Practitioners Course in Descriptive, Predictive and Prescriptive Analytics

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Lecture - 05
Types of Models

Good evening students, we are back in the course of applied descriptive, predictive and prescriptive analytics; so practitioners approach. So, we are trying to look at the a called the stuff of analytics from a practitioners view point. And we have been studying different aspects of analytics and why is it important for a practitioner, why analytics is necessary for someone who is working in an industry? That is what we have been trying to answer all this week.

And we studied about systems, models and all those kind of things and the most important thing that was established out of it was analytics is required for in practitioner in the aspect of decision making. It is a tool that helps the decision maker in making the right decisions.

So, to do this analytics you require to study the system bill models, use this models to do the analysis, from the analysis make appropriate suggestions or comments. This models could be descriptive models which could be describing the system or it could be predictive models which could be predicting the future behaviour of the system or prescriptive models which would actually look into different alternative or evaluate different options available with the system.

And so, that using that information that is in front of the practitioner; practitioner can make the right decision. So, we covered a lot of aspects in the previous lectures and today we are going to cover what we call as something the type of models that are available in the system.

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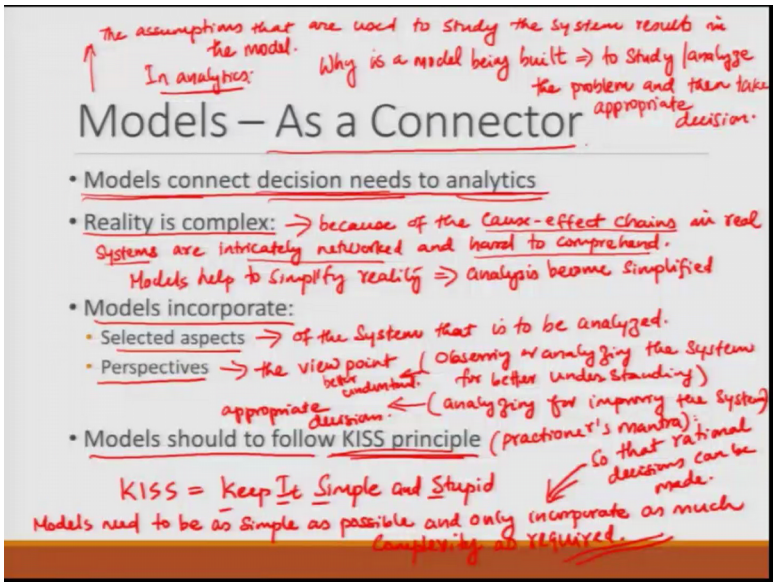

So, we also already seen what is a model and we are seen that the assumptions that are used to study the system; results in the model, we have seen this in the previous lecture. And using this we also try to in our case we also look at model; in analytics model is also it act as a connector; model very well access a connector, why? Because models connect decision needs to analytics.

So, why will you build a model, why is a model being built? To study or analyze the problem and then take appropriate decision; that is what we talk about this why is the model being? So, for in analytics model also connects your decision needs; need to make decisions to analytics. Why? Because in real life; reality is complex, reality is complex because of the cause effect change in real systems are intricately networked and hard to comprehend.

So, as we seen that the cause an effect change of the real system in actual system is intricately network and it is very hard to comprehend them. So, because of these why do we do is models help to simplify reality which results in which in turn becomes analysis become simplified. So, if you make a simplified model you are able to do simplified analysis.

So, what we do is; what do models do? Models incorporate selected aspects of the system that is to be analyzed; you only analyse what is necessary, we do not need to analyse everything. And it also involves what we call as perspectives; perspectives

means the view point. You might be just looking at; observing or analyzing the system for better understanding; that could be one option. Then you might not do much, you will be happy if we can understand it better; some people will be analyzing for improving the system.

So, in this case you will be making decisions; it will result in appropriate decisions. Here you might not do anything it might just result in better understanding. So, the perspective of the system, the perspective in which you are modelling will also determine or the model incorporates what prospective you are trying to bring into this.

The models should follow what we call us the KISS principle; KISS does not mean that going around kissing people; KISS stands for Keep It Simple and Stupid, this is what the KISS principle stands for; Keep It Simple and Stupid which means model needs to be; we can say that models need to be as simple as possible. And only incorporate as much complexity also required, do not overdo the complexity of system why?

So that rational decisions can be made while in academic interest you might be interested in making the complex model, but for a practitioner this is the biggest principle. So, this is the practitioners mantra in my opinion; Keep It Simple and Stupid; only study what is necessary to be studied rather than trying, you are doing research and another aspects of different story, but for practitioners who is looking at using to study the system in which some pretty much go out of the system can be reached. Try to build the model only to the level of detail that is needed and do not add unwanted complexity; just make the complexity as required by the objective of the analysis.

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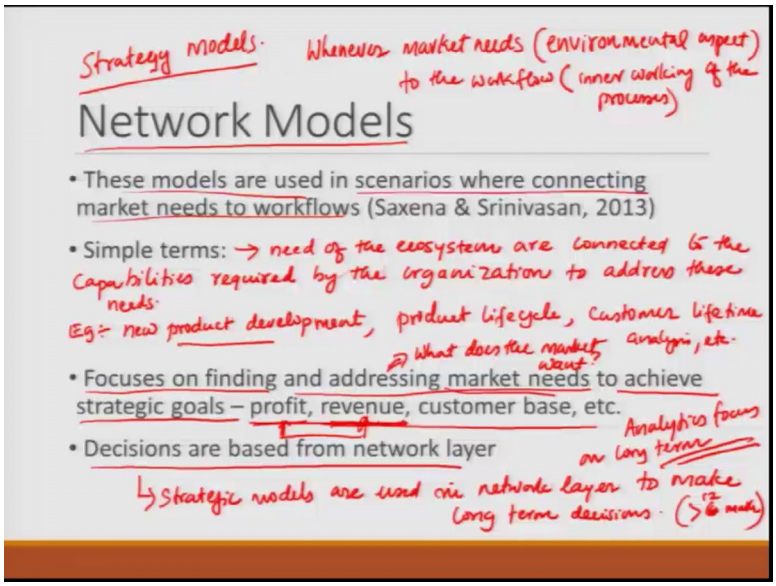

So, there are different types of models; so, let us talk about the first model or what we called as the network models. Sometimes it is also known as the strategy models or some people also called this as the long term models or whatever it is. So, typically Saxena and Srinivasan defines this network models, these models are used in scenarios where connecting market needs to workflows.

So, whenever you have to connect market needs; whenever market needs which is to a large extent it is usually an environmental aspect. When you have to connect the environmental aspect called market needs to the workflow; workflow is the inner working of the processes, When you want to connect the workflow and market need or connect the environmental aspect with that of the inner working of the system.

Then that is where we use the network models; in simple terms we can say that the needs of the ecosystem or the environment are connected to the capabilities required by the organization to address this needs. Classic example of these; some example would be include new product introduction, new product development, product life cycle then customer lifetime analysis etcetera.

So, an example of this would be new product development; when Tata developed the Tata Nano; the question; obviously, is that there is a need for a cheap car in the country. So, that is the need of the country or the ecosystem of India and that are set aside a resource to produce a small car; a family car which would actually meet the

transportation need of a common man; this is how Tata Nano was produced. So, we will look at the need of the society was to have a cheap car and the network model was how to build capacity within that company to build such a small car so, that the common man can buy that car and fulfil that need; so that is an example of a new product development.

Another example is product life cycle; sometimes you might, one of the most popular model is India is Maruti 800 and it was very popular and after some point of time Maruti 800 was stopped in India. So, when did the company decide when to stop the production of Maruti 800? The answer was that when the regulatory norms came in and said that is it cannot be meeting the crash test and as well as a safety standards and emission norms, then the car cannot be sold. Then Maruti figured out that fine trying to change this model to fit this is too expensive; it is better to always build a better model. So, that is the time they said we are stopping the production of Maruti 800.

So, the lifetime the life cycle of the product was determined by various environmental aspects there; like the regulatory bodies, as well as the cost of making its safety or safety factors been be integrated into system etcetera. So, in this kind of a system; network models we are mostly focusing on taking decisions as per the requirement of the ecosystem or the environment.

So, what do we focus here? We focus here on finding and addressing the market needs; what do the market want? This means what does the market want is the major question that your address here. And once you understand what is a market need, then you try to achieve that market need so, that you can get your strategic goal; so, why would Tata build Tata Nano? If lot of people buy Tata Nano then it will increase the revenue and if the revenue is increased; this will in turn increases the profit. So, increasing the revenue is in a large extent; increases the profitability of the company; so, that the company will grow.

So, that is the exam; that is reason why they jumped into that kind of aspects. So, most of the decisions; remember we studied in the previous class about network layer and as well as the workflow layer, control layer the kind of aspects. So, these decisions; strategic decisions, strategic models are used in network layer to make long term decisions. The decisions are usually of long term; when I say long term greater than 6 months is what I

am talking; not even 6 months let us call it as 12 months; more than an year; 6 to 12 months, 1 year, 2 year and that kind of a decision we are talking about.

So, the network models are where you are trying to address. So all the analytics that is done here; so the analytics in network model; analytics focus on long term decisions. So, here you are looking at the long term behaviour of the system.

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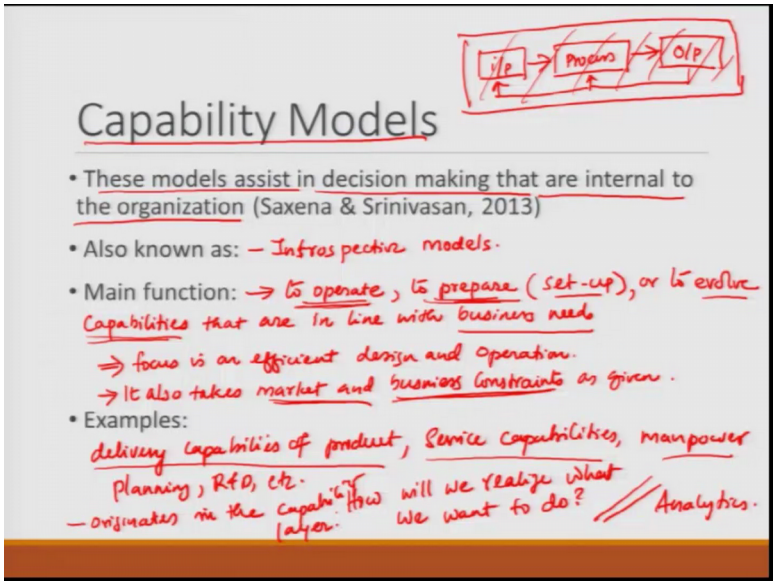

The second set of model that we are going to talk about is called as the capability models. So, the capability models as defined by Saxena and Srinivasan as these models assist in decision making that are internal to the organization. So, if you want make decision that are within the organizations; so, remember we had this input process, output and we had the feedback loops and we had the boundary of the system.

So, everything within this boundary that we are talking about the internal to the system that kind of decision making which is called as that is where we use has the capability model. So, hence it is also known as introspective model; you are doing introspection or you are thinking about yourself.

So, what is the main function of this introspective model? The main function is to operate, to prepare or what we call as setup or to evolve capabilities. The main function of this models is to operate, to prepare or evolve capabilities that are in line with what? Business needs; so here so, whatever is business needs your aim is to build capabilities to

evolve capabilities or to operate capabilities or to prepare capabilities or setup capabilities.

So, your business needs; so, in a way it is the focus point; the focus is on efficient design and operation. And the major other aspect is like; it also assumes, it also takes market and business constraints as given. So, assume that it assumes that the market and business is known and the constraint is not those you already study that we know it. And given this; given the market on the business constrain, how to operate, how to prepare or how to evolve the capabilities to fulfil the business needs? The how aspect is what is being focused on?

So the undertakes typically focus on the operational side or the preoperational side or the evolutional side of it. So, the example of this is delivery capabilities of product, service capabilities, manpower planning R and D etcetera. So, when Tata Nano was planned by Tata; they need to decide now if you are going to build so, many cars; how will be deliver this car to the customers?

When we deliver the car, the customers start using it; how will we do the service of this car? Where will the customer bring in? Where will be the service locations? And what will be the manpower? How much more additional people we require to build this factory; run this factory? Where will we do the R and D; thus these kind of aspects, so we will think about it; this is more about how will we realise what we want to do. The analytics typically focuses on this and there are wide variety models that are used in this area as related to this kind of an aspects.

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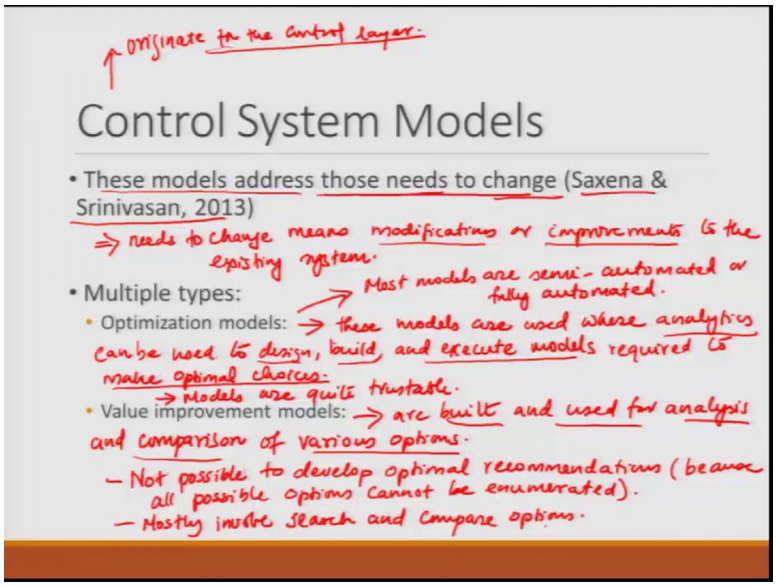

Now, we talk about the third one which is called as the control system models and Saxena and Srinivasan talks about control system models are; these models address those needs to change. So, the most interesting part of this is; by the way previously in the capability model it is in the; this originates in the capability layer. Similarly, the control system models they originate in the control layer of decision making.

So, when you talk about you know address the needs to change; so when do we need; needs to change? Needs to change implies; needs to change means modifications or improvements to the existing system. We are working on an existing system and there is some need to change, some modifications have to be done and what are that modifications or what are those improvements to be done on the existing system? Control system models actually help in this and they originate in the control layer. And there are actually four type of these models and we will deal with each one of them, we can look into them what they are.

So, the first one is called of the optimization model. So the optimization models are defined as these model are used where analytics can be used to or design, build and execute models required to make optimal choices. So, whenever you want make optimal choices; the best set of the parameters when you want to do; so, if this is the place where we use analytics to build to design, build and execute models that will help in making the optimal choice. So use this model, it will tell you what is the optimal choice associated

with that particular situation. So, here the most important thing is these models are trustworthy; models are quite trustable. Another aspect of these models is that most models are semi automatic or fully automated.

So, an optimization models are heavily used in industry to optimize the production, optimize the inventory, optimize this optimize the other got lot of optimization does. So, and these models have a high level of trusting because of the rigger that is gone behind it. And also this motion of models is semi automatic or fully automatic because once you designed it and built it; the execution aspect of it is mostly can be done with the help of a computer can system.

Second when we are going to discuss is the value improvement models, value improvement models are built; these models are built and used for analysis and comparison of various options. So, we build these models; we build and use these models to analyse and compare various options available in front of us. It is not possible to do what? Not possible to develop optimal solution or optimal recommendations.

So, the value improvement model does not help in doing the optimal recommendations why? Because most of the time the options are not exhaustive because all possible options cannot be enumerated. We cannot enumerate the entire more options and hence it is not the optimal, but it is good enough decision as far as you are concerned. Second part is that; so mostly involved search and compare options.

So, you are basically looking for or searching for some of the options are available what is the and analyzing these options and you are trying to save what from the available options this looks like the best option. But we do not know is there better option available because as of now that option is not considered. A classic example of this is like let us say there is 5 machines in a factory and you want to maximize the utilization of a lathe machine.

So, you do not really care about what is going on be before the lathe machine and after the lathe machine. Instead you look at the different options in front of you like coming up with a faster tool or quicker; different tool bed operating the process or changing the process using the different type of material; those kind of things. But doing that how it will influence the other options? You do not really know, you might not even mark consider the option of coming with the complete the new manufacturing process.

So, hence the value improvement models is focusing on what is available in front of you and how can we use that; what are other options available in front of you to improve the value of the existing process.

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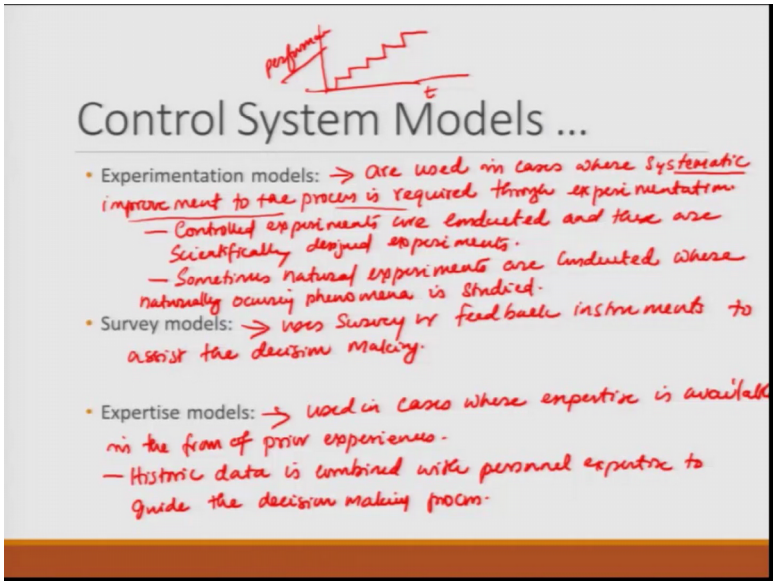

Then what we have is the control system models continued; I said the next model is call as the experimentation model and they are used in cases or in places, where systematic improvement to the process is required through experimentation. So, what we are saying here is that we pretty much conduct experiments or controlled experiments are conducted and these experiments; these are scientifically designed experiments.

So, your aim is to systematically improve; you improve the process 100 time. So, graphically if you want to think about the experimentation model; it would look like this, start at some point; it will improve like this, systematically you will keep on; as time progresses; you will, the performance of the system; you will keep on improving, you are systematically improving. So, you will go from current position to the next best from there you will keep on improving. Some people also call this as sometimes the continuing improvement models also; that is also said in that way.

But to do this, you have to do controlled experiments and this controlled experiments are scientifically designed because from analyzing the data that you are getting from that experiments; you can use it to improve or you can use it to improve the current state of the system. Also second aspect is that sometimes natural instead of controlled

experiments, natural experiments are conducted where naturally occurring phenomena is studied.

So, in our case what we have think about here; you should understand here is that if you are studying trying to study the pollution in the river Ganga or erosion of the banks of the river Ganga. Then, it is a natural process that is happening; so, you will go there systematically collect the data, you will not do experiments you just collect the data use analyse the data and come up with the model that determines the pollution of the river Ganga or the erosion of the banks of the river Ganga; it is not a controlled experiment so, natural experiment.

On the other hand, a controlled experiment would be you want to find out what is the best combination of fertilizers and irrigation to a particular field; excuse me then what will you end up doing is, you will divide the field into many small parts; in which would put the same type of seed and you provide different amount of fertilizers and water to the different sections and you see the outcrop output of it. And whichever area that gives you the best combination of the fertilizer, sunlight and water which give you the best yield that is probably best setting for that particular thing.

So, once you do that then you will implement that across the hall field and then you want to further improve it, then you will bring the concept of the we decide; which type of we decide you want to add into that. Then you systematically do the experiment on the previous settings to find out which setting work for the best we decide and you continue like this. So, such type of models where scientifically designed experiment; which are controlled experiments that is the another aspect. So, we can do controlled experiments or you can do natural experiment.

Then comes the next one which we called as survey models; so, survey models the idea is that uses survey or feedback instruments to assist the decision making. This is quite common because many of us as seen this when you are done with a particular live when you finish on air travel; the air lines will send you a survey saying that please fill the survey and tell us what was your experience about their travel, did you like the cleanliness of the aircraft, was the crew courtesy to you, was the food good; all those aspects comes out of this.

And based on the feedback there is provided by the customer and all those feedbacks are collected, collated together and from there they analyze and figure out; how good, whether the customers were on an average satisfied by the service provided by the airline agency or not.

So, that is called as a survey model and then the next one is what we called as an expertise model or expert model or expertise model. These are used in cases where expertise is available in the form of past experience or prior experiences. For example, if Air Bus; the company that built aircraft, they want to build a new aircraft they will definitely take from their prior expertise on building other air frames.

So, they might like to unless they want to build a like a regional jet kind of air thing, then they will take one of their existing loan smaller aircrafts and then they are trying to convert it into regional jet aircraft because they are trying to draw from the past expertise. They already established that this air frame is pretty good; so then from there they can use that expertise that the gained in building that air frame and then the build a new one out of it or modified out of it.

So, the best thing is there here the historic data is combined with personal expertise to guide the decision making process. So, you will probably find the chief designer decision making process of Airbus being asked you want to build this particular thing here is a history data now you advise us what to do. So, this type of models where an expertise past expertise is used to do something in future is also; this also a part of a control system model because you are trying to build capability gain here; operate or make the system better.

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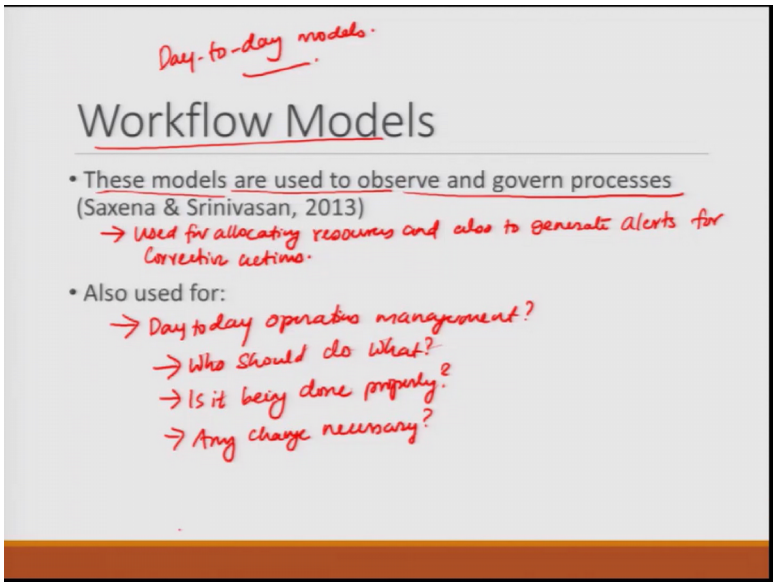

Then the last one is what we call as the workforce model or the workflow model. The workflow model, these are defined by Saxena and Srinivasans as this models that are used to observe and govern the process. So, the aim here is that you are going to observe and govern the process; you can also think as day-to-day models.

Here you are trying to think about the day-to-day operations of the system and you are focussing on the analysis or analytics that will help you in doing the day to day operations in a better way. So, the main aim of this is used for allocating resources and also to generate alerts for corrective actions.

So, if we decide that today we have to build 10 cars Tata decide today we are building 10 cars; then which are the people who will be working on getting the 10 car. And if during the process, if you see that one of the painting job of the car is not doing very good; then we generate an alert saying that the people who are working in the paint shop need to be more careful about this aspect; so, this is the workflow.

So, we are worried more about the day-to-day operations. So collecting data, analyzing data for managing the day to day operations is called as a workflow model. So, these models are also used for what we called as a day-to-day operations management. Answering questions like who should do what? Is it being done properly? Any change necessary? All these kind of things are considered as part of the workflow models.

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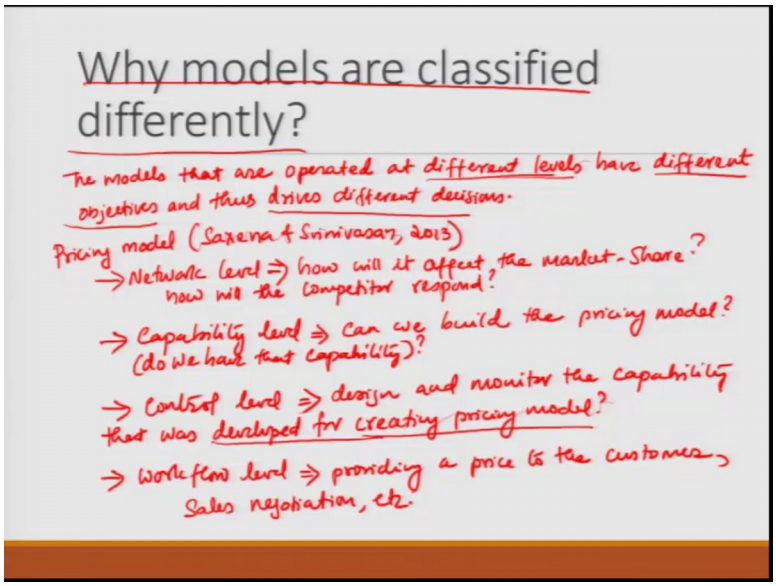

Now, the obvious question is that why do; something that we are always asked is why are these models classified so differently? What is the need of classifying the model so, differently? The reason is the models that are operated at different levels have different objectives and thus drives different decisions. So, the model that are built at different levels; whether say the network level or the control level or capability level; they will have different objectives; the objectives or the models are different.

Even though they might all be trying to do the same thing and hence it will drive different decisions. So, let us take an example; of what we call as the pricing model, this example is provided by Saxena and Srinivasan, 2013. The pricing, if you look at the network level; the obvious question will be like one of the thing will be how will it; the objective will be how will it affect the market share?

Or it will like how will the competitor respond; so, the pricing decisions that are to be done at the network level are at this case. If you increase the price of the product; is it going to reduce the market share? You increase the price of the product or decrease the price of the product; how is the competitor going to behave? How is the competitor going to do that? So, that is the one aspect of it.

Now, if you look at it a on the capability layer or capability level; the thing would be like can we build or do you have the capability to build the pricing model. The question is do we have the capability? We do not have that capability, what we need to do to build that

capability. So, we said fine we want how a pricing model to be build to predict the to increase or decrease the price of the car; then do we have the capability, if not what do we need to do to build the capability. But at the level of the control system or the control layer; control level what we do is that here the aim is that design and monitor, the certain monitors the capability that was built; that was developed for creating pricing model.

So, here what we are doing is we are trying to see; go ahead and decide to build up pricing model. We decide to put in the capability to build a such a model then the control level will be to monitor whether this capability that we built to develop the pricing model is it working properly? Is there anything need to be done? Is there something going on wrong? If so, what are the changes are to be build.

At the workflow level, lastly workflow level the questions is more about the customer is coming providing a price to the customer. Price could be a negotiation also; it could also be about sales negotiation etcetera. So, if you go to the shop and say I am going to buy 1 car; here are the discounts, I am going to go buy 100 cars. So, then come across a different discount pattern, but that is done at the sales manager at that particular level also it does not have to go to the CEO of the company.

So, the workflow level it will be more about dealing with the customer on a day-to-day basis. As a control level is about monitoring the pricing model, the capability level is the question of whether you want to build a capability or not. And in the network level or strategic level where we are talking about is that by building; by changing the pricing, how is it going to affect, how is it going to change the market share of the company.

So, the same question of the pricing at different level will have different objectives. So, that is why models are classified differently and because at different layer it has different objectives; the associated analytics associated with that objectives are also different. Now, coming to the conclusion of today we need to just talk about the stakeholders in the decision making.

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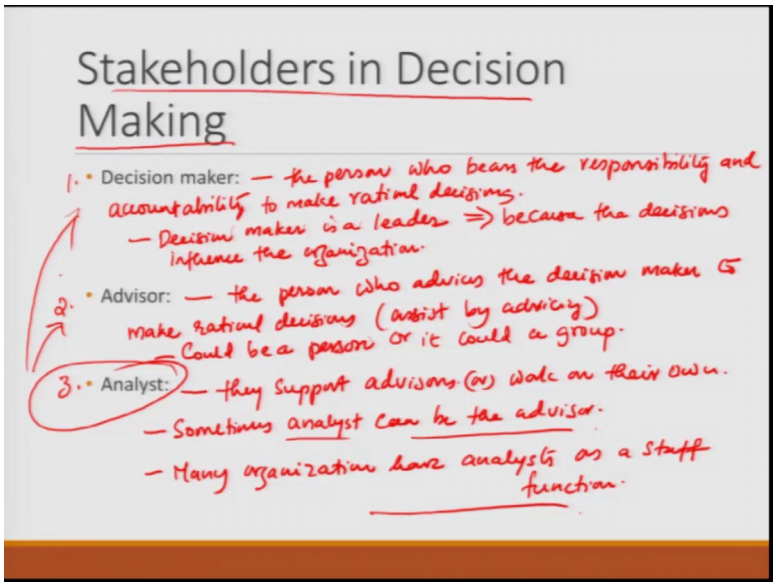

And in this case we are going to talk about just the three important stakeholders in the decision making. The first one is called as a decision maker and decision maker for us is the person, it can be a committee also; the person who bears the responsibility and accountability to make rational decisions. So, here the decision maker is a person who is responsible for making the rational decisions and he is also accountable for the rational decision making.

So, typically decision maker is a leader and because why is it called as a leader? Because the decisions influence the organization; so the person with whom the responsibility and accountability to make rational decisions; is basically called as a decision maker. And that is the person who makes the decision and with whom the responsibility of the decision remains.

The second one we are going to talk about is a advisor which is the person who advises the decision maker to make rational decisions or assist by advising. It could be a person or it could be a committee, could be a group. So, typically the job of the adviser is to provide advice to the decision maker so that or provide advice that will assist the decision maker in making the rational decision.

Then the third one what we talk about is the analyst; so, they support advices typically analyst are multiple; advises or work on their own. So, sometimes unless can be the advisor this is possible sometime the analyst can play the role of the advisor. Many

organisations have analyst as a staff function, when we say this is a staff function what is means is that; this is dedicated staff who will do the analysis and come up with an analysis and on that analysis is transferred on to advisor, who will look into that analysis and interact with that analyst and then that advisor based on these data will update the decision maker and advise the decision maker on how to make the rational decision.

So, these are the major three stakeholders decision maker, advisor and analyst and basically this course is primarily focused on how the analyst will do things so that the feedback goes into the advisor and to the decision maker. With this, we actually conclude today's lecture and from tomorrow onwards, the next lecture onwards we will actually look into data, the types of data, scales, sampling, hypothesis testing, statistics, display of data and those kind of aspects.

So, I hope you guys have got the basic foundation necessary to understand and appreciate; why analytics is required for practitioners for to address different problems and different level of decision making. As you move up and down in the corporate ladder, your decision making, responsibilities and accountability will change. And depending upon the higher you go up in the corporate ladder; higher will be your responsibility and accountability. And hence it is usually better to depend upon data driven decision or data and appropriate analysis to take this decisions so that decisions come across as rational decisions.

Thank you for a patient listening and we will see you in the next class.