Work System Design
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Lecture - 04
Productivity Measures

Namashkar friends. Welcome to session 4 in our course on work system design and if you remember in the previous 2 sessions our focus has been to understand the concept of productivity. In session 2, if you remember we have covered the basic concept of productivity. We have tried to understand that how we define productivity. We have seen that it is a relationship between input and the output.

Then, we have taken few examples. Also in the session 3, our focus was to see that what are the various measures of productivity. We have seen the objectives of measurement of productivity. We have seen that what are the problem areas related to the measurement of productivity, then we have seen 4 approaches of productivity measurements are traditional approach, the subjective approach.

Then, we have seen the Lawlor's approach and the Gold's approach for productivity measurement and we have seen that what are the thrust focus areas of productivity measurement as indicated by as proposed by Lawlor and Gold. So basically if we summarize everything what we have covered till today, we can say that productivity measurement is the key issue for any organization.

It will help an organization to benchmark its performance as compared to its competitors. It can help the managers in making decisions related to the labour, related to the money or the capital involved in the operations, related to the time spent by the workers on a particular task. So it is an overall indicator of the economic health of any organization. So productivity measurement is important that is clearly established.

How productivity is different from efficiency and performance that we have also covered in the previous session. In today's session, our focus primarily will be to see that how we can actually calculate the productivity, that is the productivity measures. We will see that what are

the various techniques that are used for calculating the productivity, how productivity can be calculated quantitatively.

In the previous session, we have seen more of theory related to the word productivity. Today, we will like to understand the practical aspects of the term productivity in terms of calculating the productivity using different relations. Relations means basically it is a relationship between the output delivered or the tangible output to the input that is going into the system.

So we will see that how the 2 relate to each other, so with this background and summary of what we have covered till date let us now start the today's discussion. You can see that there are 4 types of major productivity measures.

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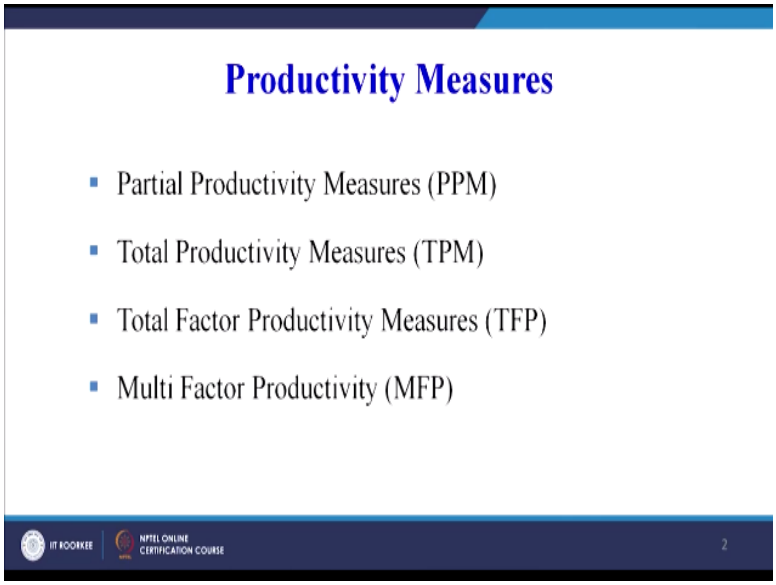

So one is the partial productivity measures, then the total productivity measures, then the total factor productivity measures and the multifactor productivity measures. Now each one of these seem to be you can say synonymous to each other but there are slight differences in the way we treat the input and the output in this different productivity measures. That is important because in different scenario in different organization we may have different sets of inputs going into the system.

And based on the input, they may like to use a productivity measure that best suits to their inputs which are quantifiable and the output that they are producing. So for different sets of inputs we will have maybe different sets of productivity measure, so depending upon the

requirement we can choose a particular or a specific productivity measure and use it for calculating the productivity of our organization.

So we will see quickly each one of these and try to understand it from the point of view of actual calculation of productivity of an organization and how we will be able to better understand it with the help of certain mathematical examples. So we will try to understand this concept with the help of mathematical representation of the data that is how inputs are treated in a particular productivity measure.

And how the output is treated in a particular productivity measure, for example partial productivity measures and then we will see how productivity is calculated. We will towards the end of today's session, try to understand the advantages and limitations of some of these productivity measures. So let us start with this background what we have understood till today that we have understood in session 2 the basic concept of productivity.

In session 3 that what are the various objectives, what are the various limitations, what are the various approaches of productivity measurement and today we will again focus on the practical aspect of productivity measurement. So let us quickly see each one of these. So first of all first productivity measure is the partial productivity measures that is PPM so depending upon the individual input partial productivity measures are expressed.

Now one important point that we can see here is you can see it is partial productivity measure let me just once again go to the partial productivity measure.

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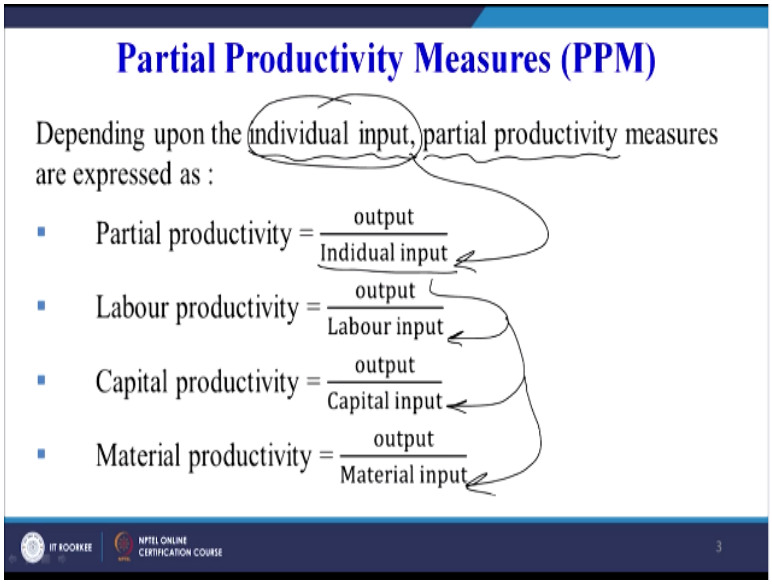

So this is you can see that on your screen the partial productivity measures and it is based on the individual input, so individual input is very, very important here. If you see what is the individual input? The individual input in this case is output/individual input. Now the examples are taken here. So individual input can be in terms of the labour input, it can be in terms of the capital input, it can be in terms of the material input.

So you can see that partial productivity measures focus on the individual input. So individual input can be in terms of labour, it can be in terms of capital, it can be in terms of material or it can be in terms of energy. So the input is one input and then the output is taken rather that may be total output. So the output is represented in terms of per unit input and that input is also may be an individual input.

So based on that we can have labour productivity, so we have labour only as the input and maybe one example can be supposed a company produces 500 cars in a week and suppose 500 people are working for the organization, so we will say that the labour productivity is 500 cars per week/500 people so maybe we are taking only one input that is 500 people or 500 labour working for the production of car.

Output is 500 cars, input is 500 people working for one week, similarly the capital productivity can be that how much capital input we have given and what is the output that we are producing and similarly the material productivity. So it is individual productivity that we are considering in case of partial productivity measures.

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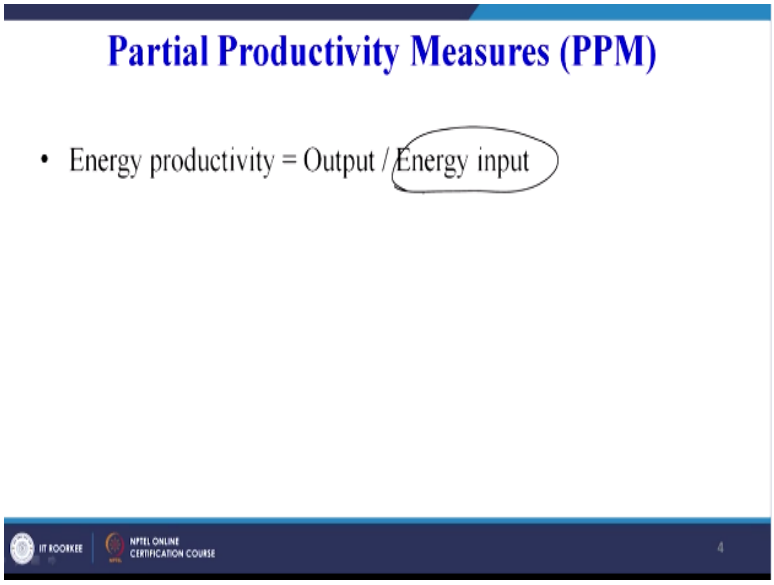

This I have already explained the energy input here that you can see the partial productivity includes one type of input only and the output can be the total output. Let us take few examples quickly. So partial productivity measures let us see what is the major disadvantage now?

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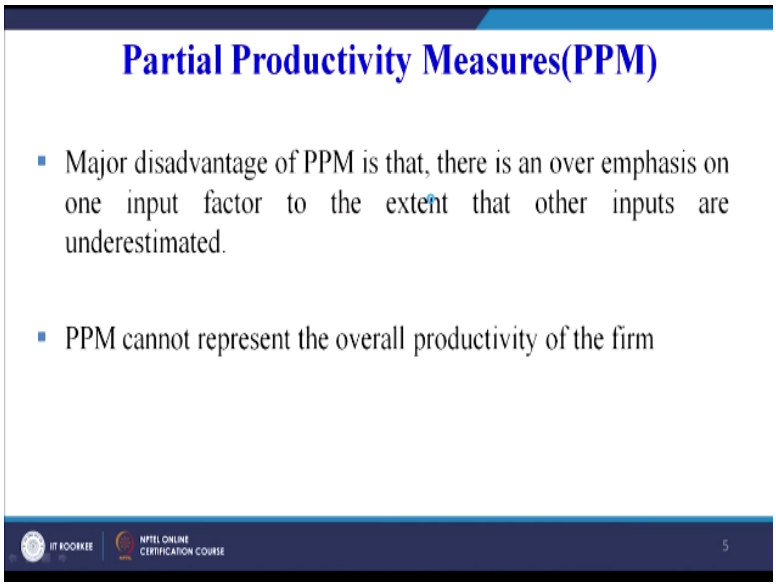

The major disadvantage of partial productivity measures is that there is an over emphasis on one input factor only to the extent that other inputs are underestimated. Now we are in case of manufacturing of 500 cars in a week, suppose in labour productivity we are focusing on 500 people working for number of hours they are working per day and accordingly we can calculate that per percent how many cars are produced.

So that can be easily done mathematically but we are ignoring how much money has gone, we are ignoring how much energy has been used for producing the car, how much power input has been used by the machines which are operated by people or which are operated by the labour. So basically in partial productivity measures we are focusing much on one of the factors only.

So that is over emphasis on one factor and under estimation of the other input parameters is one of the drawbacks of the partial productivity measures. Moreover, partial productivity measure cannot represent the overall productivity of the firm. So may be one input and the output we may have this notion that we are very, very productive from this input point of view but there may be other inputs which are not performing that well.

So we are not able to gauge the overall economic health of our organization by over focusing on one input parameter only in case of partial productivity measures. So let us now see the examples.

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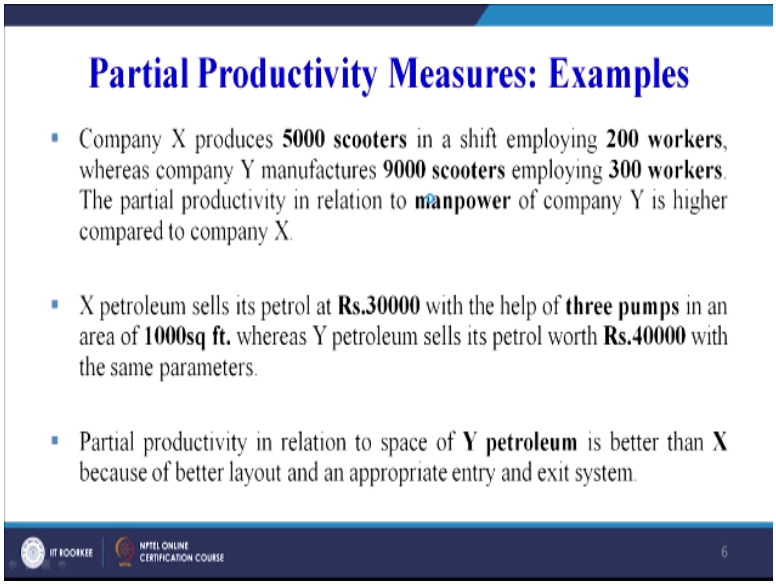

So partial productivity measures let us quickly have some examples. Now company X produces 5000 scooters in a shift employing 200 workers whereas company Y manufactures 9000 scooters employing 300 workers per shift. So the partial productivity in relation to man power so we are only now taking man power as the input, output is 5000 scooters for company X and 9000 scooters for company Y.

So we can very easily calculate the partial productivity in relation to the man power as the input for Y is higher as compared to X. So we can very easily see that output is 5000 scooters, input is 200 workers. So we can see 5000/200 is the partial productivity for company X whereas 9000/300 is the partial productivity for company Y. So we can say that partial productivity for company Y is higher than the partial productivity for company X.

Similarly, X petroleum sells its petrol at rupees 30,000 with the help of 3 pumps in an area of 1000 square feet. So now there are you can see input that is 3 pumps are used and the areas maybe the square feet area of the petrol station is 1000 square feet whereas Y petroleum sells it petrol worth rupees 40,000 with the same parameter, so in same area Y petroleum is selling rupees 40,000 worth of petrol whereas in the same area petroleum X is selling rupees 30,000 worth of petrol.

So the output is in terms of money 40,000 and 30,000 input is same so we can very easily say that the partial productivity in relation to space, now what is the input the input is the space. You can say a specific input is being used that is one input is used and the output is in terms of money the amount of petrol saved in terms of money that is 40,000 worth of petrol.

So partial productivity in relation to space you can see here this is the input of Y petroleum is better than X because better layout and an appropriate entry and exit system. So the space as a input is better utilized by company Y or petroleum Y as compared to petroleum X. So this is you can say examples of single factor or we can say partial productivity measures in which only one factor is taken as the input and is compared in context of the output or the total output.

Now total productivity measures it is slight you can say advanced version of partial productivity measures. So this is based on all the inputs. So as the word total is coming into picture it is based on all the inputs.

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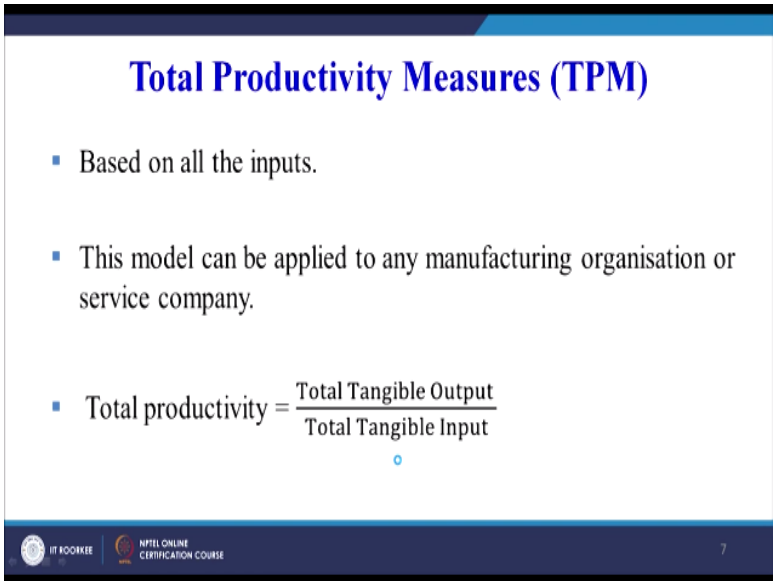

So based on all input this model can be applied to any manufacturing organization or service sector company. So total productivity is given by total tangible output/total tangible input. Now what is the output?

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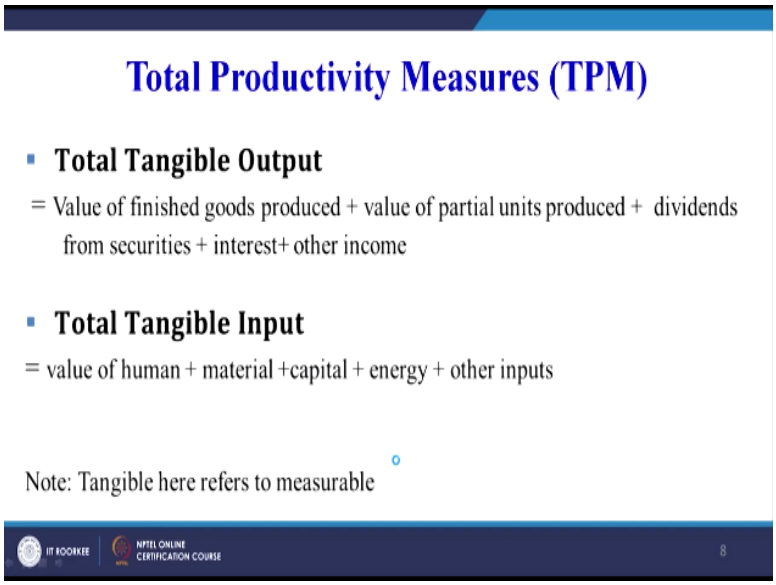

The total tangible output this is just an example that is given to clarify that what is the output, it is the value of the finished goods produced+the value of partial units produced if any+dividends from securities+interest+other income. So you have a complete total tangible output which is quantifiable which is objective in nature.

Then, the total tangible input that may be in terms of the human resources, in terms of the material that has gone into producing that product, in terms of energy, in terms of the capital which can be may be working capital or may be capital linked with the material procurement.

So all kinds of capital as a input and then plus the miscellaneous inputs. So you have a combination of inputs here and tangible output.

So the ratio of these will give you a total productivity measure. Now what are the features of a total productivity measures.

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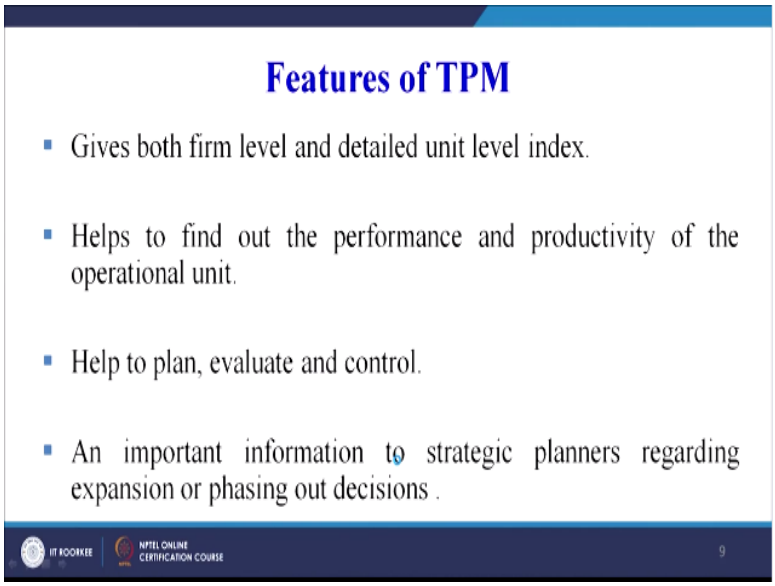

It gives both firm level and detailed unit level index, helps to find out the performance and productivity of the organization or the operational unit, helps to plan, evaluate and control. So now you have better control, you are having an overall productivity measure in which you are considering all the inputs that are going into your system and what is the output being produced by all these inputs taken into consideration in totality.

Then, important information to strategic planners regarding expansion or facing out decisions. So this factor or this we can say total productivity will give an idea to the planners or the strategic planners that whether to go ahead with the production or to face out the production. So it can help in making strategic decisions for an organization.

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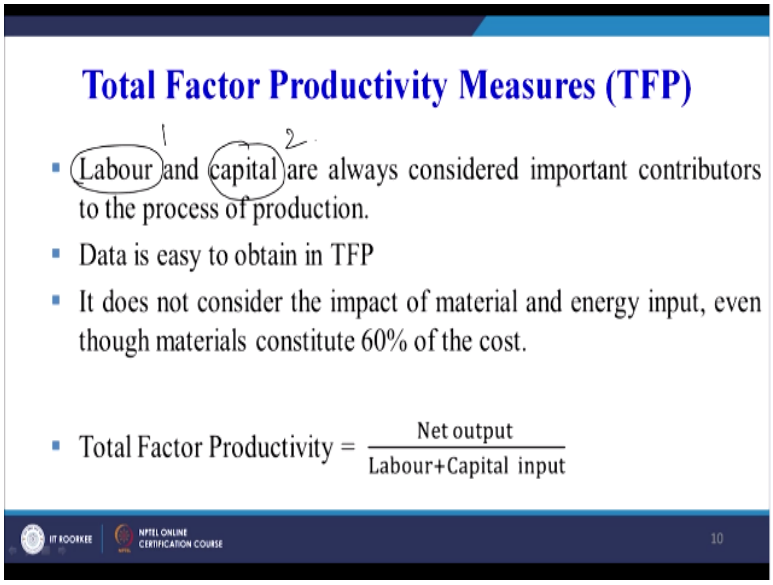

Now let us take the third productivity measure that is the total factor productivity measures. So we have seen 2 types, this is the third type, TFP so labour and capital are always considered important contributors to the process of production. So we can see here labour and capital, so one input is labour, another input is capital, so these are the 2 important inputs which are taken into consideration in case of total factor productivity measures.

So basically it does not consider so we can emphasize does not consider the impact of material, energy, input even though material constitute 60% of the cost. So material is not considered, energy input is not considered, only labour and the capital is considered in case of calculation of productivity using the total factor productivity model. So which you can see as per the total factor productivity labor and capital are only taken while we are calculating the total productivity using total factor productivity measure.

And the net output is same as we consider in our previous examples, so this is another measure of productivity. So we have seen 3 measures of productivity by now. If you remember that is partial productivity, then there is total productivity and then there is total factor productivity measures.

So based on the input, based on the information, based on the data available with the organization, based on the type of operation the company is doing, based on the factors that they want to consider for evaluating their productivity, there is a set of productivity measures available with the organizers or with the organization which they can choose from. So if they

want to focus only on one significant input parameter maybe labour if it is a labour intensive organization they can easily choose the partial productivity measures.

If they want to do the overall analysis, make strategic decision making they can take into account all the factors so they go for total factor productivity measure. So as we have seen I will again go back to the previous so this is total productivity measures, so all inputs are taken into consideration. Then, we come to the total factor productivity measures, the third one in which we only consider labour and capital as the input and we ignore the material and energy input.

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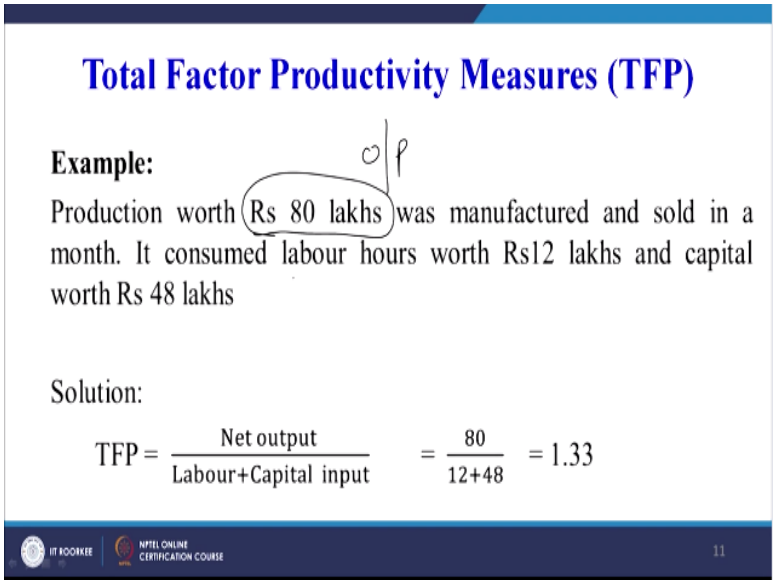

Total factor productivity measures and we can take the example here, just try to understand production worth rupees 80 lakhs was manufactured, so this rupees 80 lakhs is our we can say the output and sold in a month. It consumed labour hours, so this is our first input worth rupees 12 lakhs and capital worth so capital this is our second input and as if you remember in our slides we have seen that in total factor productivity we will consider only 2 inputs that is the labour input and the capital input.

So we have 12 lakhs as the labour hours and 48 lakhs as the capital linked with this activity. So the net output is 80 lakhs which is already quantified, it is objective so the total factor productivity will be 80 that is the output/labour+capital input, labour input is 12 lakhs and capital input is 48 lakhs, so 80/12+48, this will give us the total factor productivity. So we have seen 3 types of productivity measures.

Now let us see the last one that is the multifactor productivity measure. So multifactor model considers labour, material and energy as major inputs. So if you see the previous you can say productivity measure, we have seen that it considers 2 inputs only which are these 2 inputs. These 2 inputs are the labour and the capital involved and the previous slide we have seen an example based on that but multifactor productivity focus on 3 important input parameters.

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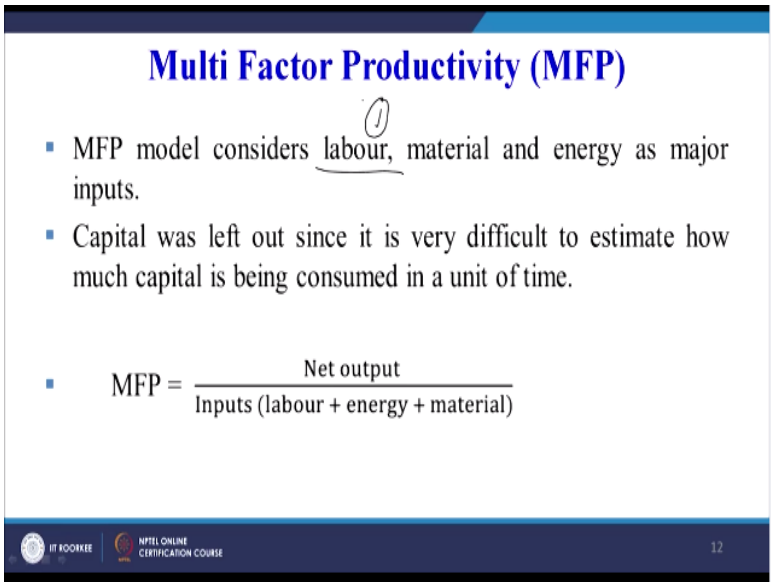

So first one is the labour which is common with the previous method or previous productivity measure then in addition it considers the material input also and it considers the energy. So what it is not considering, it is no considering the capital that is used whereas the previous productivity measure focused on the capital also. So here 3 inputs are used and capital is left out, so the capital as an input is left out in multifactor productivity.

Why it is left out? Since it is very difficult to estimate how much capital is being consumed in a unit of time. So does not consider the capital, only consider labour, material and energy as the input parameters. So the multifactor productivity can be calculated as the net output which remains the same as in the previous measures but the inputs are labour, energy, and material.

So here 3 inputs are considered whereas in the previous productivity measure we have considered 2 inputs only that is the labour input and the capital input. So overall summary of this 4 productivity measures is that based on our requirement we can choose any productivity measure and use it effectively for our strategic planning, for our decision making processes.

So with this we conclude the 4 types of productivity measures. The partial productivity measures, the total productivity measures, the total factor productivity measures.

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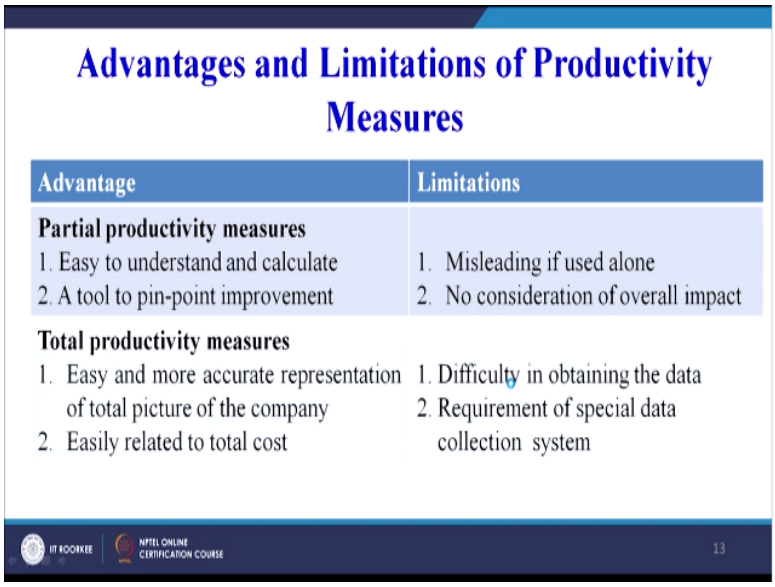

Now let us see the advantage and disadvantages of these. So partial productivity measures easy to understand and calculate, so only we have to quantify, we have to objectively represent one of the inputs and then try to relate it to the output produced or the net output produced so easy to understand and calculate.

A tool to pinpoint the improvement, so we can see that from labour productivity point of view how we are doing whether we need to pull our socks, whether we need to work hard, whether we need to pinpoint the problem area so that our labour productivity improves because we are taking only one input in calculation or in the overall productivity measurement.

So there are advantages with partial productivity measures also but the limitation is that as I have already explained it can be misleading because we are taking only one input parameter and if there is no consideration of the overall impacts of the inputs that are going into the system which already has been explained today. Total productivity measures, it is easy and more accurate representation of and it gives the total picture of the company, easily related to the total cost.

So may be in the denominator when we add all the inputs, it can easily help us to estimate the overall cost of production but sometimes as I have already explained it is very, very difficult to quantify each and every type of input that is going into the system. For example, for

making a particular product or for improving a particular set of operations there was a consultant who was hired for this purpose.

Now the payment to the consultant is definitely input that is going to go into the system but whether that he may be there for 10 days only but his inputs have maybe changed the way the operations are done and it may be influencing for the next 10 years the way the operations were being done or operations are being conducted. He has modified the way the operations are being conducted.

So his input how to put this input into the overall productivity calculation for the organization, sometimes it is difficult so it may require special data collection system. So we may need to have maybe specialized you can say softwares where we can see that what type of input we are giving and how it can be included in our productivity measurement system. So that is you can say sometimes are challenging task, each and every input that is going to produce a tangible output sometimes may not be objective.

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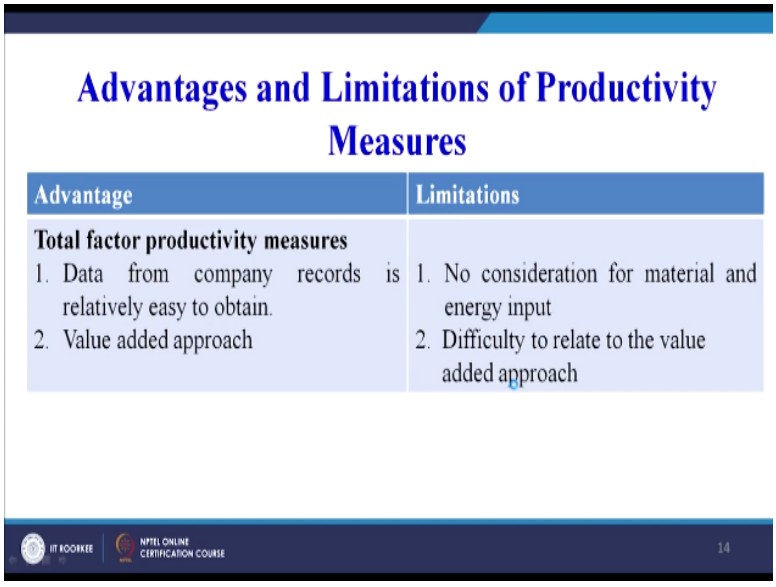

And sometimes may not be quantifiable, so that is one challenge of the total productivity measures and then the total factor productivity measures, data from company records is relatively easy to obtain and it is a value-added approach. So whatever inputs have been given so they are valued to our output. So no consideration for material and energy input although we have seen that material cost is approximately 60% as was represented in the slide, difficult to relate it to the value-added approach.

Sometimes there may be other inputs also which must be considered in order to understand the overall value addition of the inputs into the outputs, which is not possible because here our focus is primarily on 2 inputs only. So with this I think we conclude the today's session and I think in the maybe last 25 minutes or 26 minutes whatever we have discussed this topic on we have at least been able to understand that yes it is possible to quantify the inputs.

We can try to relate these inputs to the outputs and depending upon the information data available and the basis on which we want to compare the productivity or the area on which we want to focus, we can choose our productivity measurement approach and accordingly calculate the productivity for comparing or for improvement purposes. With this we conclude the today's session.

In the next session, we will carry forward our discussion on this important topic of productivity which is you can say a backbone of all work system improvement techniques. Thank you.