**Introduction to Lean Construction**
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**Productivity & Production Impact; Visualizing Activity Productivity & Production Performance**

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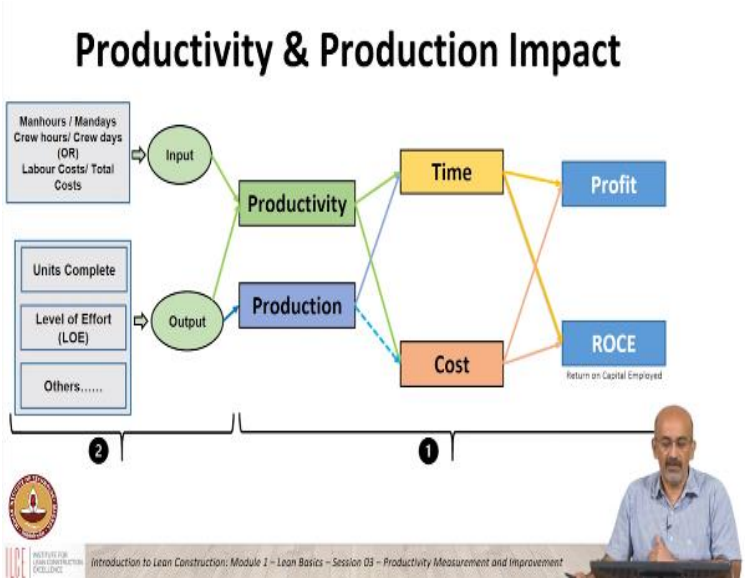


Now what we are going to do is to look at how productivity and production have an impact. So, ultimately we are interested in profit, we are definitely interested in return on capital employed on the project. As we go back, what is the influence of time and cost on this? From a schedule point of view both get impacted, from a cost point of view also both get impact.

Now what does productivity and production do to time and cost, what does productivity influence?

Student: Time and cost.

Professor: Productivity influences time and cost. What about production? Production influences cost or time?

Student: Time.

Professor: Much more of time. So, productivity influences time and cost, production primarily influences time because if I am slow I can increase my resources on a project, I can increase my resources and the increased resources will cause increased output.

Student: Productivity will be less.

Professor: So, productivity will be less my production will go up, I will catch up with time but I am paying with cost.

Student: Extra cost.

Professor: This happens a lot on our projects, we have some delay on something and then we increase the resources, increase the labor, bring in more equipment, get more output but we do not necessarily measure what is happening to the productivity, we increase production and when we go back you can see, so then these inputs and outputs are there and you have seen the various factors that go into the inputs and outputs.

So, if you look at this big picture there is a importance on productivity and production on the final profit and return on capital employed and we will come into a little more detail on this after the next topic which we take.

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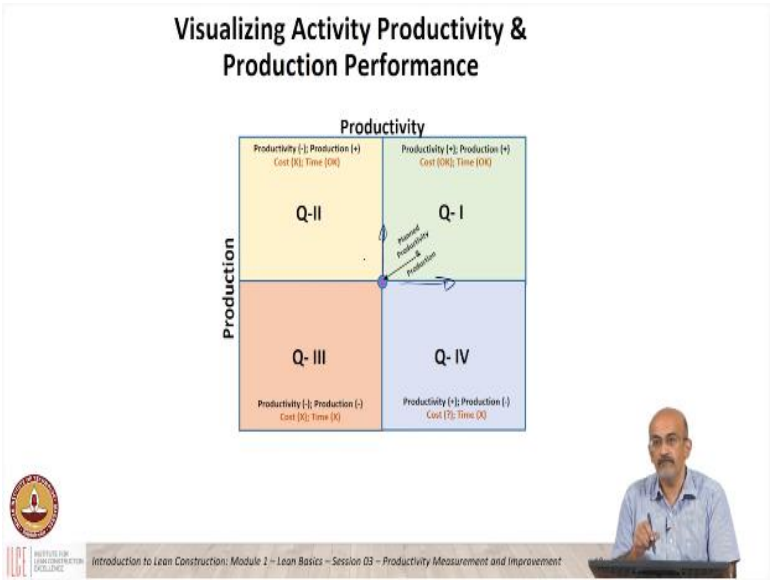


And this is the topic which we are going to take up next which is to understand how productivity and production are related to cost intake. So, you can see that what we have

here is basically I would call it a graph or a matrix, I will just put it as a matrix, as a management matrix. You have four quadrants, quadrant you can see the four quadrants that is 1, 2, 3, 4. At the middle we have the plan productivity and plan production, so this is almost a graph, so this is not a 0, 0 origin this is where my planned productivity is the x axis, production is the y axis.

So, this is my middle, if so as my productivity, actual productivity gets more than planned productivity, I will go in this direction. As my actual production gets more than planned production, I will go up here. So, any activity you are doing, if you measure production and productivity you can fall in either one of these quadrants or right in the boundary or in the middle, any questions on this representation?

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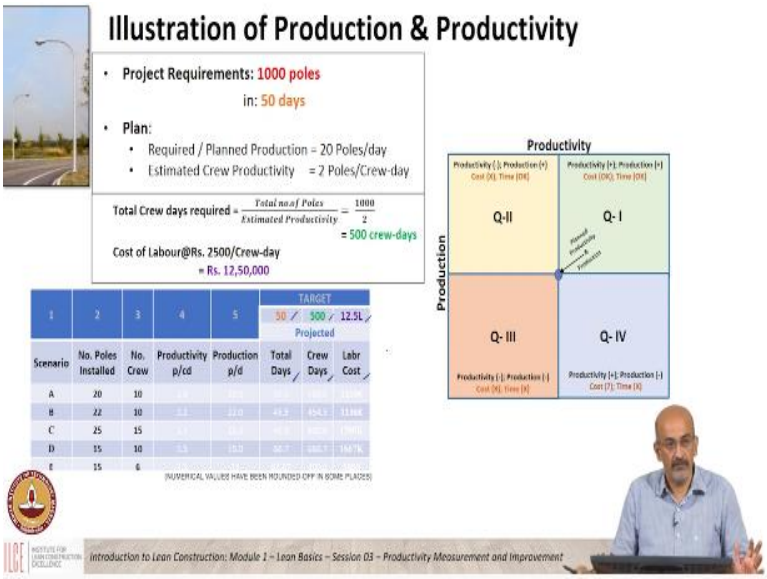


So, we will take this a little more detail so our objective is to take this illustration and see how we can use this representation to understand how productivity and production influences time and cost. So, the illustration is simple we have a project requirement of 1000 poles to be installed in 50 days.

So, you can see these are typical I mean lighting poles on a street and so if we say that these have to be installed in 50 days that is all I am giving an initial requirement, so you need to install 20 poles a day and that is the production and based on data we are saying that look a crew which we are mobilizing for this job can install up to 2 poles per day,

that is I am taking it a crew level, crew might be 2 workers, 2 helpers whatever it we are just taking it abstract form can do 2 polls for crew.

Also giving you a little more information so if you take the total crew days required it is 500 crew days, that is total if so that is the total number of crew days required, so if I have 500 crew it means 1 day, so depending on how much, so depends on how many people I can mobilize and my cost of labour is given there it is 2500 rupees per crew day working out to 12.5 lakhs is my total cost for labour.

Now what we are going to do is we are going through different scenarios that can happen. So now, this is my plan, what you will see here is different scenarios A, B, C, D, E each scenario is independent, each scenario is independent we are only going to discuss these scenarios we give you a number of poles installed and number of crew that were used to install the number of poles.

And what we are going to try to do is to see based on the number of poles installed and number of crew used we now have the productivity, we have the production, we have the total days it will take, so this is the productivity and production calculation, then here we have the target what I have shown here in these three numbers are the target that is 50 total days is the target we will 500 crew days at 12.5 lakhs that is target that these numbers on top will remain the same.

But here for scenario A what is the total crew days that will actually take given the productivity, given the crew, I mean the total days given the crew days and the labour cost we are going to estimate this and we are going to see it with relation to the quadrants. So, this is where we are going and we are going to take it scenario by scenario.

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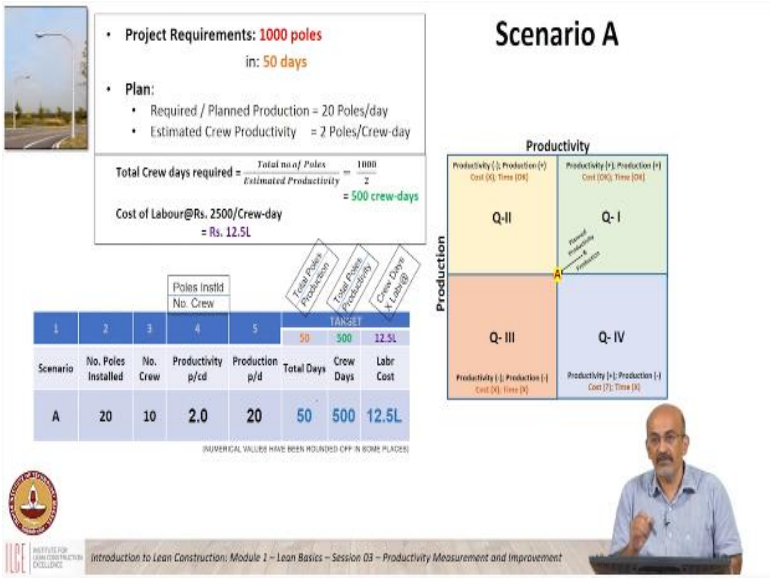


So, taking scenario A. So, number of poles installed in scenario A is 20 and it took 10 crew, this is assume this is the first day of operation you had 20 poles installed by 10 crew, what is your productivity?

Student: 2.

Professor: 2, your productivity gets to be 2 and your production will be 20. Now, if I take 2 and 20 it is exactly the planned, it is exactly, so I mean this is a bit of a hypothetical situation it worked exactly as planned, so that is where my current point is. Now the total days will obviously be the same, if I project, if I continue to work at this pace I will finish on 50, I will need the 500 crew days, I will need 12.5 lakhs to finish scenario A and that is exactly where the point occur.

Now so you can see we have some formulae up there with required number of poles installed by number of crew gives you the productivity, total poles divided by production is total date, total poles by productivity is a crew days, you need to use or you know crew days into the labour cost gives you the total labor cost.

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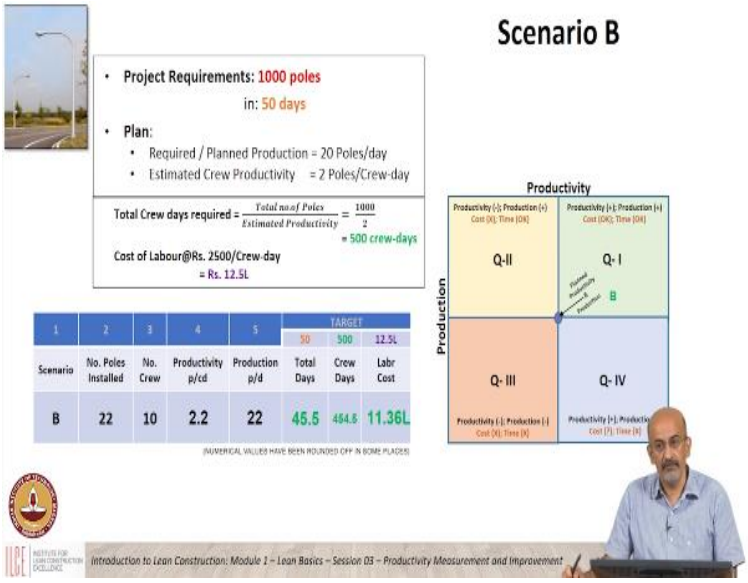


If we now go to scenario B, slightly different numbers now 10 crew install 22 poles in that day, so this is independent scenario instead of scenario A now we have scenario B. So, my productivity is 2.2, my production is 22, so where would this be which quadrant would it be?

Student: First quadrant.

Professor: Quadrant 1, so I will be in quadrant 1, if this is a good quadrant to be in?

Student: Yes.

Professor: Yes, my production and productivity are better than what I had planned, so I would expect both my cost and time to be to be reduced. So if I go in for total days instead of 50 days I am finishing it in 45.5 days and instead of 500 it is reduced and my corresponding labour cost is also less.

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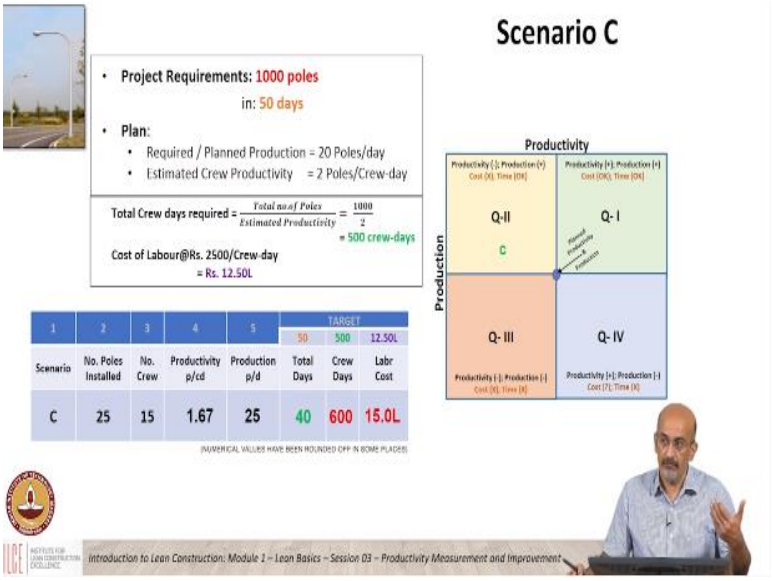


Now go to scenario C. Now I have 25 poles installed by 15 crew, productivity, so we go in this is the back to the quadrants 1.67, production is of course 25 and where would this be on which quadrant would it come 1.67 is less than 2, so remember this is 2, 1.67 and 25 is more than 20, so it comes into quadrant 2.

So now I have my production is good, my productivity is not as is less than what is planned, my production is more than what is planned and my productivity is less than what is planned and because my production is good, I am able to finish it before my 50 days but more crew days, I will need more effort, more crew day input goes in and so my cost goes.

So, do review this, you should be able to go into details and there will be might be you know in the quiz and in the examples this will be they will have more elaborate version but this is the principle on which is based.

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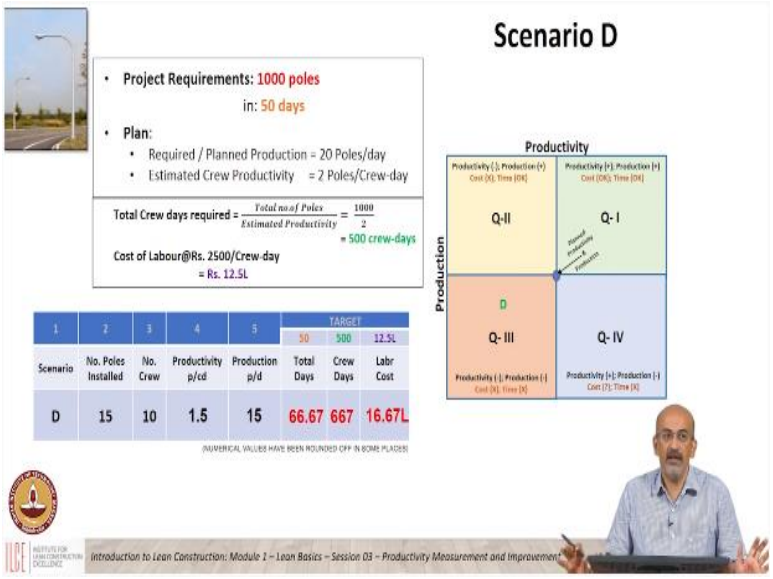


We go to the next scenario D. Now I have installed 15 poles and its taken 10 crew, so you can see you know what is coming, so you have productivity of 1.5 which is less than what is what we had planned, we have production of 15 again less quadrant 3 in which case that is quadrant 3 and the result is both cost and time are in the negative, that we are now we are going to overrun cost and overrun time.

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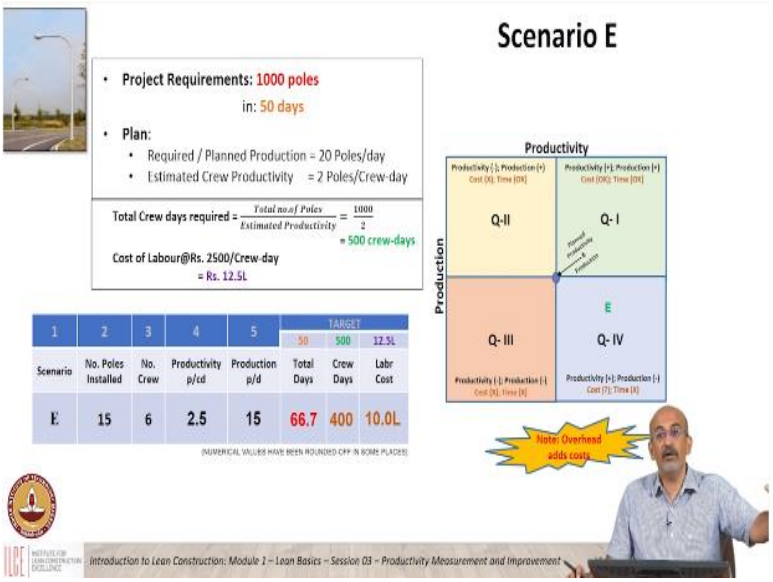


So, now we go to scenario E. Now so here in E what we have is now we had 15 poles but less screw, so if you compared the earlier scenario we had 15 with 10, now we had 15

with 6, productivity is more, production is 15, productivity is more than 2, production is less than 20 which means it is quadrant 4, this is E, now what is the implication on cost and time?

Student: Time will be less.

Professor: Remember production is? Production is less, so total days will be more, I will have time overrun because my production, I am just not getting the throughput, my productivity, my crew are very efficient but I am not getting the throughput I need and we think that we are saving on labour cost but because my duration has increased, my overhead cost might be there, so by no means do we actually finally save on project cost, so this is a dangerous scenario.

I might be getting so a lot of times in the past if people put very few crew, so there will be less what you call crew interference this, that etcetera, productivity might be high but the production becoming low and if there is no, I mean you do not see the scenario often today because there is a huge kind of premium put on time, on schedule.

So a lot of times today we see more of quadrant 2 but in several situations quadrant 4 is also possible but by no means does the cost come out although just the labour cost might be seems okay.

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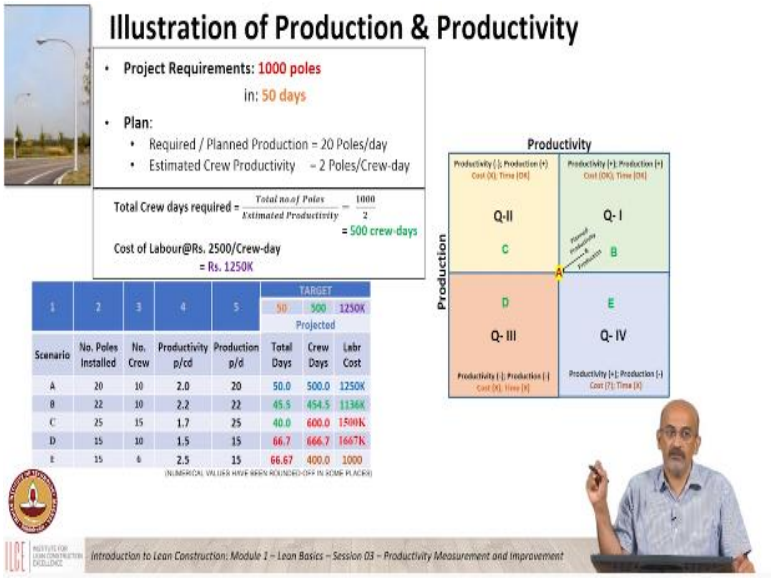

So, we went through these scenarios and to summarize this is what it looks like, we have put all of these now, are there any questions which you have or any comments?

Student: Can we say that productivity is directly proportional to production?

Professor: It is not directly proportional, we just found that right, we just in this whole exercise we found that, so when we if it is proportional then I would not have four quadrants?

Student: Yes sir, that is why I was confused these are not totally related to each other.

Professor: They are not related to each other, correct, so as you can see I can have high productivity low production, I can have high production low productivity, that is really the message that you cannot measure just productivity or production and control your cost and time.

Actually okay let me put it the other way which one would you, if you wanted to control one item which one would you try to control productivity, but you can see in quadrant, in quadrant 4 productivity is there but still production is not. So ultimately, you have to keep track of both, you cannot just keep track a lot of times, so which is easier to keep track?

Student: Production.

Professor: Production is easier to keep track of, okay so we do tend to measure and kind of control and do production because it is easier to keep track of, but we miss productivity in the process and so as a result we miss what is the time or cost, we are not able to control cost.

So, we have to if you are looking at where should we focus, we should focus, I mean not just ignore production but also start focusing on productivity and they are, you can see they are not correlated, they need not be correlated, if I keep my crew constant, increase my production, increase my output, yes, my production increases and my productivity but a lot of times the crew is not constant, the denominator of input is also varying, any other questions?

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