Project Planning & Control

Prof. Koshy Varghese

Department of Civil Engineering

Indian Institute of Technology, Madras

Lecture -14

Factors influencing Productivity, Example for Ideal Productivity, Factored Productivity and Working Time Factor

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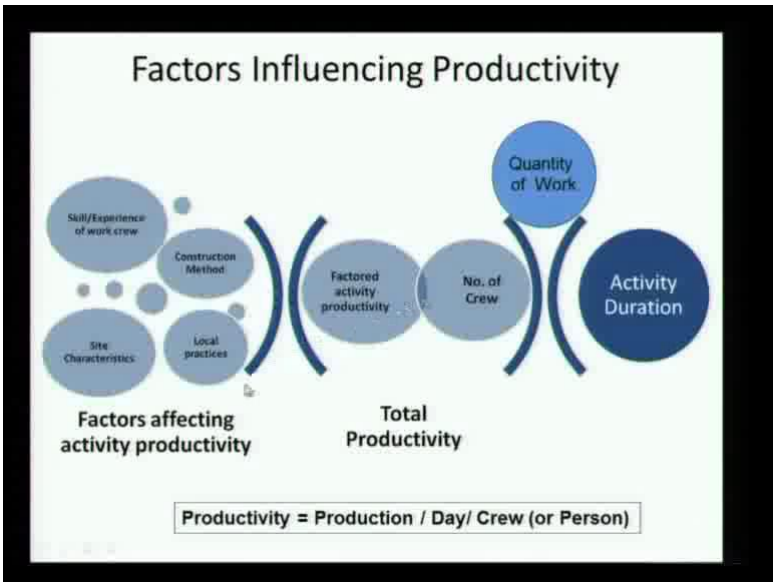

So, as we move, so now, we look at this in a very summarized form. So, we can see a, we put few of these skill experience of work crew, construction method, so because masonry((Refer Time: 00:28)) we did not list construction method here, because it review, assume it is a single method, local practices, site characteristics, all of these what happens is there we come up with the factor called factor productivity.

So, I might say productivity of I go back, I might say productivity is you know 20 square meters a day average, but I have actually to get into the site, look at all of this and then, factor it appropriately to know, what is the, what can I expect out of that site at that period of time. Now, my factor productivity and when I take a number of crew I actually get the production, I get the production and this production, and when given the quantity of work and production, then I can estimate activity duration.

So, productivity the way we are defining productivity is production per day for the crew.

Productivity=Production/ Day / Crew (or Person)

So, I want to take again this opportunity, a lot of times I mean we have projects where they say, they have to improve productivity and so. What do you think the control action is? They have to increase the quantity of work to catch up with the schedule. So, they tend to increase the manpower on the project, increasing manpower on the project increases what.

Student: Cost.

Cost

Student: Increases production.

Increases production, it does not necessarily increase productivity. Then, so there is a difference between production and productivity, and ultimately duration depends on production and productivity. But, I mean depending on you know if time is the, is really the most important issue there, sometimes rather than you know and try to slowly improve productivity, the project manager might only have an option of improving production, and that is what sometimes happens, you know quite often.

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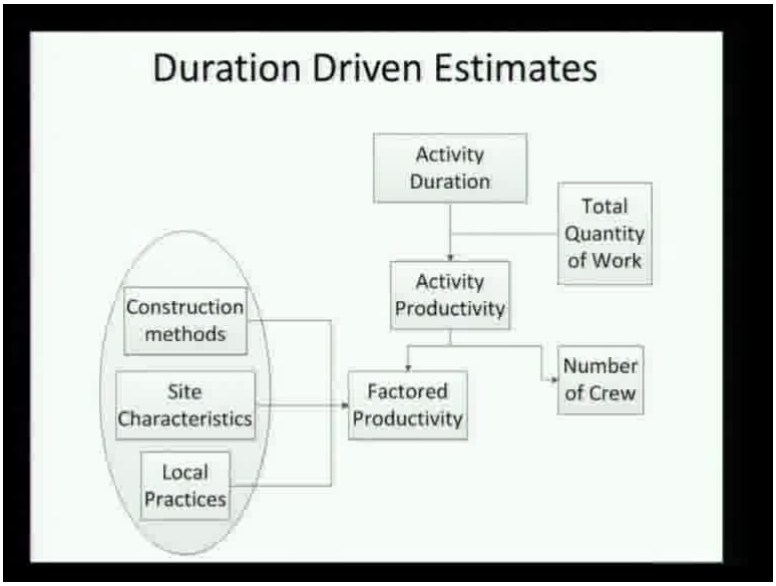

So, now we move to when we have to calculate duration, what are the influences that come into play. So, we have an activity duration here, we talked about activity productivity, we talked about construction methods, site characteristics; all of these are influencing the productivity to get a factored productivity. We have a quantum of work, and we know that we can change, you know we can might decide on the number of crew to be able to change production and thereby change the duration.

So, what is, so for example, I mean I will take an example later, but just discuss this here, what of this is constant, what of this is variable? What are the factors here which are given to you which you cannot change, what are the factors which you can change?

Student: Duration ((Refer Time: 03:26))

Is it fixed, yes

Student: Sometimes we made the fix the duration in the ((Refer Time: 03:34)).

Exactly, so you might fix the duration and which case, what do you have to vary?

Student: Productivity, the number of crew.

You could vary productivity, but let me tell you it is more difficult to change given a certain, given a construction method, given a site characteristics, given a set of labor you can change management practices to improve productivity. You can certainly do that, but like we just discussed it is just easier you to increase or decrease the number of crew to change production and when you change production, your duration

Student: Decrease.

Decreases or increases, it changes. So, again I am reiterating we could work on changing productivity, but that is really a little more difficult than changing production. And if you really want cost effectiveness on your project, you should be changing.

Student: Productivity.

Productivity and not production and that is the next term. So, if we, so we can go two ways, like we have been discussing. One is if a duration is given to me I can change; I should be able to find a number of crew for me to achieve that duration. If the duration is not given, you know I have flexibility on duration I can with my current number of crew I would put in, and I can find, how long they will take to do the activity.

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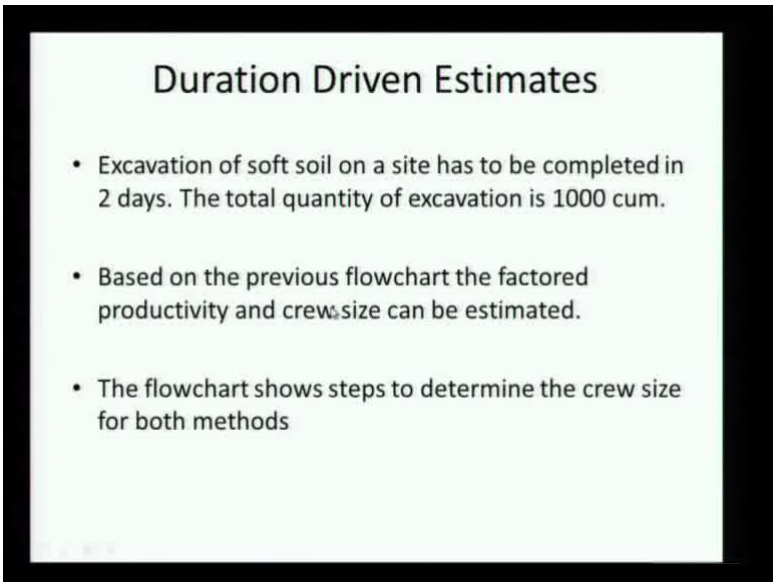

So, if we go with duration driven, so let us take an example here. Excavation of soft soil on a site has to be completed in 2 days. Now, you are fixing the duration, the total quantity of excavation is given. Based on the previous what we have discussed, we are going to try to factor crew size.

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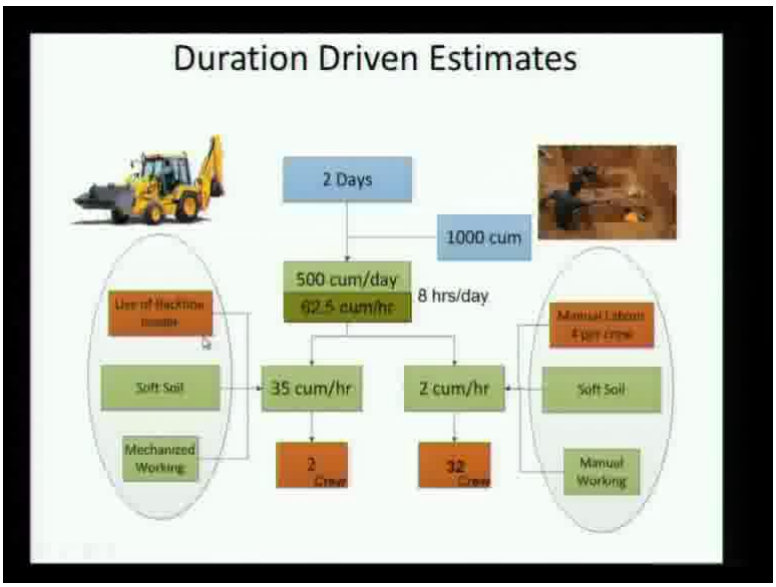

Let us take this flow chart here, so this shows you the example. So, we have two days which is the duration of the project 1000 cubic meters is the quantity.

Student: Total quantity.

The total quantity of work. Now, so if I have to do 1000 in 2 days, each day I have to do 500

cubic meters; taking an 8 hour day, so that is, so much per hour. Now, so this gives me if I am bringing it down to an hourly basis. Now, I am come in from this side, if I am have two options, I am looking at using an excavator or using manual labor. If I am using an excavator this is the cubic meter per hour I can get, which means in order to achieve my required cubic meter or I need 2 crews, whereas if it is manual this is the cubic meter per hour I can get and this is the number of crew I will need to meet the requirement. It is pretty straight forward analysis.

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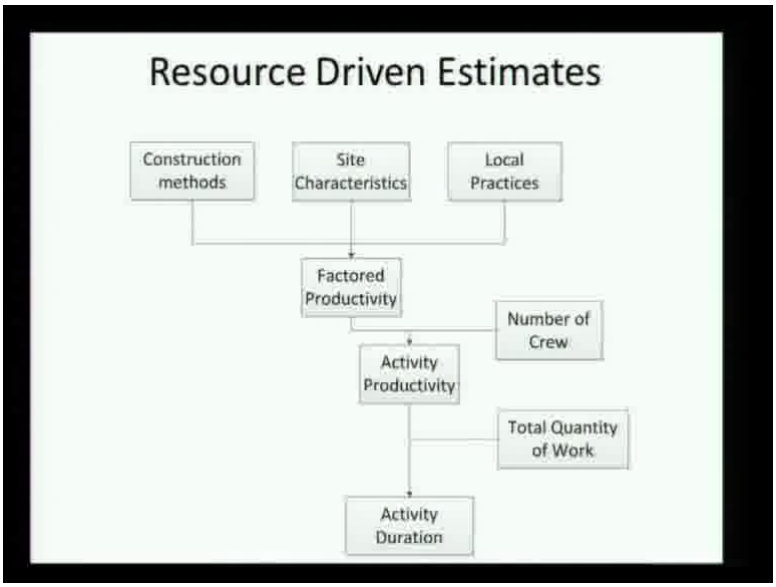

Now, I can go the other way around which we are saying is resource driven; that is my methods all of this is fixed, only my duration shift change or I mean, I cannot mobilize more crew. This is what I have, and a lot of companies face this problem or face this issue. They actually say this is what I can mobilize, how long will it take me to do the job or to do the activity.

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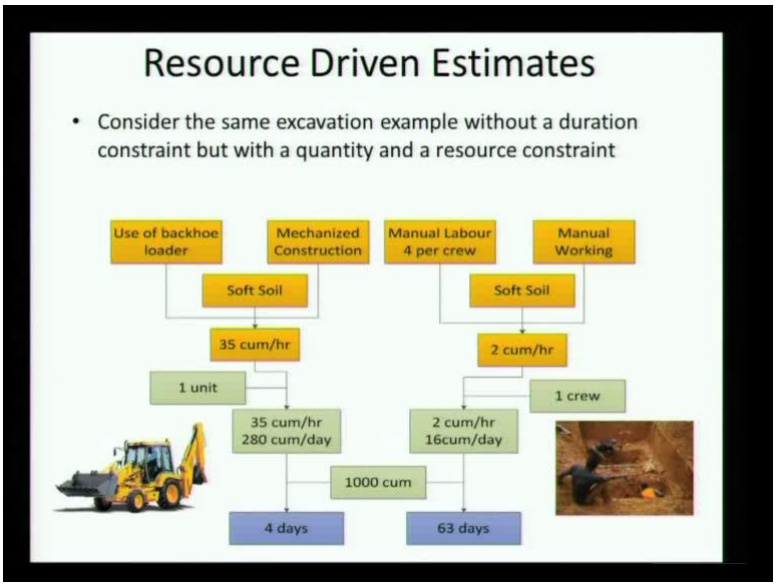

So, if we go in this direction with the same example, so you have a backhoe loader and it is the same example in the reverse direction, where you have one unit; 35 cubic meters per hour and so with the backhoe loader you say 4 days is the total time to with one unit, with the manual crew you get 63 days of work. Now, what is going to cast you more time-cost trade-off all of this is can certainly be discussed, but that is all it is a different issue.

Any question so far? Now, let us take an example, which I want you all to solve; it is again it is not very complicated, but let us make this let us take it step by step and see how we bring in different factors.

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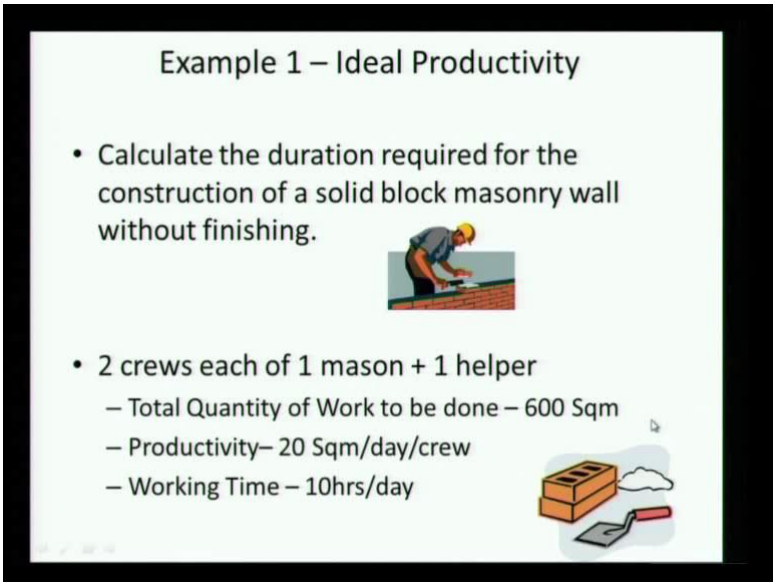

So, here we have a masonry block, a masonry activity. There are two crews of one Mason plus one helper, the total quantity of work to be done is 600 square meters, productivity is 20 square meters per day per crew, working time here is 10 hours. What do you think is the, how long will you take to ((Refer Time: 08:21)).

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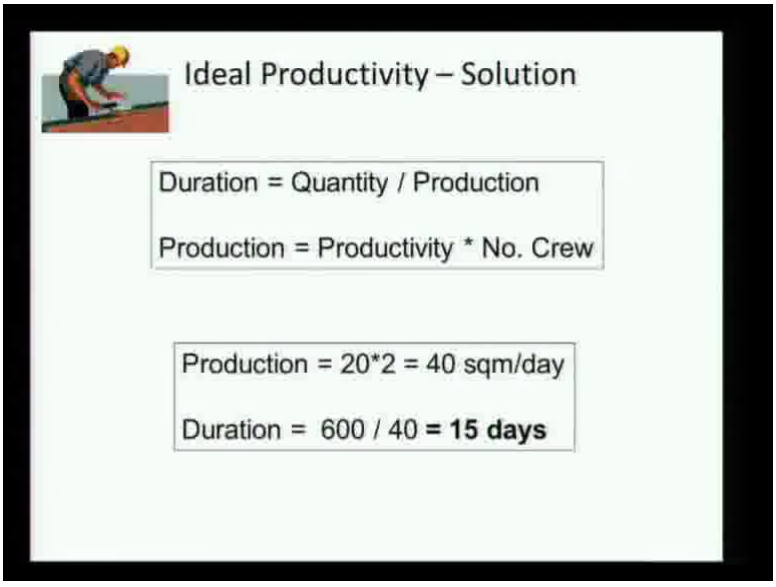

So, if I am going into the, from a productivity perspectives, I am saying duration is quantity by production. Production is productivity in a number of the crew if I am a production, and I find a duration.

Duration=Quantity/Production
Production=Production*No.Crew

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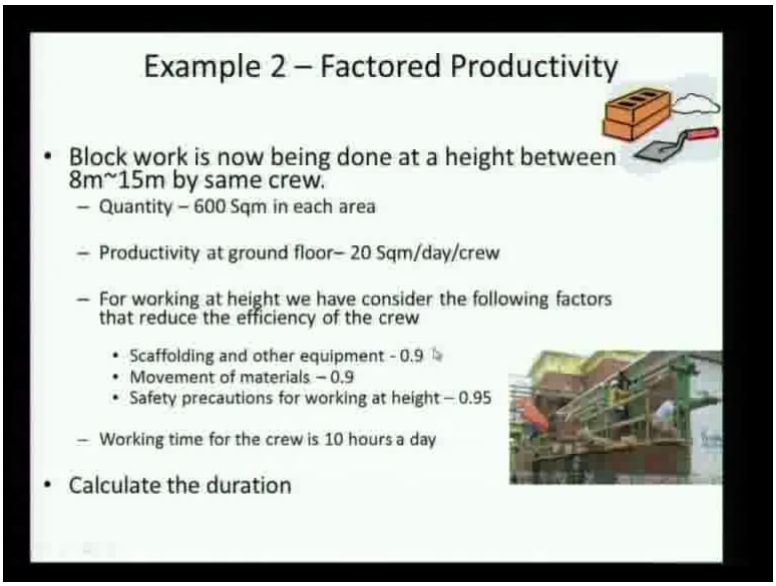

Now, we… Any questions? ((Refer Time: 08:40)) I am sure there are no questions on this, very straight forward. We get into; now we bring in these other factors we talked about. The challenge in this earlier place is not the certainly not the calculations, but productivity.

Student: Productivity.

No, how do I actually calculate production? How do I come up with this number? You know, which really represents what is happening on my site.

So, when you go into this, when we extend this example it becomes a little clearer. So, here we have, now the same crew is going to work at a height of you know 8 to 15 meters on a scaffold. Before they were working on the ground they could walk around is no problem no, no safety harnesses is nothing was require, now they going to work on a scaffold as you can see here. And, what you think other factors, now that influence productivity.

Student: Working in the scaffold.

So, why should they productivity we more or less, less, less why? The working area is less they have to be more cautious they cannot move around as freely as before.

Student: And getting the material from one more effort.

Yeah, getting the materials up is a little more effort you know that has to be done, if the mason has to walk to get some other tool or material he has to claim down that is more time require to claim down and claim back up and all of this. So, this is the pretty common when you actually take on multi-story buildings you find that as the building gets taller and taller productivity keeps decreasing. Even a simple think like, I mean, so you know if the work mean needs you to come down for materials the travel time itself just increases significant.

So, of course, there are many ways to counteract it. So, in this particular case, all we are taking is, now we have to come up, so we know that productivity at the ground floor crew is 20 square meter per day per crew. Now, we come to this scaffold, how will be estimate the productivity, we will have to factor the productivity. So, we know it is not going to be 20, right? So here are some numbers I came up with scaffolding equipment we are factoring that 0.9, movement of metrical 0.9, safety precautions for working at height 0.95, like we discuss these numbers are I mean on what basis do we come with these numbers is really a question.

But, if I have data if I have a means of actually collecting data of you know productivity of masons at this height productivity of Mason it is scaffold of a certain height, then I could probably come up with more rational ways of coming with this estimate, and that is really

critical. Now, given this data how would I factor it?.

Student: Multiply all these factors.

Multiply directly are each of them is independently reducing the…

Student: One by one reduction.

Ok,

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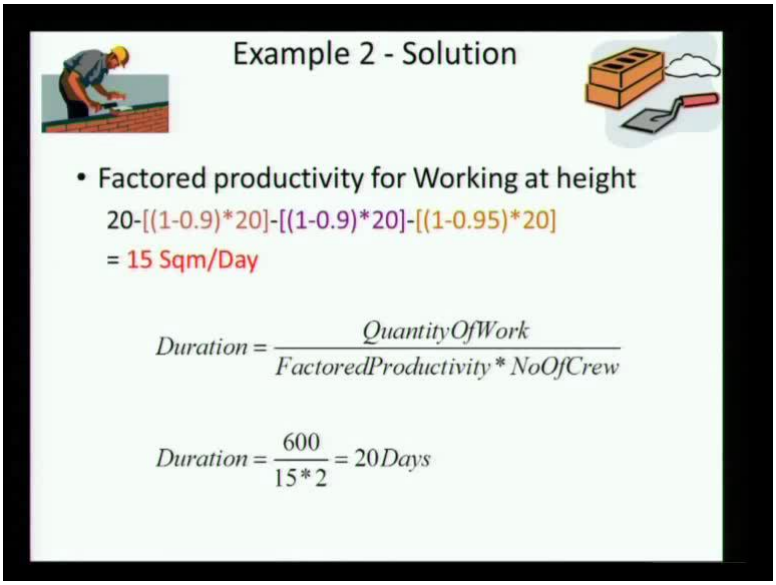

Duration=(Quantity of Work)/(Factored Productivity*NoOfCrew)

They are all reducing the productivity 20 is a base each factor is, is reducing it independently we assert now. So, you get 15 square meters per day, and now, what was taking 15 days the earlier is now, talking 20 days because it is a working on height. So, this is the factor with this is one way of factoring and if you actually go into corporate, what you say productivity ((Refer Time: 12:41)) norms, they will have factors like this and those are such, you know closely hell secrets, because this, based on this is what your…

When you originally make a bid for it if you have these factors right, then you get your bidding and your target price correct if you do not have these factor right you can be anywhere on the over the cost part, and you will you know you might make a big loss you might overbid and not be competitive at all.

Student: Sir, these factors are nearly based on historical and experimental data.

Unfortunately, there is so much experimental data, but it is mostly based on seeing this is where, how can we make a factor like this based on an experience is difficult.

Student: It is based on the importance of the factors which influence the ((Refer Time: 13:36)).

But, how do I come up with the number that is still the critical thing? So, it is let us just take a minute off what would be the most structured scientific way to come up with this ((Refer Time: 13:48)).

Student: So, you got on a particular project test project we check out for a particular kind of task given a certain number of crew members, how much is the productivity that is coming I mean depending on various factors such as the height or you know the materials is the site of construction fine all the factors you take into consideration compare it with standard test.

So, first is there will be no test projects as such you have to take a project which is going on and you do if example on campus we have, so many buildings being constructed I have to now make sure that when I am recording the masonry crew or when I am I know where they are working at the end of each day I have to record what they are productivity output is how many man hours went in and where you know and then you know, so then at the end of the project are somewhere when I have enough data I have to say, I have to sort out the data and say and this much of height this is the average productivity as I get higher this is the average productivity you know.

So, we take a 3 or 4 story building we should be able to take we should be able to find out a productivity at different floors you should be able to find out the total productivity average. So, 3, four-story building, but coming back is one is we have to collect almost daily data, and we have to get the data characterized by location and by the crew and by various other factors, which are then required for the analysis.

So, lot of times data is not available of these factors are not available today because people do not collect data at that level of detail people are saying output for the day, so, much fine total number of people work is, so much and you will get average productivity on that site for that day, you will not be able to get the final characteristics of the work, any other question?

Student: Sir I think if we are going for final any productivity factor, then we have to make other variables constant, which is highly impossible.

Yeah, no, no that is what, so remember here, so if you take for examples of someone like I

mean like a lot of the companies like not only productivity factors based on something like a building and height but will have region will have size of subcontractor they will have experience of subcontractor they will have, so many factors built into that. So, you are right there are a lot of factors, and it would be impractical to assume that only one or two factors are variable, and everything else is constant.

But, the challenge here is there are you list about you know 8 or 10 factors that there are about 50 factors, which going to productivity and unless you keep collecting data on project after project with this fineness of attributes you will not be able to do any analysis to get these factors that're the point. So, you know you take a you take a large construction company which works all over the country they will have a number of projects they will have to kind of sort out the data based on region based on type of project in region all of that or in contrast you take builder who would work only in Chennai.

He also, but he has to do this same thing for him most of the labor everything as you know is around Chennai-based material supply Chennai-based everything, but still he was to able to find different I mean find finer details to the productivity influences to be able to actually estimate productivity. So, which is takes us back to our earlier discussions of project versus process because we are in a project mode there are, so many factors and like that example we are discussing the builder in Chennai is more in a process mode can be more in a process, because his variables are less where as a person, who is with the companies as doing global construction as much more in a project mode.

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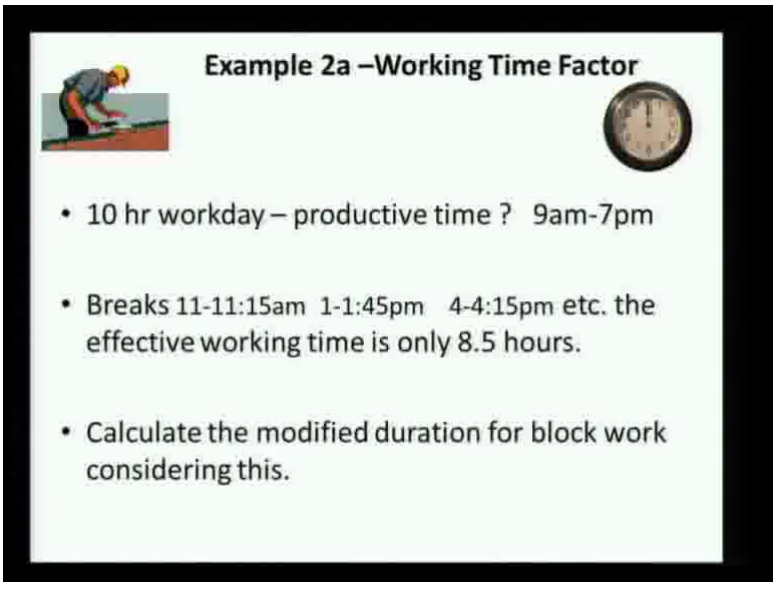

Let us take this example further we talked about working time we have set 10-hour working, but if I am going to take a 10 hour work day it is what is the effective work. So, I think somebody mentions this point earlier that I am not going to be able to get a full day's work you know the person is not only constantly working. So, might be effectively it is only like you can see that are breaks in the work time you know at least many of our sites we have a tea break, we have a lunch break, we have an another tea break, and I mean we will get probably 8.5 hrs of effective working time.

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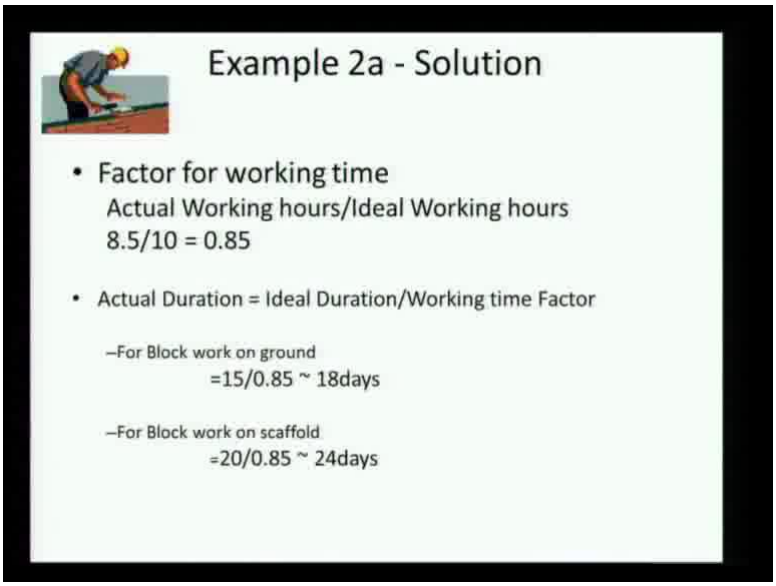

And here we again have to be able to, now modify this form the overall productivity and say, what should I have taken 15 days now take 18 days, work takes 20 days, it takes 24 days. So, you will find that there are lot of, so even if we take the, you know 8.5 hrs of work do you think people are actually working for 8.5 full hours?.

Student: No

So, again how do we factor these. So, it gets tricky and will find that we come in with the certain productivity estimate.

But, we are simply not able to hold the production to that productivity, which means ultimately there are something going on in our estimating, which is not accurate, and we have to take these factors and control these factors to be able to reach our duration, which we are estimating. Any question on this?.