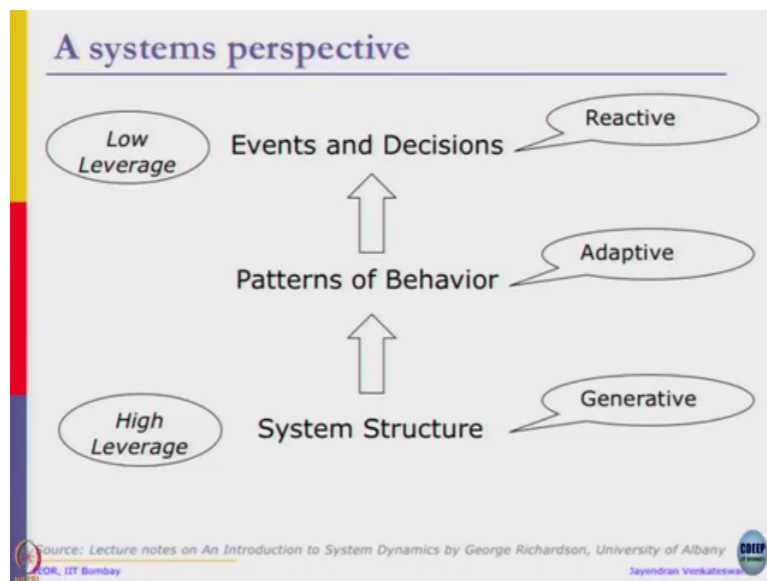


Introduction to System Dynamics Modeling
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Introduction
Lecture – 1.1
Introduction to Systems Thinking

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We are use to seeing events and decisions in our daily lives. If you looked at newspapers, tweets, Facebook posts whatever it is you mainly highlight all the events that is happening around, and newspapers, and news channels highlight various decisions that has been taken there are response to events and anticipation of some events are things like that.

But that has been the primary focus how we have being looking at things, where it is things are happening like a discrete set of events that has been happening. And everything is a news

for some time after it disappears some our radar, some other news that catches on. So, that kind of view we call it as an event oriented view, right, where focus is for a on only one particular few events and few decisions often seen as being disconnected with each other, right.

They are given a newspaper that has so many articles there is going on, but when we read it we read it like it is all different events because nothing do with each other. Some maybe rightly so, some maybe not. We are not really sure, but we do not look at things that fashion, we look at things is disparate set of events that is happening a different places with different people for different problems, actions.

But in the systems viewpoint what we encourage to do is to look at what is called as this patterns of behavior. What we mean by that is do you want to see how things are evolving over time. So, it is not just disconnect set of events, but the things are actually changing over time. So, that aspect is what we call as patterns of behavior that we are interested in whether things are going to be improving or things are slowing down or is it just happening in a cyclic pattern. So, those are the things that we want to understand and discover.

Of course, for more long lasting efforts what we want to do is, right to influence the system structure itself. So, the systems theory or in a systems viewpoint we will come to understand that system structure is what is going to drive the behavior of the system which in turn is going to cause various events, maybe a sporadic events or regular events periodic events whatever it is. But it is an underlying system structure that is driving these behaviors which in turn is causing all of these events, all right.

So, if you want to actually leverage for a long lasting change we need to start looking at a system structure, understand these structures and try to influences the structure itself, maybe it is a policy design or maybe appropriate set of poly system structures. While see you are go to keep reacting to the events and decisions when our leverage point will be very low because, you are only solving that particular problem and that particular instance. But the problem is not gone away it may come back much later, maybe not to you maybe to somebody else.

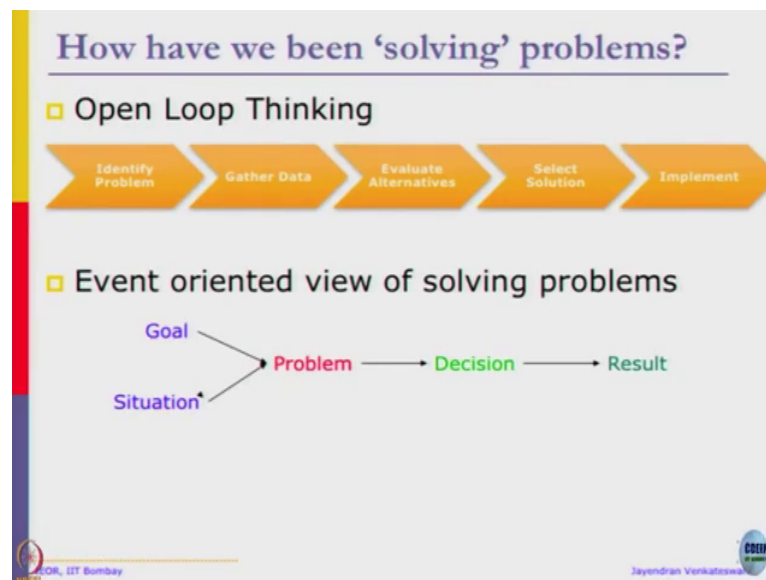
So, this can be actually classified like this also. Like when we are actually looking at events and decisions they are to be reactive. If you are looking at patterns of behavior then we are being adaptive as one simple example of that would be a rainfall patterns based on the rainfall that is occurring. We know it is going to happen.

Every year we do not exactly when it is going to happen, we do not know exactly what date how much quantity, but come monsoon season we are all prepared we get a rainfall we get are umbrella etcetera we have prepared to handle it, right such kind of adaptive behavior that we exhibit. But if you want really result in lasting change then we need to look at generating these behaviors by influencing the systems structure. So, that is what you are going to be doing in this course.

How we how to do this? It is by distancing ourselves away from these events just for enough, but the event start the blur and we start to see the patterns and the behaviors that happen over time and that is one. Second one is we want to see various other component that is also there in the system and how they are being linked with each other.

So, we want to move away from this discreet events view or a view that there are event that is happening in discrete points in time, disconnected to each other, to a view where multiple things that are being connected and how the behavior is changing over time. So, that is pretty much what we were going to do.

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Now, let us see how we been solving problems. Traditionally, we are very comfortable in this what is called as a open loop thinking, where we come up with first to identify some problems, then gather data, evaluate alternatives, select solution implement. So, this is true in not only student projects, but also in real life, people want to a like a new district administration comes, new government comes, we always try to list out that are problems and say ok.

What is the best we can do about it and then suggest a solution need not, solution need not always be the optimum solution or the fair solution or some solution gets implemented and then it gets implemented. Sometimes you have an evaluation etcetera also does not happen improvement may not happen. So, that is a typical open loop thinking that we do. Especially,

when dealing with solving thing which are not connected with oneself. I will come to it in a minute.

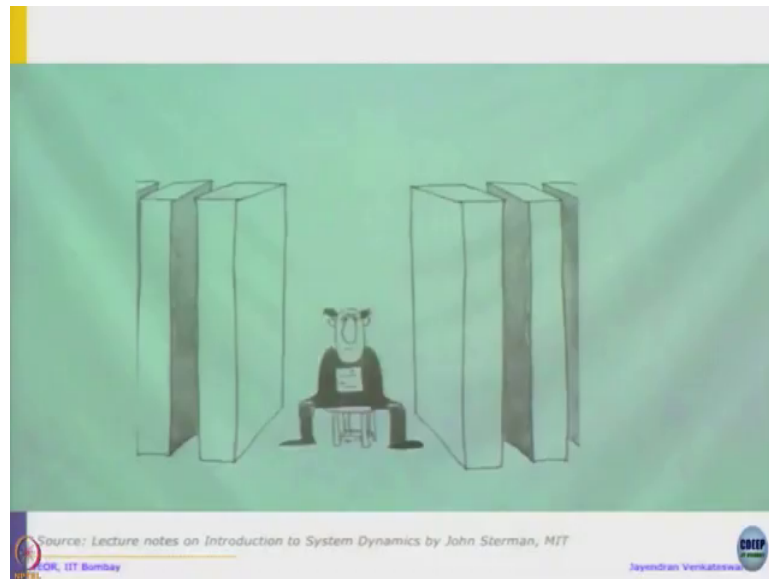
One extension of that is event oriented view we just saw that there are events and decisions happening, so that means, there is already some situation that has arise and we have our mental picture there is some goal for the system. This how it should be and this is where we are, ok. There is a gap, ok. The gap is perceived as a problem that has occurred, ok. Now, how to solve the problem? Let us take some decision. It is will accept it and then we expect that results would happen.

Many times that result may not be what we want right or it may not be lasting long enough to result in a sustained change in addressing the problem completely. Take for example, if the goal is to say that should not be any let us say hungry people in the city, ok. There is a problem that is the situation is there are so many people were without access to good food, and the goal is that everybody should have good food or complete nutritious meal.

Problem was identified you can start a massive campaign and you can cook and give meals to everybody, it will address the problems today or for this round, but people going to get hungry in the evening, then they are going to get a hungry tomorrow day after. So, how do we ensure that there we going to get nutrition will every day continuous.

Certainly the problem becomes much more difficult because it is not a just not question of, they have so much meals let us just cook it and start giving people. So, it will be become little more complex because it is not just a there is not such a can I say a technical solution to all the problem especially when you consider economic, social, environment kind of issues. Let us pause put yourselves in situation.

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Imagine you become a mid-level manager, many of you lose your hair; you cannot help it. Your manager where nicely whatever job dream job working there for the last 15, 15 years we have at 40s then what you do? There is so many problems and so many issues that is coming up every day and based on whatever data you have, whatever the information you have you have to take a decision.

And through the decision what are you going to do is you are going to solve the problem. They are going to push the decision away. You are going to you have to push the problem away like a doing appropriate decision.

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And we will be evaluated for that and probably you will get rewards, management will promote you, yes you have an a nicely solve the problem, sales was down, now you got a rapid the improvement in the sales, it affected my the this quarter's profit. So, you going to get an nice reward and nice what can I say dinner treats and try to various conference that you have an head quarter etcetera etcetera.

So, you do enjoy the outcomes that arise out of decision that you have made and what makes you the manager and you like what you are doing. But sometimes after whatever happen could at some point in future could at some point in future could go all the way around and hit you, but this happens repeatedly, this happens repeatedly. And people are finding it difficult to learn from this. Why? In this figure what we are trying to see is what are decision that you taking today can has something of an impact later.

We know our mind it is going to happen, but we still do not learn from it as much as we are supposed to do. Why is that? Why do you think we do? We are not aware of the system, ok. What else? What else? Limited information, ok. So, we made the decisions keeping short term objectives in mind or short term goals in mind or short term rewards in mind without worrying about the long term consequences or what it would lead to or it may lead to, that is good, may be great. What else?.

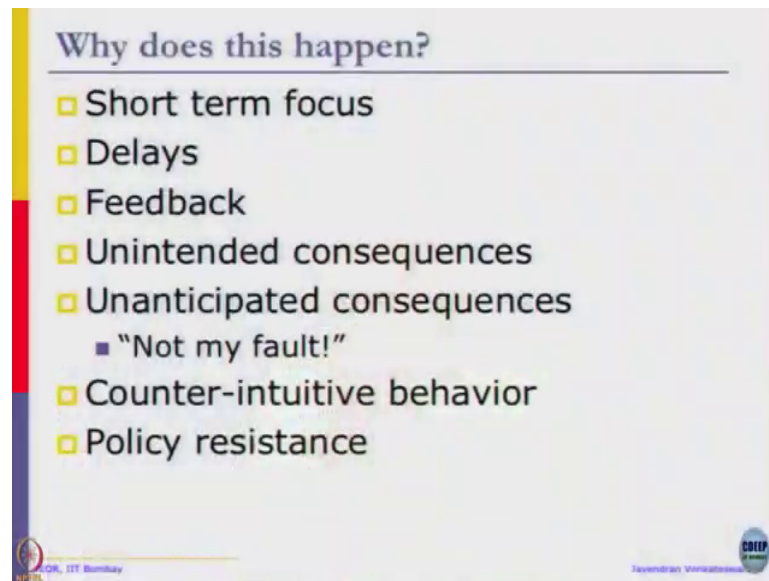
Anything else adding to that when you say short term and long term, inherently what it here addressing is that, there is some sort of a delays. As soon as this start making decision, it does not come back immediately. There is a long delay before things all the consequences of decisions come out. Even if you want to gather data then takes some time.

So, you are taking decision and what all it has to implication and everybody has to react accordingly and then it has to come back. So, after delay there could be a feedback on the system. But sometimes it need not come back to you, you already take navigation you got promoted, so somebody else will be sitting there.

So, that also may discourage would you have, it will be somebody else have problem, I have done it, I have done a good job, but unfortunately that fellow will be a bigger mess and you will be in position evaluate the person and that person cannot even tell you that he is in the mess because of your decision humans are living. So, he has to answer it you why is companies in a mess, right.

So, the feedbacks focus on short term goals rather than longer term or short term rewards rather than long term goals and delays within the system can prevent us from understanding or learning from this as much as we can. What else? And some other points was covered saying you are not aware of the full system structure.

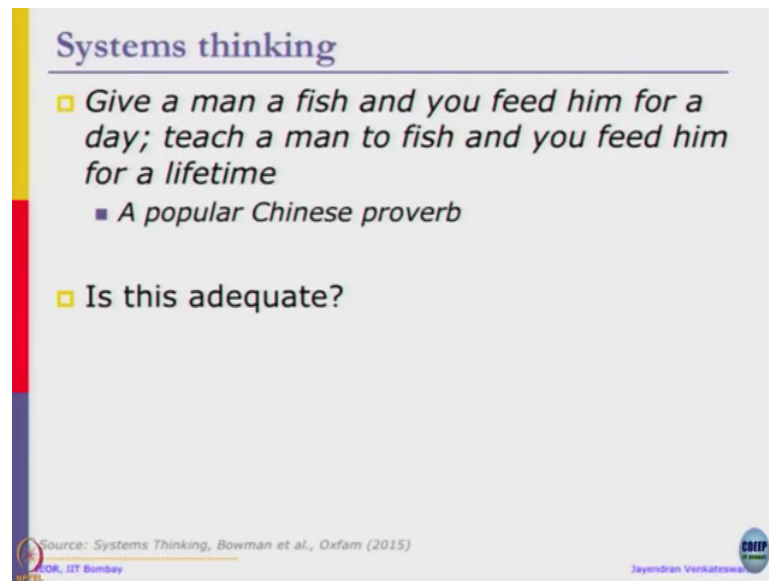
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So, we do have that short term focus, delays, feedbacks, unintended consequences, unanticipated consequences. So, you are not aware, I do not know this system structure, but unfortunately that just cannot continue now. It is not my fault, there is a common adequate, if it all it is you have made the decision. So, but how much can we considered that we will see.

Maybe there could be some counter intuitive behavior and policy resistance gives a nice position, but unfortunately people resist that change that is called as policy resistance or you thought something will happen, but you know the behavior counter intuitive to what was accepted to you. These are the reasons where and the delays and feedbacks, makes it a little more difficult for us to learn if you do not do it to in our systematic fashion. So, what we are going to do in systems thinking? Let us try just try to do bit of system thinking.

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Systems thinking

- *Give a man a fish and you feed him for a day; teach a man to fish and you feed him for a lifetime*
 - *A popular Chinese proverb*
- Is this adequate?

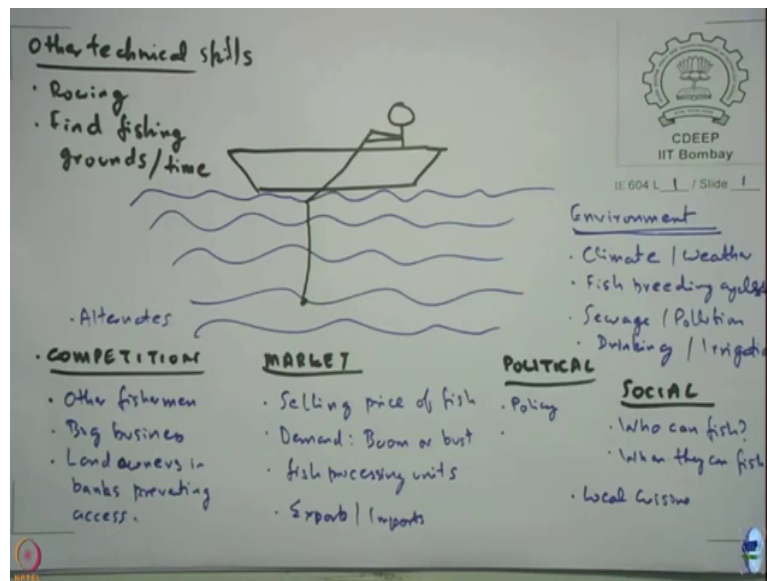
Source: Systems Thinking, Bowman et al., Oxfam (2015)

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Jayendran Venkatesan

Popular Chinese proverb, you might have seen it. Give a man a fish you feed him for a day, teach a man to fish and you feed him for a lifetime, right. You have done any of few much heard it. Is this adequate? You teach a man to fish nice technical skill that has been given to the person, is it sufficient, so that he earns his lively food for a lifetime.

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Let us see. That is go up to here. You got man to fish. The question is this adequate? What are other things that can affective to you know solving this seed for a lifetime. What are other things that can affective? We (Refer Time: 15:38), ok. So, more technical skills. So, what you are saying is the other technical skills, rowing, ok. What else? You should know where fishes are, find fishing grounds. What else? Grounds slash and this going to happened here, ok. So, let me just write environment here.

Let me just put climate, weather, fish. Tell me, ok. Now, we are getting somewhere, now we are getting somewhere. Where we are all can be face competition, competition from other fisher man, competition from big business, right. We got we got fish, but then the huge business are come and behaves few boats and ships and trollers and I know all the fisher amounts, so much in land, so much offshore that will become difficult.

So, big business can be completion other fisherman, similar to him can give to completion. What else can affect? What about owners in banks preventing access, prevent. Anyhow large water body and there is land around it, people can just buy of that private property and preventing access him going there, right. It is not very aesthetically nice to see people going and fishing (Refer Time: 19:03), they have calm lake with nice views, right, ok. It can happen that is again a combination for you to do it. What else?

Now, you are getting somewhere. Price of fish, let me put it under market. Selling price of fish. What can happen to the demand? Let us just keep it both ways boom or bust maybe there is a huge growth a suburban or city or the population the nearby areas and you will demand for fish increase whereby supporting a business or maybe demands fall it down due to stop eating fish or whatever reasons, maybe demand went down we do not know it, right.

We went can be either way or there could be other things also like for example, maybe government come with policies to promote let us say fish processing units, fish processing units meaning there is small unit, so that means, that increase your demand. So, they can get the fishes and send it. What else? Now, we are getting somewhere.

Sustainability of the business, how? That happens in the fish breeding cycles. What we are only referring tools can be capture under fish breeding cycles, (Refer Time: 20:59) fishes and all that apart. Let us put a political policy. What is happening to our provolone? You have pass through it so many times. Pollution that can affect the marine life, that can preventive from engaging and fishing business. Then what happens in the river lake?.

River lake also people going fish because water is used for drinking or some cases suppose if rivers or somewhere water can be sent away for irrigation. People will diverted then a people once like a another reasons where dams are being discouraged in the rivers where is one it will affect the flow of say for say for example, even the sand, as well as it is going to prevent the moment of fish.

So, if traditionally farm fishermen where along the coast and near the delta region they are going to get severely affect and if flow of fresh water is getting stop and getting diverted for irrigation and other purposes, right. That is, what else? What else? Anything on social? Maybe this is social and cultural norms, it dictates who can actually fish you cannot train, you may not able to trainee anybody to everybody to go on fish.

There will be some cultural norms now who can actually go and fish or when they can fish, need not, everything need not be driven in a very what can I say. So, based on as I told fish breeding cycles or checked then based on that it need not happen, just based on cultural and social norm things can happen. Local cuisine so, that can (Refer Time: 23:56) market or social.

Now, this write it here. Maybe it is abundant amount type of fish, but that is not consumed locally and you are unable to export. So, the policies, then exports as it imports. Very important fish are, imported fishes are cheaper. It is going to affect your competition or may be are going to fish and send it to export market, maybe here is gives demand, so that is also good for you, right. So, all are listened, I do not know what is alternative process but let us just write alternate. I just write alternate, anyway.

So, now, you have got an idea, right. It is we are all doing IIT, all are engineers, at least engineer by training. Most you have done a bachelors engineering. We have been used to looking at a problem in one way and find a solution to it. I have a technical problem, I need to increase employment, there is a nice opportunity, statistics shows that (Refer Time: 25:17) many fisherman let us start training as many fisherman as possible that need not base sufficient either.

But expecting them to understand all these things and operate at the level of a training it is also may not be possible. What we must teach people with capacity, so that they can adapt and changed and improve because we do not know how these things are going to come. Some places there may competition, some maybe not, some may there may have market, some may not have market.

So, there has to be opportunities some facilitations to be done, so that we can look at it from the more systemic view point, so that we can identify the correct leverage point and attack there, is it because of policy issues that has happened, is it because the demand is not there, is it because of export restrictions that because of a lot of big businesses that is there. Trying to understand the cause is always required before we can start teaching people to fish and expect that they are going to increase, get their lifetime, they are set for life only based on this technical skills that has been provided that environment is not (Refer Time: 26:26).

If you say for example, building a bridge or building this building, the steps are known maximum it can be delayed because of various reasons, but we know, first we not make a big whole, lay the foundations and then sequentially things come we do not do electrical wiring first. You get the civil structures in place and then work it out. You get the designs and place, and then you know the sequence you know what is going to happen, right.

So, that is we are sure. But if any come to social, economic or political system we do not even know what are all the elements that has there. So, it is difficult for us to sequence them. Take your own life, what it is according completely according to plan? Like when you are young yourself (Refer Time: 27:22) is what I am going to do, this month, next month, next year, next decade everything is laid out. Maybe your, maybe your parents side I do not know, but whatever it is it did not happen.

We are all here not by design or not by your plan which was done long ago, it has not a linear way I have to do, let me do all these things in sequence. It is never is. But what you did, first you adapt it based on the opportunities presented, challenges presented and your own broad goals that you have in your life you adapted to the current opportunities, current challenges and make decisions and then moved on with your life or moving on with your life, right.

So, when it is true for us and we are going to be designing systems and solutions which is affecting not just what can I say I went to build a bridge, I have build a building, it is not just building the building, people are going to use it, it is going to stay there. So, it is also going to

interact with that environment and you know (Refer Time: 28:27) consume water and electricity and people are going to come in and out.

There are so many buildings in Mumbai where I am sure you will feel that building is so nice everything is nice, but approach will the 1 kilometer before the building it shows narrow and congested it cannot support may be 1000s of people are living in the building for example. And the building is also contributing to the traffic jam and other thing that has happened. So, trying to understand that and plan, so as needed.