Introduction to System Dynamics Modeling
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Casual Loop Diagram Part- 1
Lecture – 2.2
Guidelines to build CLD-I

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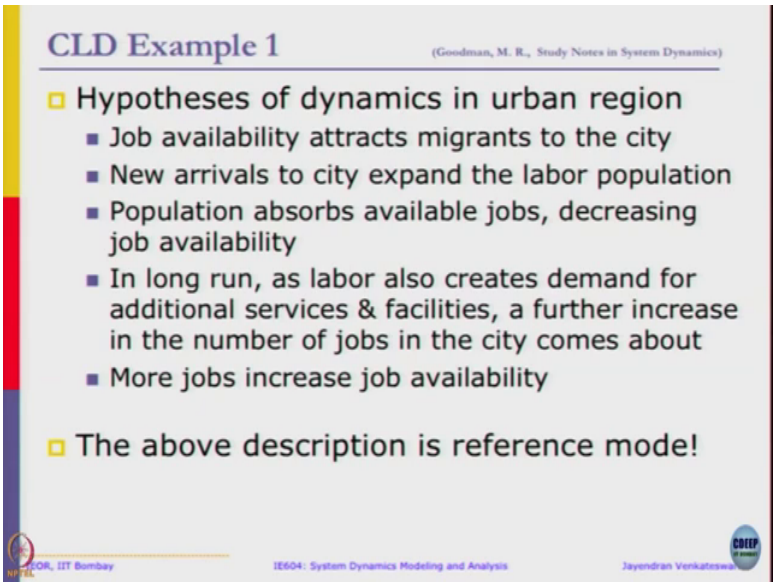

One simple example, first we will identify a variable for system and then we will try to draw a causal diagram for this one. Hypotheses of dynamic in urban region: so, job availability attracts migrants to the city new arrivals to city expand the labor population. Population absorbs available jobs decreasing job availability. In the long run, as labor also creates demand for additional service and facilities a further increase in the number of jobs in the city comes about; more jobs increases job available.

So, pretty simple and kind of for example, we have done a more straight forward language. So, using this we can identify one causal link per statement that is what it is about. So, we have a job availability attracts migrants to the cities. So, job availability should influence migrants or migration into the city in migration whereas, migrations occur that expands the labor population within the city for second statement.

So, first statement variables are job availability increases migrants or more jobs are job availability is there more migrants into the city. The more migrants are as migration happens, migrants are going to expand the labor population within the city. As population as the entire this thing labor as this labor population absorbs the existing jobs, decrease the job availability.

So, population is going to take up jobs; jobs will decrease the job availability in the long run labor also creates demand for additional services as more labor comes new shops open, new services has to be offered. So, that will after long term increase the number of job availabilities within the city.

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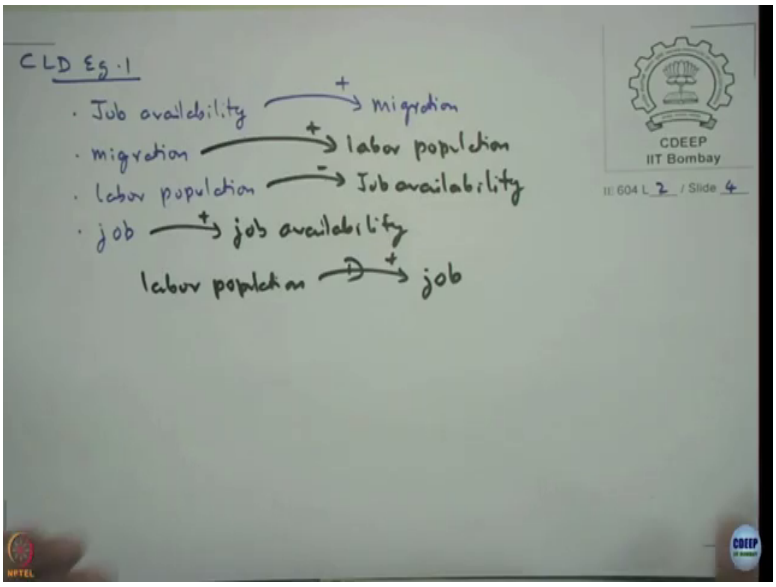

So, we will identify this lets state it CLD example 1. So, we can identify some variables or let us say job availability, migration, labor population and jobs these are the four variables we identify. Using this let us create a kind of first causal loop. So, let us create the links I guess. So, let us take the job availability, you see affects a migration. The first statement said job availability attracts migrants to the city. So, job availability is more, migration is going to be more that is what we can (Refer Time: 03:41) expect. So, job availability of x migration.

So, these left side are the initial variables to identify and migration expands the labor population within the city. So, migration increases the labor population. As labor population is more, how you can expect? The job availability has to come down because they are absorbing the new jobs decreases job availability. Of course, this more jobs come that is more

job availability and there is one more statement there which had the same wavelength tool links.

Other one was the labor population, after sometime increases jobs within the system. So, to indicate the after some time path, we can simply put a D on the link to indicate that there is some delay in the process after some time the labor population increases the jobs in the system.

So, these are the initial set of causal links that we are created based on the description, but this again is still very cumbersome to read. We can just combine all of them we do not need to repeat all the variables. So, many times and create what we call as a nice causal map of it. We continuing the same example.

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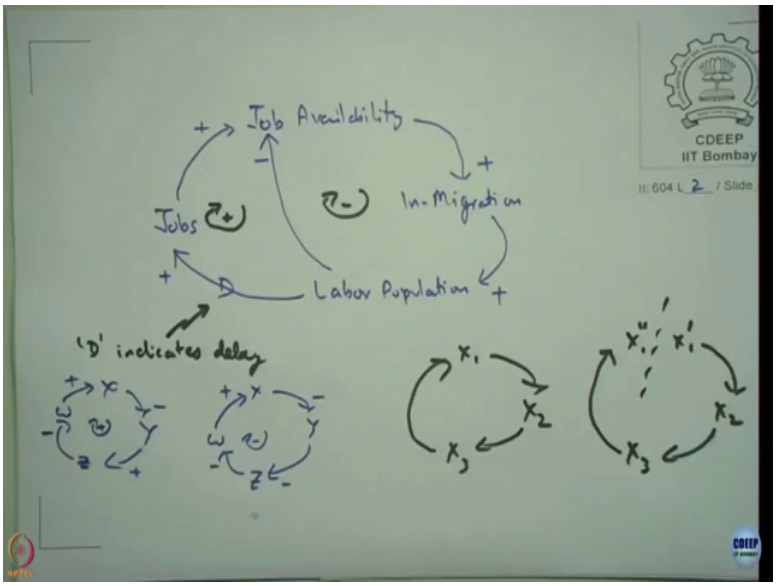

Let us start with job availability. We can call it in migration also, we are not all talking about people leaving people coming in and make it more explicit, then we have labor population, then we have jobs. These are unique variables that we have job availability increases in migration increases in migration is more. We can expect (Refer Time: 06:26) in labor population less layer population observes the jobs and decrease in general job availability has to happen which quite after sometime, labor population increases the number of jobs, but after sometimes there is a delay.

And there is jobs increases of course, job availability also tends to increase. So, just to indicate it this D indicates delay. So, this is a nice diagram, we have this captures the same description that we had in English, but it is much more easier to read and much more compact. So, idea is not to just make the diagram, but also to have a discussions involved around that suppose we say as job availability is more, we can expect the in migration to increase that in turn is going to increase the labor population that is going to observe the jobs as labor population increases there is going to decrease the number of jobs available.

So, as jobs decreases, you can expect migration also to slow down migration rate. As migration rates slows down, the labor population increase that also slows down and it going to come to some sort of a balance in the system. So, this loop will again be a balancing loop; this loop is again a balancing loop. So, in this model as you can see there are two loops that is start a job availability in migration labor population jobs and job availability, there is an outer loop and there is an inner loop see inner loop is negative feedback.

Let us look at outer loop, as job availability is more in migration increases. As they increase labor population increases as labor population increases jobs increase that increases again job availability. So, there is a positive feedback also there is happening in the same direction are strengthening the phenomena.

So, this so, we have what reinforcing loop or a positive feedback loop. This is a balancing loop or a negative feedback loop. Again the term positive negatives are all place holders negative does not mean bad positive, does not means good this reinforcing of balancing are

positive or negative. Throughout the course, you will find that it is very easy to explain the concepts.

In fact, let us say that is the entire thing about causal loop diagram I am done, but the difficulty comes in when you start practicing it and start trying to say for example, read newspapers and try to come up with the causal map of what is actually happening to understand dynamics. Now that becomes challenging.

There are some certain guidelines for this causal loop diagram which I will discuss let me move on some of those guidelines for the causal loop diagram. So, this above description itself is called as reference mode. So, many times we can use this causal loop diagram, this kind of mapping actually understand what the problem is; many of us want to become analyst right.

So, this kind system thinking tool will really help you make a good analyst or a systems analyst rather than focusing on domain of the subject. You can actually become the system analyst that this kind of causal diagram can help to understand and link the various variables that help understand the problems this itself can help discover what the actual problem is that we are trying to solve ok.

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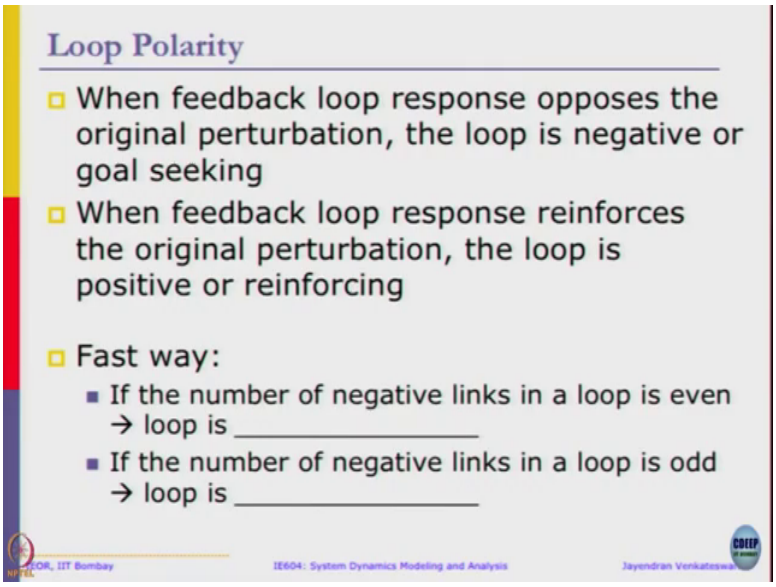

So, we already seen this the loop polarity links, we saw and loops also we saw balancing loop and reinforcing this going by reinforcing it. When loop feedback loop response opposes the original perturbation, the loop is negative or goal seeking. When feedback loop response reinforces original perturbation, the loop is positive or reinforcing. So, it is a negative loop or goal seeking loop or balancing loop same and reinforcing a positive feedback loop are the same ok.

So, one way to understand that is suppose we have links like this. So, for example, X 1 of affects X 2, affects X 3; it is again affects the X 1 right and if wanted to do right way, then what we need to do is split it. Let us call it X 1 say dash, let us see how X 1 affects X 2 and how X 2 affects X 3 and in turn how X 3 affects X 1. So, in anyway we kind of cut the cut

one of the variable it is ok. Let us initially allow X 1 to increase and I saw X 1 changes how it affects X 2, X 2 changes how it affects X 3 and again as X 3 changes how it affects X 1.

Ensure that you again come back and see what is happening to the variable X 1 which we which we point out initially and if the original direction of X 1 dash and X double dash is the same, then we say that it is a enforcing loop or a positive feedback loop. If it is the opposite direction yes we initially cut out this the by increasing it, but then eventually X 1 w dash seems to decrease here then it becomes the goal seeking loop or a negative feedback loop

We are not interested in the quantum of increase, we are not interest quantum of increase we are only looking at the direction. It may be that even the positive or negative direction is very tiny, but still we are only interested in that for now and more dissimilation put numbers, then we will worry about actual how our system is behaving we will come to that, but right now we can only worry about the direction of (Refer Time: 13:04).

For example, the job availability attracted huge number of migrants, but maybe their job creation is very low, the new jobs they (Refer Time: 13:14) it can be there is because their population is high does not means that similar number of jobs has to be created. But the direction is the same the number of some additional jobs happen that is all we are trying to say.

So, it is a here. So, even in this so, one of the shortcut to figure out where is positive or negative feedback loop is simply count the number of positive or negative signs within a loop to the number of negative signs is odd, then it is a positive feedback loop. So, here if you see plus plus and there is one minus sign. So, there is odd number of minus signs so, it must be a negative feedback loop.

Even in this example, I can do one more; let us say X Y Z W X. So, here suppose I have minus plus minus plus as X increases. So, there are two negative feedbacks. So, X increases Y decreases, as Y decreases Z also decreases same direction; as Z decreases, W increases; as W increases, X again increases. So, it is the same direction finally, the variable X. So, short

way is there is two negative feedbacks or a even number of negative feedbacks of a negative links, then it is a positive feedback system.

So, it is odd because X increases, Y decreases; as Y decreases, Z again increases; as Z increases, again W decreases; as W decrease, X also decreases. So, eventually X went down when you are originally started with X increasing. So, the shorter way is you can see there is odd number of negative links; that means, it must be the negative feedback loop. So, we have two loops here; loop job availability in migration labor population job availability, this is the loop.

The second case job availability in migration labor population jobs, job availability that is the loop. So, and all are in positive direction that case you do not have any problem. If all are positive, it has to be positive feedback system. The only problem comes in when there is one negative link, then what happen when you count the number of negative links. If it is even, then it is must be a become a positive feedback. If it is odd number of negative links, we have then must be a positive. (Refer Time: 16:06), all this small tips we can give, but then we will go through them, then we will do lot of examples.

So, number of negative links in a loop is even the loop is reinforcing number of negative links in loop is odd, the loop is balanced.