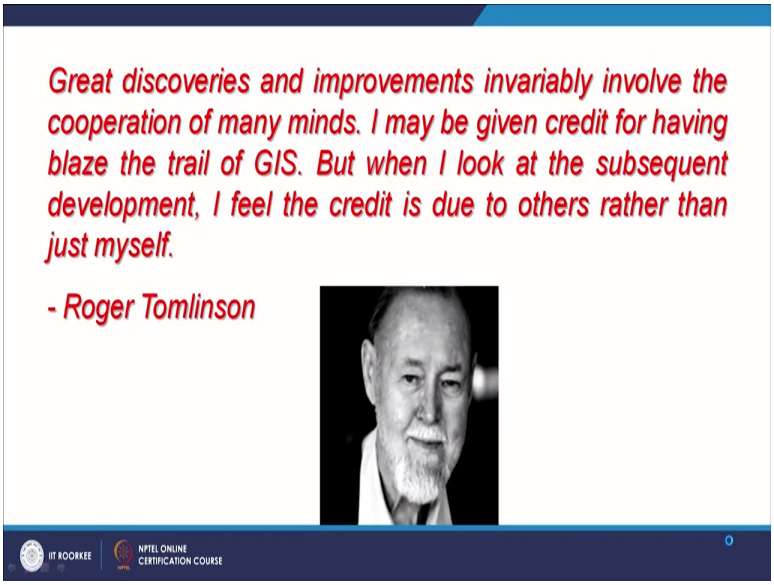

Now the other part of this discussion is and this is the last basically is that the GIS; the term is still meaningful because it was introduced somewhere in 1965 by Roger Tomlinson. And since then, it was being used but the same time, people are bringing new and new terms. So, the question comes whether the term GIS is still meaningful. Roger Tomlinson which also called the father of GIS.

And we paid a tribute and discussed in the very first lecture, when we discussed what is GIS. So, Roger Tomlinson wrote to share his thoughts on the recent discussion regarding the term geospatial. And he wrote that the great discoveries and improvements invariably involve cooperation of many minds. I may be given credit for having blaze the trail of GIS. But when I look at the subsequent development, I feel the credit is due to others rather than just myself. This is his feeling; the inventor. But what others are doing?

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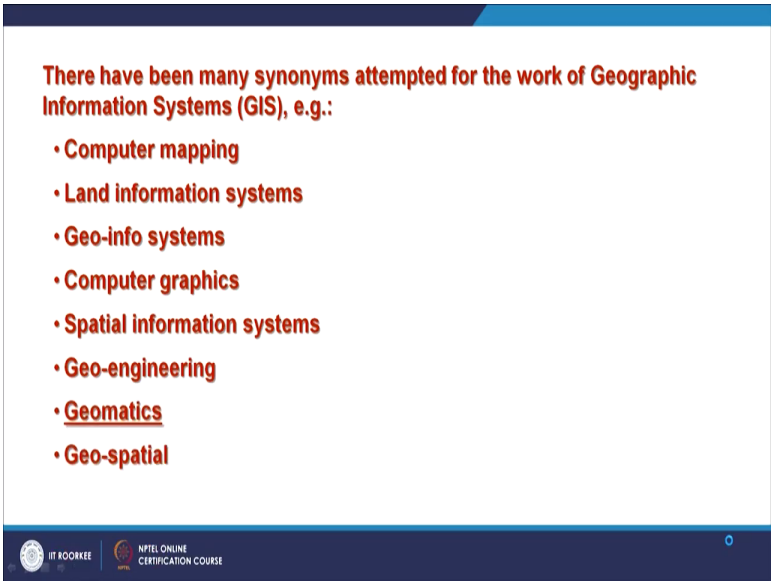

They are bringing many names and trying to forget his contribution like instead of calling GIS, people have started calling computer mapping, land information system, Geo-information Systems, Computer Graphics, Spatial Information Systems, geo-engineering, geomatics engineering, geo-spatial engineering and topographic systems. If you start looking one by one about these terms which are being used instead of GIS, you would find that they are all talking about GIS; that is geographic information system.

What is wrong if we use the word GIS rather than the other fancy terms. One more term which is becoming quite popular geo-informatics. So why we would not like to use GIS rather than all these words? There is no explanation. What is lacking in GIS which these are supportive? If I say topographic system that means it is only handling the topographic data. But GIS is not only for topographic data handling.

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And if I say GIS Info system again ultimately, I am talking about GIS. So, also some other terms like Computer aided design, conceptual surface analysis, urban planning systems, hydro informatics systems, graphically reference data storage and retrieval system, land use and natural resource systems, interactive composites mapping systems etcetera. So, these new terms are coming instead of using word GIS, they are all bringing confusion in this field which is not good.

There is nothing wrong using term GIS. It is popular and it encompasses all those works or ideas or aims which we would like to have.

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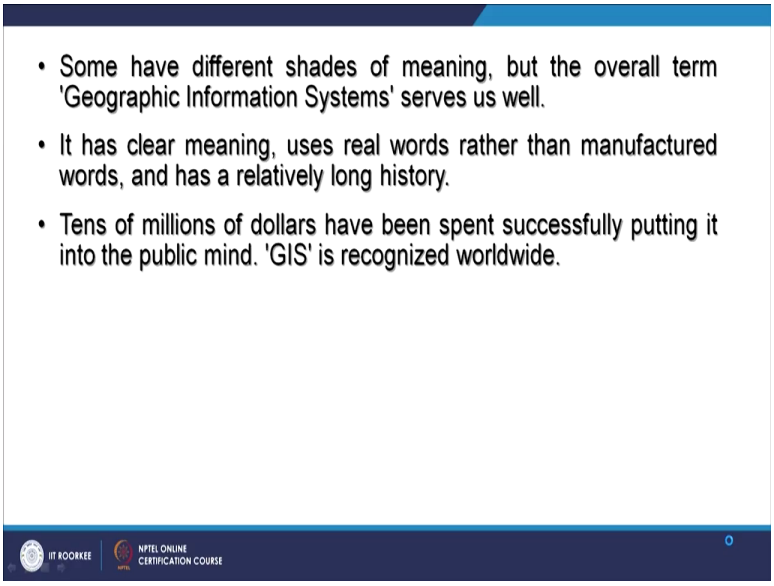

Some have different shades of meaning because all these terms which I have just mentioned, they are having some other you know purpose. But the overall terms geographic information system serves us well. And it has clear meaning, uses real words rather than manufactured words and has a relative long history. Tens of millions of dollars have been spent successfully putting it into the public mind with GIS is recognized worldwide.

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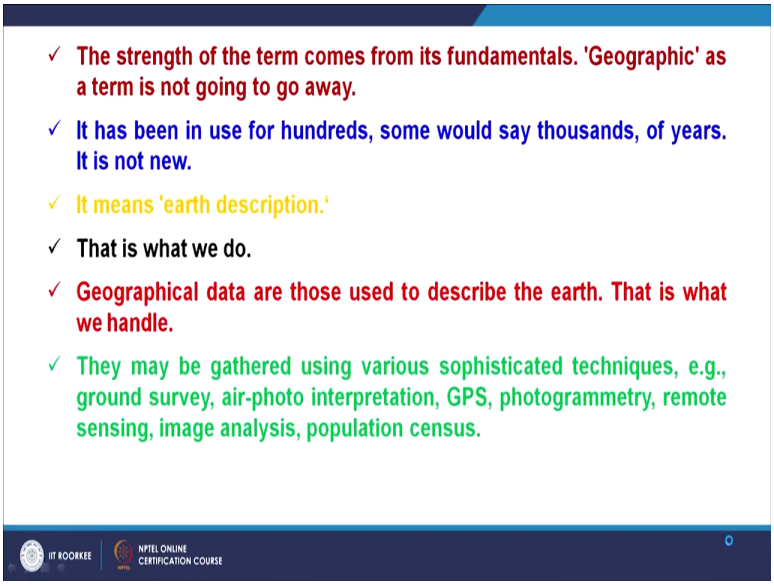

If I say a topographic information system or hydro informatics system, next question would be by anybody who are here first time, what is that? Oh! You are talking GIS application in hydrology. So, since I am working in hydrology, I call as Hydro Informatics. No! You should use the word GIS and its application in hydrology. No problem! So, the strength of the term comes from the fundamental that is the geographic, not geography as the term is not going to go away.

And it has been using for hundred, some would say thousands of years and it is not new. It means description of the earth when we say geographic and also it carries the meaning that objects are having geographic coordinates. That is what we do basically in GIS. Geographical; some people also used. Geographical data are those used to describe there that is we handle. So, the most appropriate term even today is geographic information systems.

So, there may be gathered using various sophisticated techniques that ground survey, air photo interpretation, GPS or GNSS, photogrammetry, remote sensing, image analysis, digital image processing, population census etc. And the results of all this is geographical data.

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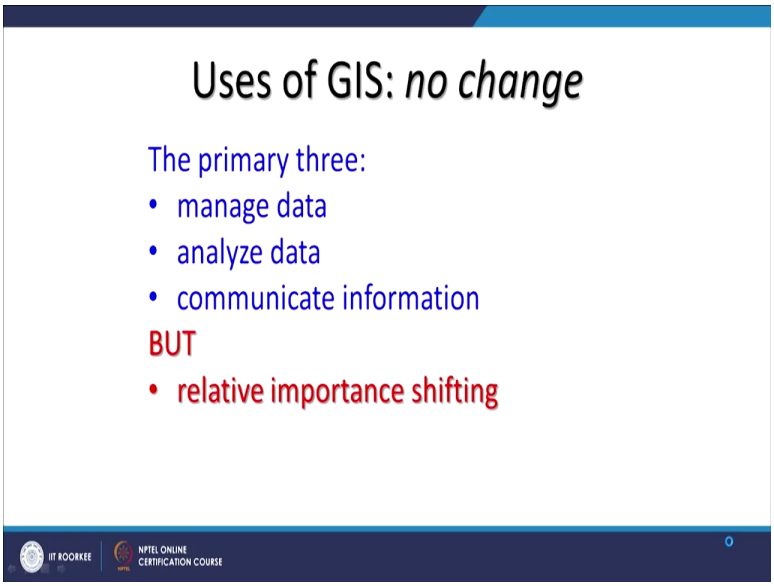

So, uses of GIS, no change. The primary 3 that manage data, analyze data and communicate information. So, the roles of GIS have not changed so why do change the name? However, the application of GIS may be in different domain that is the purpose basically because the data itself is coming from variety of sources. So, applications can be also variety of domains. So, no change because of primary; manage data, analyze data and communicate information in GIS but relative importance shifting.

New things are getting added like I mentioned about digitization. Now using typical digitizer, that flood bed digitizer is not used now because now we are having very high-resolution screen and mouse and we use that one. So, sometimes the importance keeps shifting. Implementation of technology keep changing. Again, the technology or hardware sometimes change. Earlier when we did not have the reliable this GNSS system, we used to rely for GCP for some other sources.

So definitely, those things are changing. Now, some thought about these changing emphases and future. So, what we are; from data to analysis. That should be the aim.

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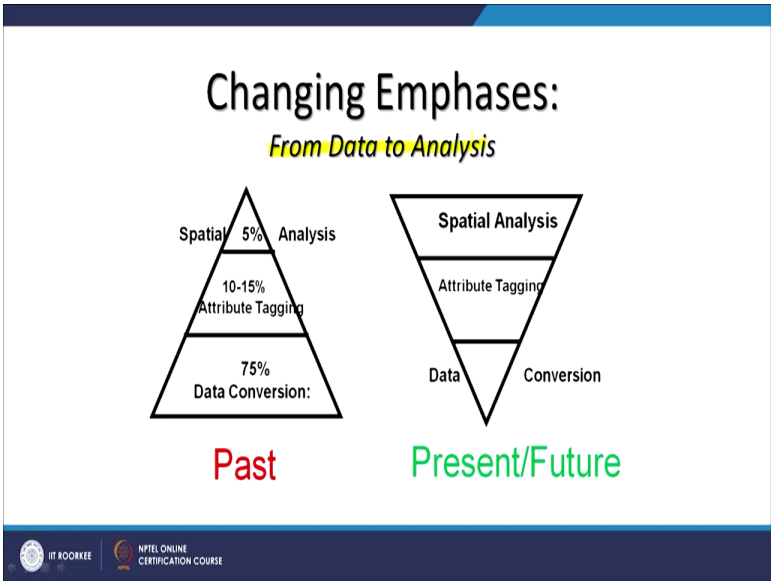

So, here spatial 5% analysis in the past because we were spending more time for data conversion from analogue to digital, organizing data, making compatible to GIS software platform and so on. And then we used to spend lot of time for roughly 10 to 15%. This is world average about tagging the attribute data with the spatial objects. Now, this triangle has inverted with time.

Now we spend most of the time in the analysis because the data is available in GIS compatible format, in digital format quite easy for example, digital elevation models. 20 years back, we did not have so many. Now, you are having from 1-kilometer to 20-meter or 12.5-meter freely available. And also, sometimes you do not have to attribute tagging or typing because data is already available so the technology has improved, our approach has improved.

So, this is what is the present and future is going to be of changing emphases from data to analysis. Earlier the emphases were to organize the data. The time it took or consume or the energy it used to consume was only for the data organisation. For example, somebody is doing his say MTech dissertation. Now, he has to spend lot of time for organizing the first part. And then, when he approaching the last date of submission, he left only few weeks. So, he would spend little bit time on the analysis.

Now since day 1, he is having lot of data available in digital format and not only digital format, GIS is compatible format.

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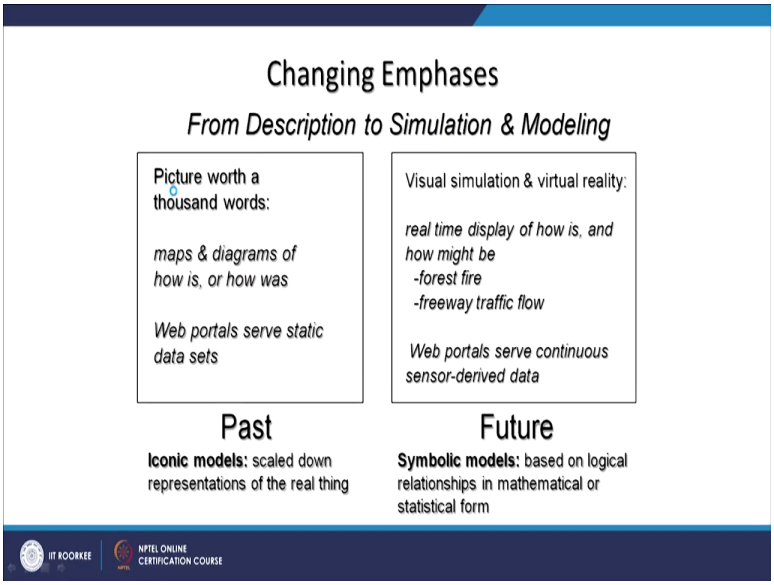

Now this changing emphasis is also shifting from descriptive to simulation and modeling. That is the ultimate aim of the GIS. Some simulations I have shown. Some models I have also discussed. So here, we used to believe that picture worth a thousand Words. Now, we are having visual simulations and virtual reality. So, emphases are completely changing. It will further change and we are going from our own GIS system to a sort of internet-based GIS system.

Best example is Google Earth, Google Maps. The data is not in our machines. The data is somewhere else on cloud or servers or other places. We are just users so that way, we do not have to spend much time of creating our own data sets. The data would be available only we required how to analyse the data for a particular study. So, earlier the maps, diagrams; these were the main emphases.

Now, the real time display because the data is increasing. Large volumes of remote sensing data available. Earlier we used to buy the data. Now lot of free data from various satellites, various sensor of varied spatial resolution is available on almost daily basis. So, we are changing to real time display. Further, web portal serves static data sets. This is what they have been doing in past. But now, we are going for web portal serve continuous sensor derived data.

The data is being scanned by the satellite and it is becoming available or will become available in future on the web portals very easily. So, from iconic models; scale down representation of the real world which was the past. The symbolic model based on the logical relationship in mathematical and statistical form. Now, the tools or techniques which are becoming more or getting implementation in GIS like AI, machine learning, artificial intelligence or ANN (artificial neural network), all those things are also getting percolated into GIS and in that way, the future is very bright.

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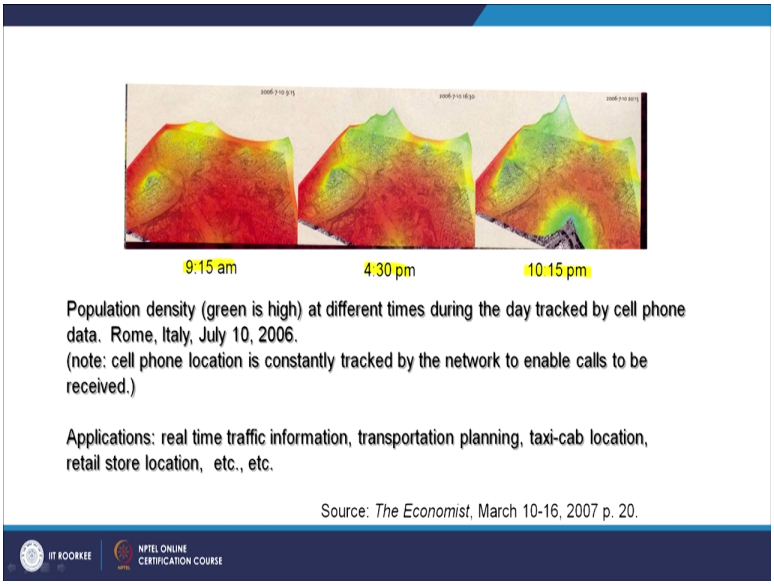

Now here, this is the example that how a digital elevation model if we are having the SAR interferometer data for example or stereo data, it can be created like this if things are changing on the ground. So, in many natural disaster conditions, these can really help us to find out what is really happening. Real time or maybe population density or maybe some other things which are changing with time; forest fire and other things, they are all changing time.

We want in many times information based on satellites many times in a day. So, there we can employ these things. Applications; real-time traffic information, transportation planning, taxi cab location, this is already implemented. Retail store location and so on so forth. So, all these things are going on. And lot of new developments are taking place for the GIS in this field of GIS.

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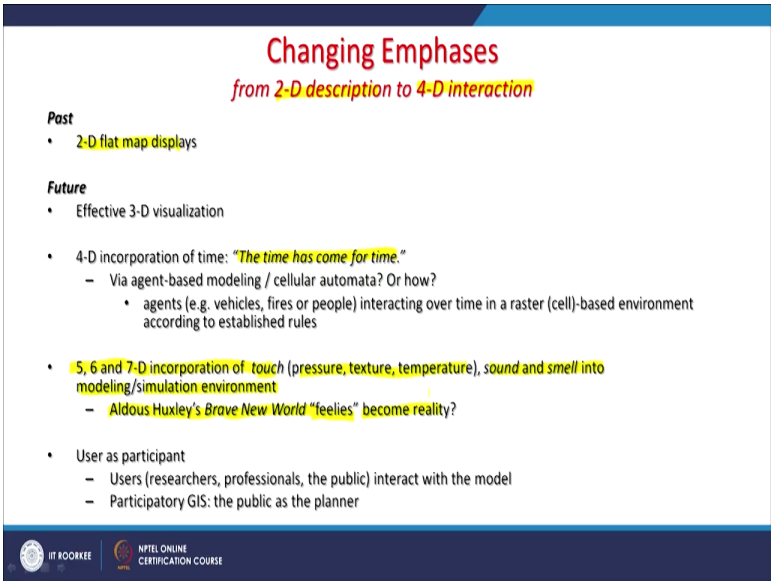

Changing; further we are changing emphases from 2D descriptive to 3D or 4D interaction. That means we are adding time. How things are changing? So, past 2D flat map displays, future is Effective 3D visualization, also 4D incorporation of time. Time has come for the time. That is most important thing because now it is possible. Lot of data is available so we can detect the changes which might be happening hourly. It might be happening on daily basis or in a yearly basis.

So, that time is getting added into the GIS. Earlier it was not possible. We were restricted to 2D flat map display. Now, we are talking about 3D displays, 3D simulation, 3D visualisation along with the time; changing. And may be in future 5,6,7-D dimension incorporating touch, pressure, texture, temperature sound, smell in modeling simulation environment. But these things will also might come in future.

So not only adding the fourth dimension, that is time, but adding few more things pressure, texture. You know like on this touch screen. We are using this technique. So may be in future, in others. So, this new word, Feelies becomes reality. And users as participants. So, users will be the participants. They will not be simple users. And users of all this development may be from researcher background, professionals, the public and of course participatory GIS.

That means this GIS is going to come and we also use the term like crowd sourcing. Lot of this crowd sourcing so lot of a crowd sourcing will come and becoming anyway reality. So that is that is leading us to a participatory GIS. In the past, again changing emphases out of this world. The GIS is applied to the planet earth.

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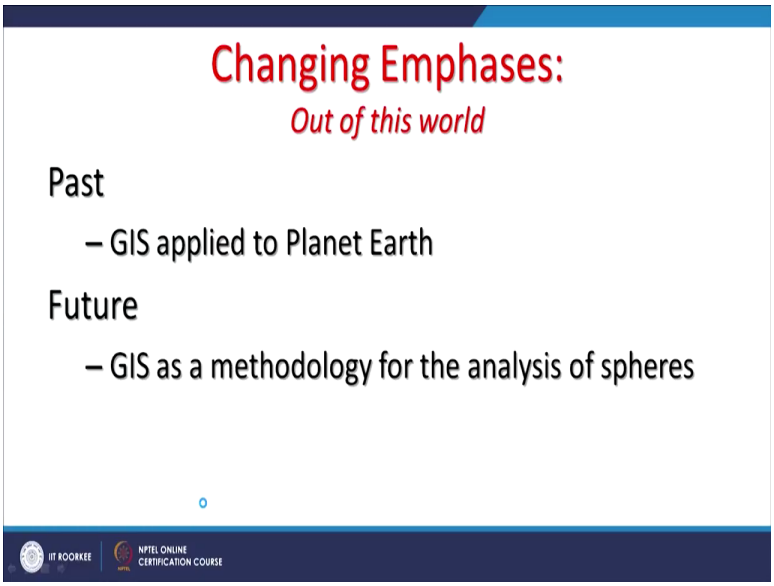

But now we are going away from that. Not only this but we are going far also for other planets like Mars, moon and other Spheres also. So, other planets, we are trying to cover. Now few words on the future of GIS that if I really knew, would I still be there here?

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That means it is very difficult to guess the development which is taking place in computer science development which is taking place in communication and also in the satellite based remote sensing. Also, in the positional improvements through GNSS systems, it is very difficult to predict what is going to be the future? But some things we have already discussed that what is the future but this last is if I really knew, would I still be here? No! I do not know but still I am here.

With this, I thank you very much and I really enjoyed with you in this course and I hope that you would also enjoy this course. So, with this, thank you very much.