Introduction to Geographic Information Systems

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Lecture - 20
Limitations of GIS

Hello everyone, and welcome to the last lecture of this course, of a principles of GIS - Geographic Information Systems.

In this particular lecture, we will be discussing 4 sub-topics; those are a small one so I fitted in one lecture. The first one is the limitations of GIS, and, a, second one, we will see the rules of GIS. Third one is, a, because lot of new names are coming for GIS. So, is this meaning of GIS that is Geographic Information Systems is still is meaningful or not, still it is relevant or not, that we will discuss little bit. And lastly we will discuss, the future of GIS, where future where future is going, of a GIS. So, let start with the first part, is the limitations of GIS. As you know, that GIS is not a universal tool. Each and every tool has got it is limitation. If I give you example, the work which hammer can do, the plier cannot do, and the work which plier can do, the hammer cannot do. If you try to do the work of plier by hammer, either you will injure yourself, or you will not be able to execute that work. So, no tools are universal, neither GIS.

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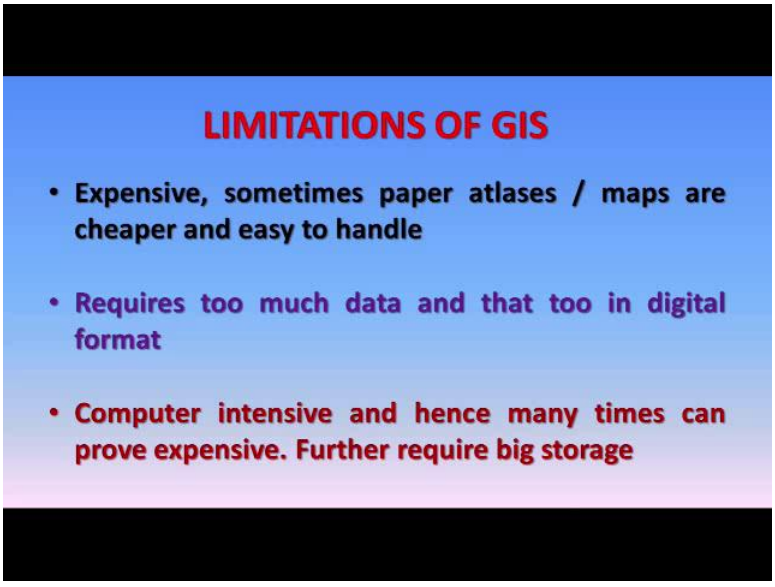

What are the limitations of GIS? We will see, one by one. First one is, it is mentioned that GIS is expensive, to some sense, it is correct also. Because it is a computer based information system, and if it is a large enterprised GIS, lots of hardware and software are required, and that involves cost. So, it can be said, expensive, especially compared to paper maps, atlas, and other way of representing the map. So, sometimes, GIS is expensive. But let me say one thing at this point of time, initially it is expensive, but later on, it would be more cost, cost effective because, the reason is there initially, you have to invest lot of money in hardware, or software, and expertise, which one, once the setup is there, then now, it is much easier and it, it will become cost effect very soon. Because updating of data in GIS, is very easy, as you know that GIS is ongoing and continuous activity.

So, therefore, that system, or database which have somebody have developed, can be used later for other applications as well. And since everything in digital format, and therefore, within, if the data remain within same organization, then, the cost will not come there. So, that initial, the database development, will require lot of lots of expenditure, but later on, once the database is there, only updating will be required. So, therefore, in long term, it is not really expensive, but still, if you just start comparing with paper map or atlases, of course, initially it is expensive. Second is, it is also said that that it requires too much of data, it is a data hungry, it does not, you know, it a tool box, but it empty, initially. You have to feed the data. Every time you have to feed the data, update the data, and everything has to be in a digital format, and it is expensive as well. Say for survey of India topographical, map it may cost a 100 rupees, but if you go for digital data, it would cost many thousand rupees.

So, because digital data is expensive, paper maps are easier. So, this is, this makes another reason for a GIS becomes expensive. Once, the data is in digital form, and then it is not that expensive. Now, a, by definition, GIS is a computer based information system, and therefore, it is computer intensive, and hence many times can be have proved expensive, further require big storage as well. Because the data, once that it requires the space for data, and the output it will create; that too has to be stored, and also backup system has well. So, it is not that, a, initially it is not that cheaper. So, there is one limitation of GIS

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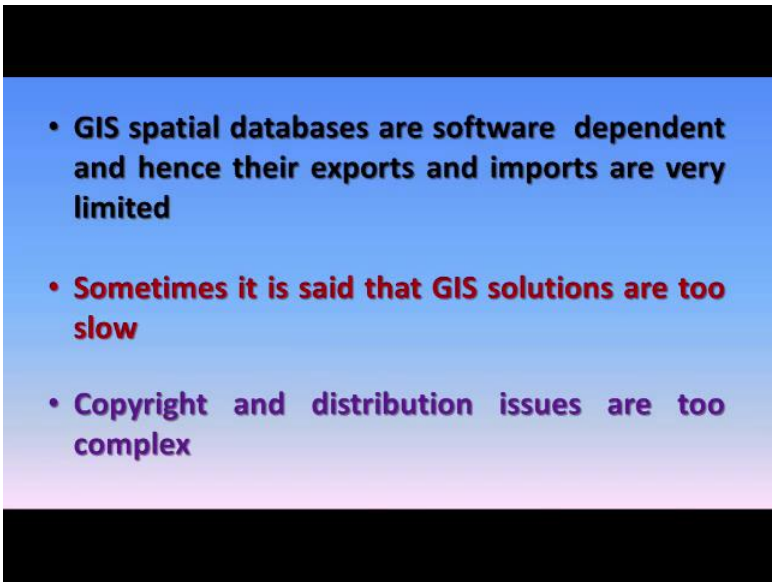

Now, GIS spatial database, are software dependent, and hence their exports and imports are very limited. What it needs basically, that if somebody might be using, a first initially, may be the database management system which is available within one GIS software. Now you are going for large operations, or an enterprise solution. There the database might be in other form, like in oracle or other.

So, now, you know, this is a transportation of data, from one database management system, to another, again will involve cost conversions, and conversions might bring errors. So, that is another limitation, of a GIS, that it is dependent on the software, which are handling the database management softwares. And sometimes, it is also said, the GIS solutions are slow. The reason is because, if everything has already been organized in a digital database, then the results can be achieved very easily, but if everything has been developed from the scratch; then definitely, the solutions will come quite slow. So, this is bad thing, which is mentioned about GIS. But initially, this thing will happen, but later on, as for the cost, so the speed of the solutions, will start coming at the later stage.

Once the setup is ready, the database is ready, then that issue will not come. And another, a, because everything being handled in a digital format, therefore, this issue sometime become very complex, which is copyright and distribution issues. Because a, if I have bought a digital data from, say for example, from survey of India. Now it is my, I cannot give to anyone. Even sometimes if I am using part of the data, and creating something,

and giving to something, then this issues will also come, the copyright another things. So, this is a, this we enter, once we go in the digital format, we enter in it, completely complex issues of, copyright and other things.

So, one has to be taking care, that rather than just presenting the same data, as we are supplied by some organization. Instead, if we produce some results, out of the data, through the analysis, that would be safer and such issues might not come. So, this care must taken, otherwise things may, it may become little problematic. So, these are the limitations of a GIS, which. Also one of the limitations, is depends on the output device, because ultimately, a, that, the though the data, everything has been done digitally, now everything cannot also be all the time presented in digital format. So, then it has to be printed. So, once from sort of a live map, becomes you know a fixed map, on a paper. Or it has to be only viewed on the computer, if you want to see that a digital form.

Now, every time, a, for the decision makers, they cannot come in your setup, you have to carry, everything cannot be carried. So, ultimately you will reduce the information, prepare certain maps outputs, and present to them. So, the real feeling of the GIS, and the accessibility of the full data set, becomes limited.

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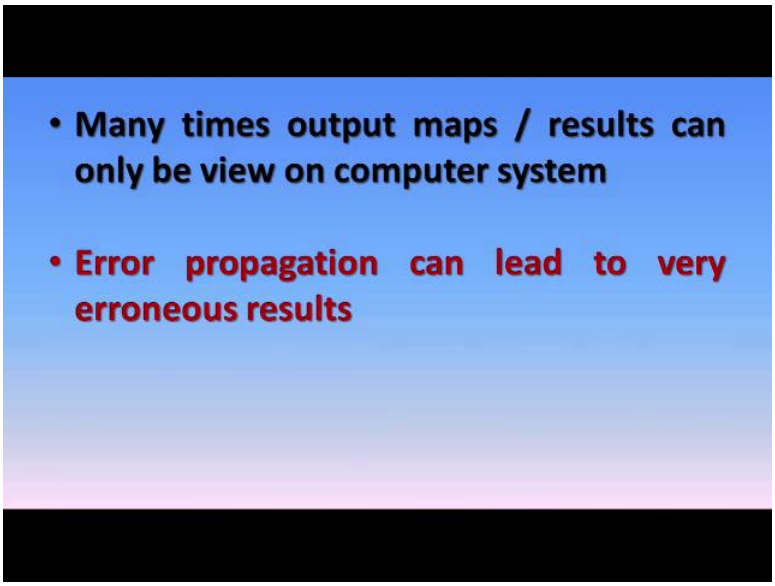

So, this is another limitation, because of it is purely computer based information systems. This I have already mentioned in the previous lecture, that error propagation can lead to very erroneous result. One has to be aware, and is a very important thing is there. So,

after these limitations of GIS, we come to the rules of GIS. And these rules you may not find in literature normally, but these are the rules which are coming through experience, and working in the GIS

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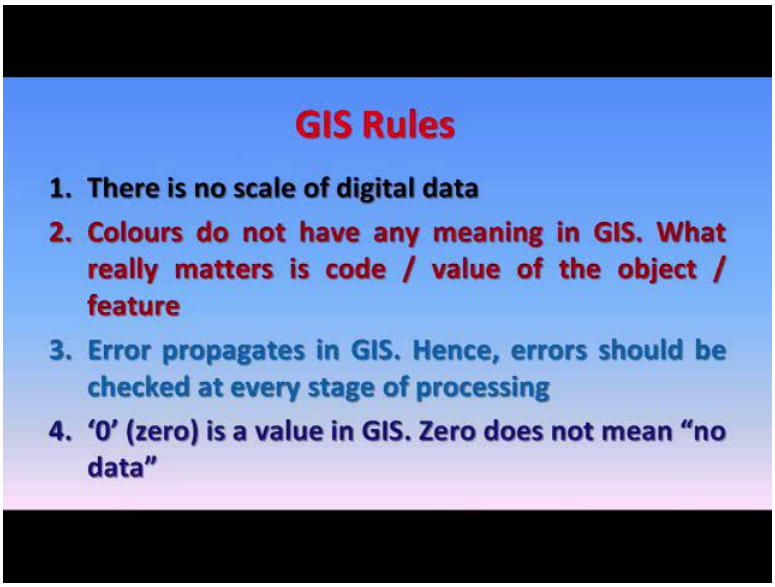

The first rule is, there is no scale of digital data. This looks little, very straight forward, very strongest statement, that the digital data does not have a scale, but it is true. Because as long has the data inside a computer, or say a map, it in digital form, is in the computer, it does not have any scale.

Once you project it, or print it, the scale is frozen. So, that is why, this statement is there, is no scale of digital data. Now the resolution is a different thing here, suppose a satellite image which is having 10 meter resolution. If it is residing in my GIS database the resolution will remain same, it is not going to change. But once I print that one, then the scale is fixed, the resolution is fixed there. Because I may print at the same satellite image, in a 4 size or may be in a 0 size. So, then the scale will change, but has long has in the system, it will not change. So, this is very important to remember, that, there is no a scale of digital data.

Now, another thing is which is sometimes misleading is also, the colors. Colors do not have much meaning, except that they have been used, for that using some standard scheme. So, the values, or, like attribute value, or a elevation value, of a Raster matters most, not the color. If, if there is elevation of a say 200 meter, I can assign a red color, or

somebody can assign green color. So, if I start thinking that red color meets 200, and then somebody assigned green color, my concept will change. So, colors do not have basically any meaning, what matters basically, the code or value, of the object or feature.

Now, the third, which we have discussed already, that air propagates in GIS, hence the error, should be checked, at every stage of process. This is a standard part, let us make this rule is, after each and every operation in GIS, or processing in GIS, check for errors, if found, correct them immediately. Do not go for the next step, because then, error start propagating, and you would forget to correct the errors. So, immediately after each and every step of GIS operations, one would check for errors. Another related thing is here, that instead of going for a very complicated equations, or compound instructions, or syntax in GIS analysis, go for simple, simple one may be in multiple steps. So, that at after each and every step, you can check for errors, if found, correct it then go to the next step.

Another very important thing, which has already been touched in previous lectures, that the 0 is a value in GIS, 0 does not mean no data. So, there is a complete no data concept, which is a value, which is in reality it is not possible, if it is a digital elevation model. So, a no data value, for a digital elevation model, might be a value of a say, and you know like wise 10,000 meter. You know that highest point on earth is 8848, that is, which is Mount Everest. So, 10,000 cannot be there, and, this value, we can assign to the computer, it is no data value.

So, once it is declared that value, that 10,000 in a digital elevation model, is a no data value, system knows, and therefore, in any calculation, any analysis, it will treat has a no data value, it will not treat as a numeric value of 10,000. So, there is a 0 is a value, whereas, 0 does not mean no data. So, this no data concept, have to be understood very carefully. You can declare a your own no data value, otherwise the system the standard GIS software’s will declare themselves, the no data value depending on the range of values, and that these value is so far from real values, that system can recognized very easily, and that this is the no data value, not the value, or 0. 0 is a value in GIS.

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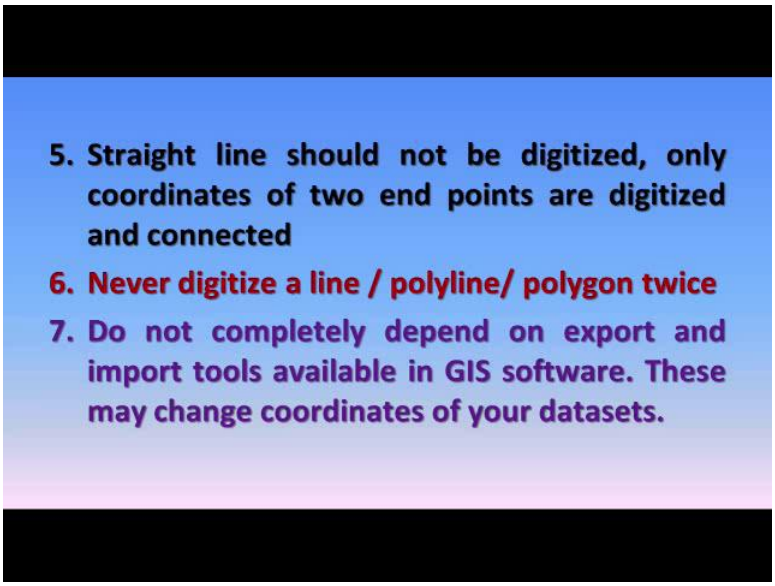

This is another rule, there is straight line, should not be digitized. Only the coordinates are digitized, and then connected. Because if you start digitizing a straight line, you will add few more inter nodes, and that will never be a straight line. So, if it is a straight line, suppose you want to draw a border, a boundary of a steady area, so just 4 points, would be sufficient for a polygon. Rather than in-between you are digitizing, that will bring errors. And a sixth is, the never digitize line polyline, polygon twice. Because a no human can digitize, the same line twice identically. It will change and therefore, this should not be done. And this is, what is a in, while discussing topology, this issue also came, because the common boundary, between 2 polygon, should be digitized only once. If it is digitized twice; that means, it will fall in this one, a line is been digitized twice, and if it is digitized twice, there will be some gaps, and there will be some overlaps, and this will bring artifacts, or unnecessary polygons, which we never intended.

So, the topology, and construction of topology, will definitely avoid this kind of scenario. But if you are not following that thing, not constructing topology simultaneously, then this can become a big problem later on, in your analysis. So, remember never digitize a line, or polyline, polygon twice. And do not completely depend on export and import tools available in GIS software; that means, the convergent tools, or save as tools. Sometimes as Tif file save as Jpeg, you are losing the quality or precision also. So, these all tools, all conversion tools, all export import tools, are not fully transparent. DSF file, if you convert into shape file, it might bring certain errors. And once you have done it is

conversion, check for errors. If found, correct it, or change the tool. So, this one has to remember all the time, that a there, these conversions are not fully transparent. Export import of the data, from one format to another, is also not fully transparent.

So, once the data has come into the system, which was originally in different format, must check for errors, whether it has introduce some errors or not. So, because it might bring certain problems, in your coordinates, this brings to the end of this particular a small discussion, on rules of GIS. Now third one is, in this way a lecture is, whether this side, the term which was originally was given by Roger Tomlinson, which is Geographic Information Systems is it still meaningful, is still relevant.

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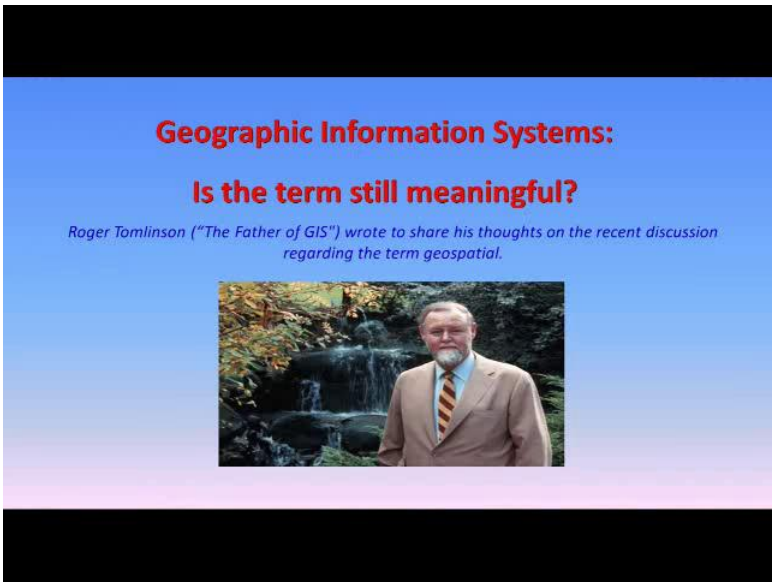

Because a, after that invention, lot of new names are coming, have been coming, is still coming. Everybody is trying to modify this term GIS, to their own you know, benefits or whatever purposes.

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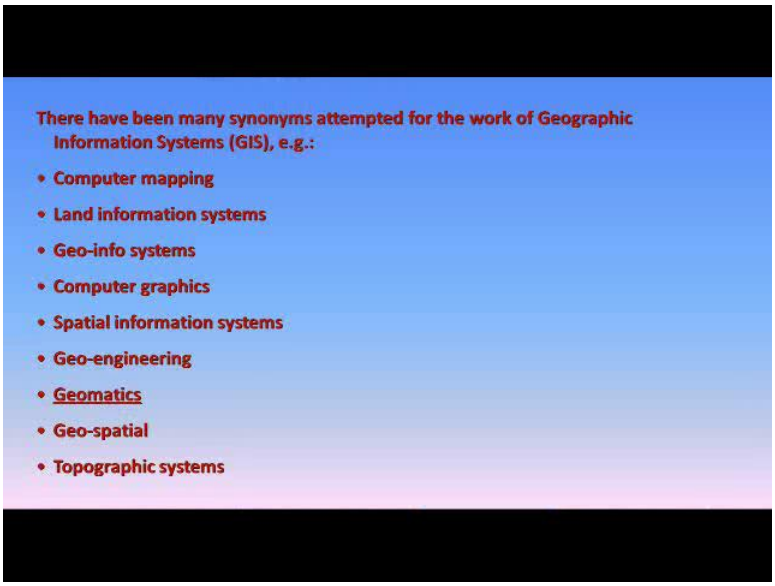

For some people are writing like, instead of writing GIS, they write like, Computer Mapping, Land Information Systems, Geo Information, Computer Graphics, Spatial Information System, Geo Engineering, Geomatics, Geo Spatial Topographic Systems, all kind of names are coming. But that term, is it still complete, still complete by itself, and it is still relevant. This is what, a he also emphasized, that some have different sets of meaning.

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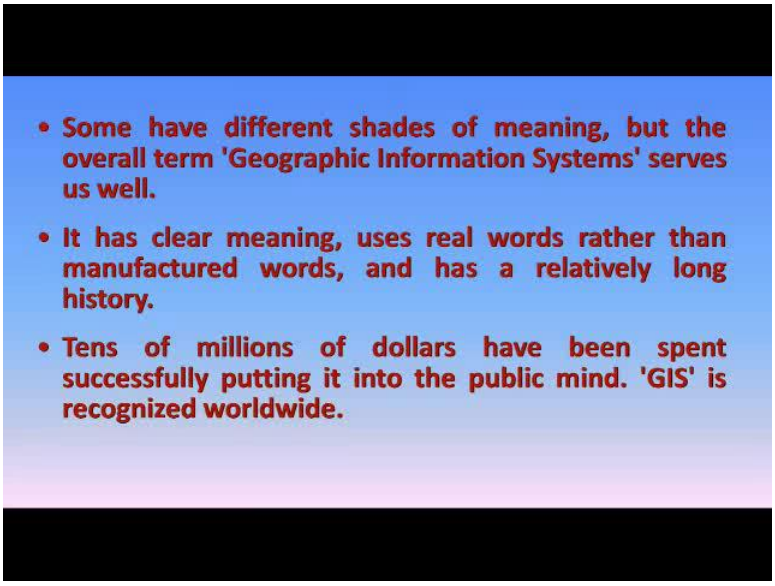

But the overall term, Geographic Information System serves still today. This is, because it incorporates all the tools, the concept as per the definition, everything is there in this one.

So, Geographic Information System in that way, still meaningful, it is. And there is no need for going for all different terms, which might bring some confusion, in the users mind. So, it is a clear meaning, uses real word words, rather than manufactured words, and has a relatively long history. And tens of millions of dollars have been spent, successfully putting into the public domain, the GIS, in recognized worldwide. I can give you an example, like GPS. A person might be using data, from Russian network, which is Gronos, but still they will call as GPS. So, likewise, you know here, the GIS will be still meaningful, and relevant. And the no other term, can really replace the original word, or original concept of GIS. You might be having a custom design GIS, and then people have started giving a new name. So, which is a, which is a very (Refer Time: 18 :50) version of a full GIS. So, though that is giving a misleading information, but it is not substituting, or replacing the term GIS.

Now the fourth topic here, or the last of this lecture, is the, or last of this entire course, is there the future.

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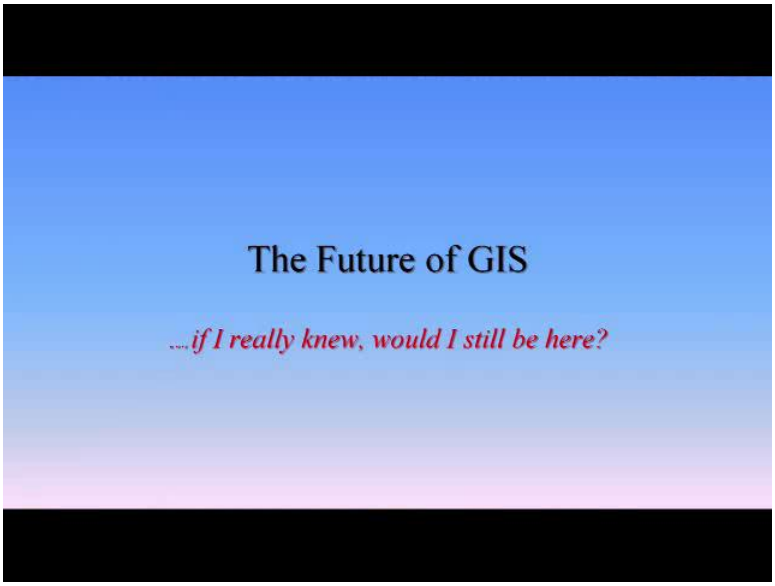

What lies ahead? What is going to happen, as per today's understanding? It is very difficult, as mentioned here, if I, I really knew what is the future; I would, would I still be

here? So, nobody knows basically, what is going to be the future? But, whatever the presence circumstances, present availability of data, hardware, software, and concept we can think something about the future of GIS. if we start looking little past, we will find, that basically the GIS presently, is being used mainly for manage data, that is spatial data, and analyze spatial data, and communicate information, from one end to another, may be through net, may be otherwise.

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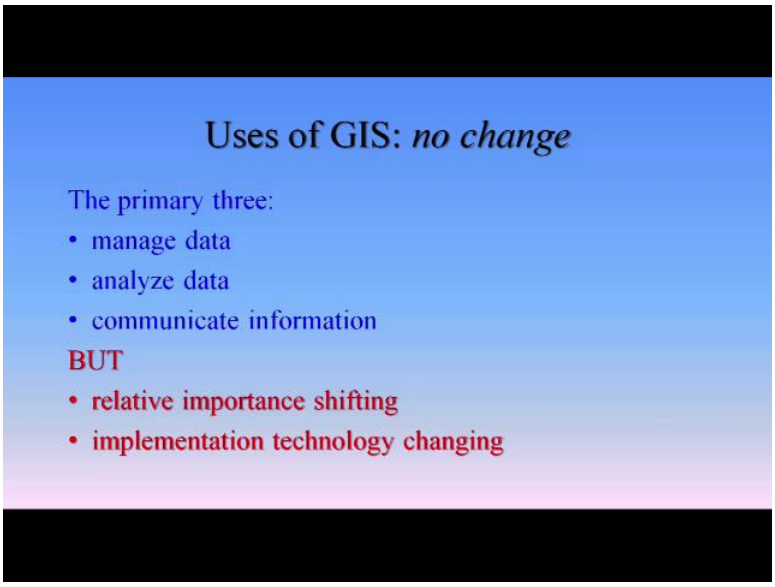

Where, but, where future is relatively, the importance shifting, and it is a getting influenced, by the implementation technology. As the new technologies are coming, the integrations with other technologies are becoming much easier, and therefore, the face of GIS is also changing. So, like few years back, we never thought that we will have a Google map, on our smart mobiles, and we will be using that Google map, as a navigation system. There were used to be a separate navigation system, probably all of them have disappeared now, and Google has come because the updating is done. It is easier, and it works on almost all types of mobile devices.

So, the technology, as the new technologies are coming, whether it is in communication, or in computer, or in mobile. So, it is bringing its impact, or benefit into the GIS as well. And new products, new applications, and new usage of GIS, will be there. The people, those who are using Google map, may not know, that they are using a spatial or custom

design version of GIS, but they are happy, they are using. Another thing is that the changing emphases.

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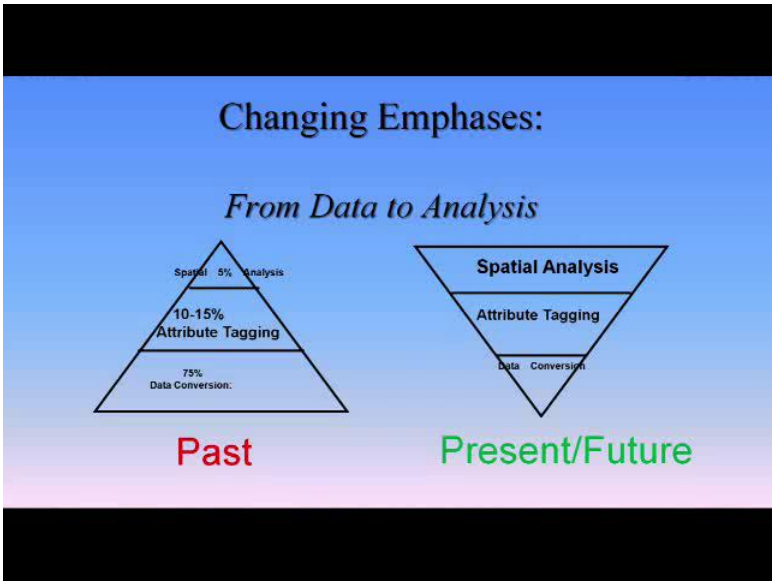

Initially, the lot of time used to spend, on the data conversion. Especially from analog to digital, but now, these data conversion here, it is getting less. That means, now less time is being spent on data conversion, and less resource, and less resource are being, because lot of now data, is becoming available in digital format. 20 years back, this was not the scenario.

So, then, this is inverted triangle, in that sense, and that time 10 or fifteen percent, attribute tagging. At that time, time used to be spending here. That remained almost same. Then, there were less time, for a spatial analysis, or analysis part. Because, lot of resources and time were spent for data generation that too in digital format in a creating a spatial database, nowadays, lot of data is available, from different organization, or on net, or otherwise, and that is fully GIS compactable. GIS compactable means, compactable to standard GIS softwares, if you get the vector file that can be directly seen in your GIS software or if you get the Raster data, you can directly use that one.

So, this is what meaning is compactable. And therefore, in now, or in future, people will be spending more time, on a spatial analysis, rather than preparing everything, for the data analysis, and very little time in energy there is, spend for data analysis, as in the

past. So, this is the future, from basically data, generation, conversion, to now analysis which we are moving.

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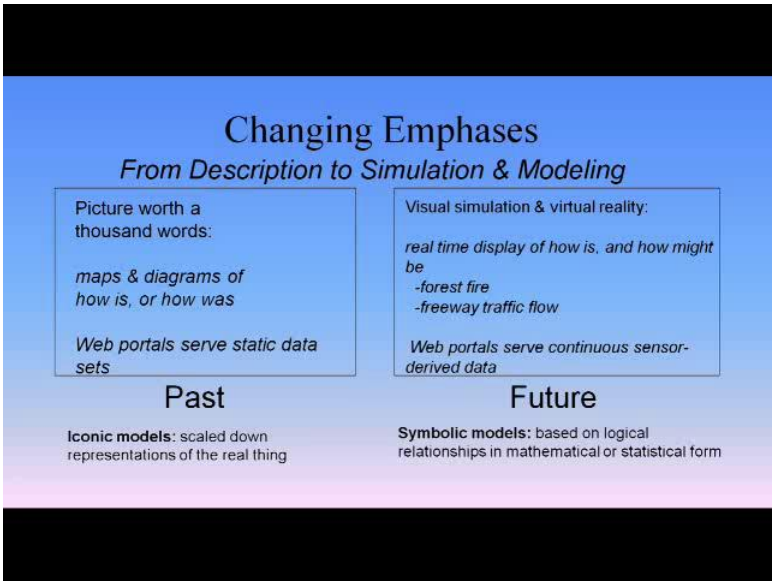

Also, in the past, the emphases was gone the description, now it is going toward simulation model. Just the ultimate aim, if I recall the definition of GIS, at the end it says, the model, an output. So, this modeling is very, very important, because it you can predict something, which has not yet, yet happened, and accordingly, remedial measures or preparation can be done. May be it is related with flooding, may be it is related with earthquake may be it is related with droughts and so on and so forth. So, that is the advantage of having GIS, and then modeling can be done.

Once the database is ready, that is happening now, that lot of data is becoming digitally available. So, now, from description part, we are moving towards simulation and modeling. And this is how, the things are changing, in a, this is the future which we are seeing, that the visual simulation, and virtual reality, real time display how, and it must be. Like forest fire, I will give you this example, or freeway traffic flow, and other information are available. Forest fire, there are the satellites, which are acquiring data almost every day, like more days (Refer time 24:26). And in tandem, it has a modus, in the sense, also in tandem. It is having 2 satellites, Terra and Nekva. So, these satellites are acquiring data, day and night. If somebody is working for a forest fire, at least in 12

hours, every 12 hours, he can get one image, and these sensors are having thermal channels.

So, putting automatic algorithm, detection algorithms, and one can detect the fire. With some human interventions, also a plume can be detected, in day time or night time data. So, that will confirm that, this is this signature is really a fire, and how we can call as a forest fire, because in, in GIS platform we can have a forest cover map of the country or area. So, once a, a, a hottest pot, with plume comes, we are assured that, this is forest fire and accordingly, and things. So, GIS is going in that way, in the real time, or near real time.

Another thing is that, like in, you know this, in Google maps, traffic information is coming. So, there is also almost near real time. How it will, how it is coming, we will see little later.

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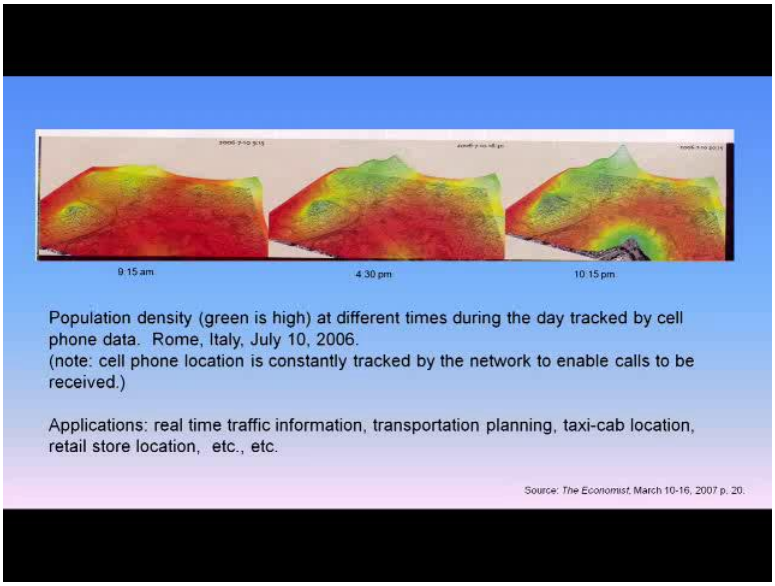

And that comes basically, and through the density of mobiles, which are located there. So, if suppose, along a road, there are you know, the mobiles are not moving, or moving slowly. So, it is assumed that is of traffic is slow, and therefore, in your Google maps you see this, road network in different colors, at patches you will find red; that means, at that location, the traffic is not moving at all, if you find in orange color; that means, it is moving little slower and so on so forth.

So, similar applications are coming, which are using the, the mobile density, or population density, and then putting, like here, the tracked by the cell phone data, and there you know, how things are happening. So, here, in at particular time, this was the scenarios, that reach to the very high, at this example, at 10:15 pm. So, that means, a people were elsewhere, during this time, and that time, now they have a got assembled at one place. So, to looking through the mobile density, one can estimate, what kind of population density is getting there. So, maybe population density of the vehicles, maybe population density of the human, but the input is coming from mobile data.

So, this is a near real time. This is really, not really, near real time, it is happening in real time. So, that this is all the output from GIS. So, lot of applications is coming, which are real time traffic information. I have given the example of Google map, transportation planning, taxi cab location, retailed store locations, and really in the disasters, natural disasters. Like in earthquake, or in flooding, and which occurs suddenly, especially the earthquake phenomenon. And there once such phenomenon occurs, the first thing people start looking, maps, and satellite images. And they are, they would like to have, immediately after that earthquake event. So, that the houses which got damaged, people are in need, can be reached very easily.

So, how to assess? Because one such phenomenon occurs, the accessibility becomes very poor. And all those networks, like mobile and other, power grid and other things, fails. So, therefore, at that time, people immediately resort to the maps, or GIS product, or satellite images. So, there, it is really required, in real time, or in near real time information.

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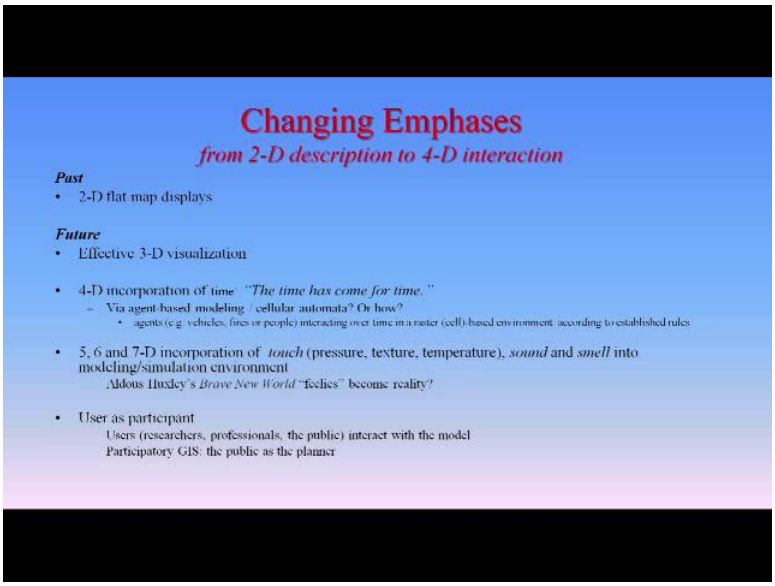

Now, also the emphases is changing from 2D to 3D, or even 4D, time is also coming. Google map is bringing, in that way, 3D, time is third component, and some people are thinking, to even go for more 5D, 6D, 7D, by bringing pressure, texture, temperature, sound, smell, all into your simulations and modeling.

So, this is the future probably, as per today's understanding, about the technology and perhaps requirement. This is the future of GIS, which is coming. As in beginning, it is said, that it is very hard to predict future, but this is what it can be thought at this time.

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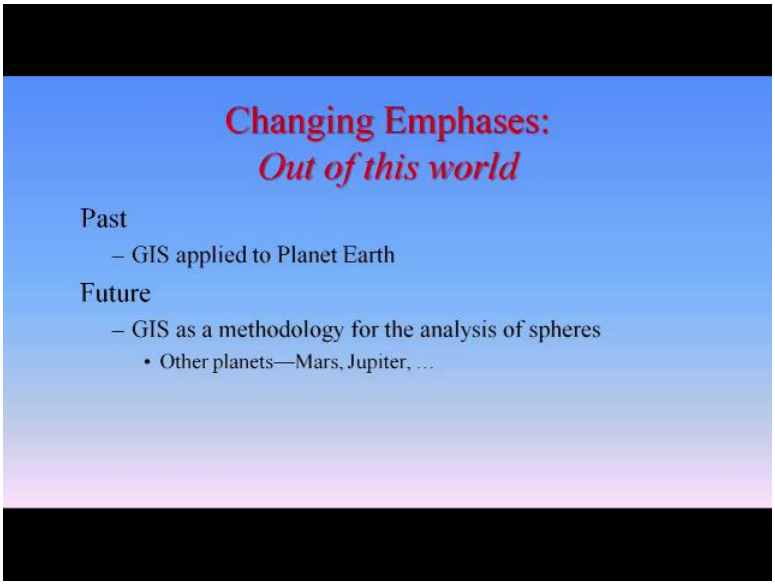

So, past was GIS applied to, this is another future for GIS. GIS was focused mainly on planet Earth, now we are moving towards other planets, like Mars, Moon, and Moon of course is a satellite of Earth, Jupiter and other planets. So, thank you very much, and I hope you have enjoyed this course, on principles of GIS.

Thank you very much.