Principles of Industrial Engineering
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Lecture 60
Productivity & Work Study

Hello, I welcome you all in this presentation related with the subject Principles of Industrial Engineering and in this presentation we will be taking up a new topic that is about the productivity and the work study. So, how the productivity and work study can be related with and can be used favorably to improve the economy of an industry or of a society or of a country.

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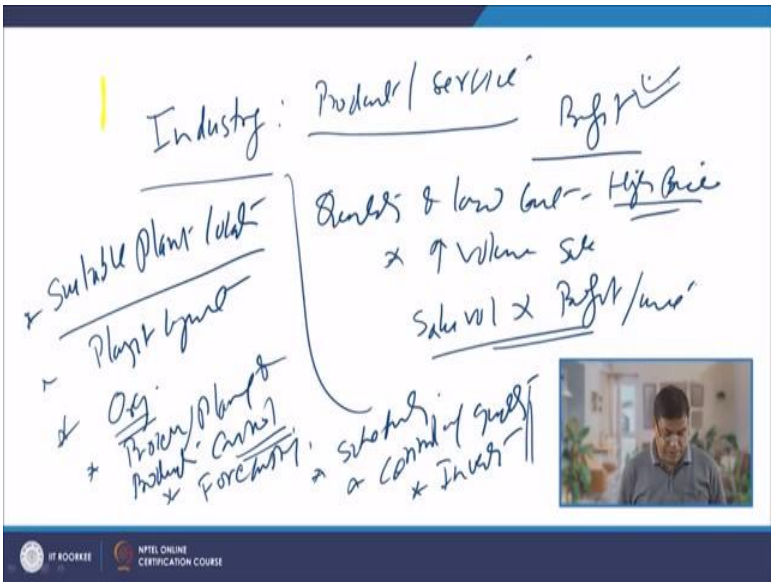

So we know that all the organizations whatever industry is there, industry is a primarily they produce the products or they provide services with a primary goal of the profit. So to increase the profit, what is done basically? The product and services are made available, basically the quality products and services are made available at the low cost, so that it can be sold if at a high price that will be leading to the best situation with regard to the profit and thereafter increasing the volume of sales.

So increased volume and high, the sale price to the actual cost of the product difference will be leading to the increased profit. So the sale volume multiplied by profit from each

per unit, that will be giving us the increased profit. And for this purpose, organizations, industries will be doing all the possible things like locate the plant suitably, suitable plant location so that the cost is less or they are able to increase the sales, and develop the plant layout in such a way that it avoids unnecessary extra movements and the flow of the materials, manpower, resources is such that there is a minimum hindrance and in minimum time they are able to come up with the products and services.

Then, accordingly, the suitable organizational structure is developed so that the manpower is very effectively utilized. They understand their role with the, and with a minimum conflict there the responsibilities are executed and then a proper process planning and control.

So, like what is to be produced, in what volume is to be produced and whatever is needed to produce the required volume so that the customer requirements can be satisfied and taking the suitable initiatives and actions to meet the target date so that the deliveries can be made on time, so the production planning and control, production planning and control, this is the another thing.

Then, how much volume of the goods and services is to be produced in a coming time for that forecasting is done. So through the forecasting, how to produce the things on time without delays? So proper scheduling of the things is done and then the things are to be produced in a required quality, so the proper control of quality of the goods and services is needed and whenever and whatever is needed to be supplied for production or for supplying the need of the customers, proper inventory is made. All these things are done to realize the goal of the maximum profit.

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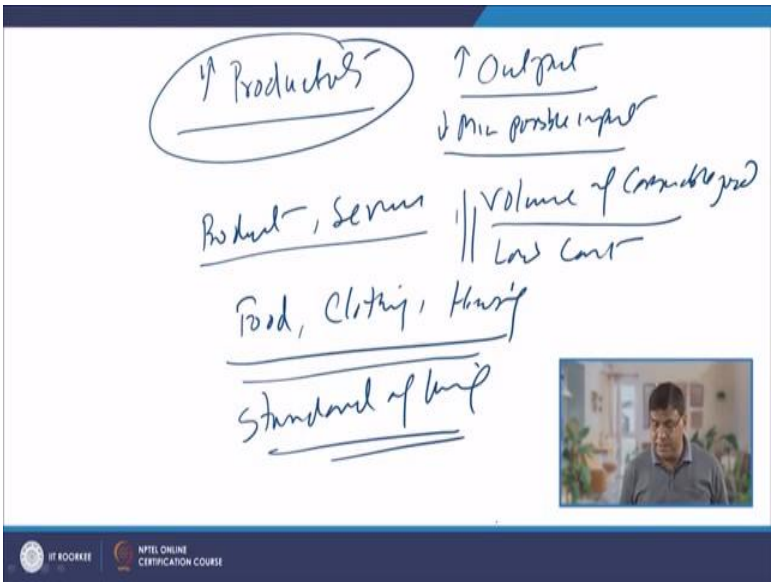

So, the idea here is that through all these factors, efforts are made to increase the profit through the high productivity, means coming out with the more and more goods and services while using the minimum possible inputs in form of the various resources which are needed to produce.

So, when this is realized, increased output with the minimum possible input resource, this helps in increasing the productivity and when we realize this, means using the less resources we are able to produce more product through the more effective utilization of the resources and more services are being made available.

So basically, this will increase the volume of the consumable goods and services which can be consumed by the public and the society, so volume is increased. And if that is made available at the low cost, then the availability of the things to be consumed by the public in society will be increased and that in turn will be increasing the availability of all materialistic items needed for the people, for the public in a society.

So means if we say, increased productivity means increased availability of the food, increased clothing, increased availability of the housing. These three things are, if available, in a very large volume at low cost, then everybody will be able to have the access of these which in turn will be increasing the standard of living.

So the productivity in that way is extremely important in improving the productivity, increasing the standard of living of the public in a society. Whatever type of the industry and organization is, efforts must be made to produce more using less.

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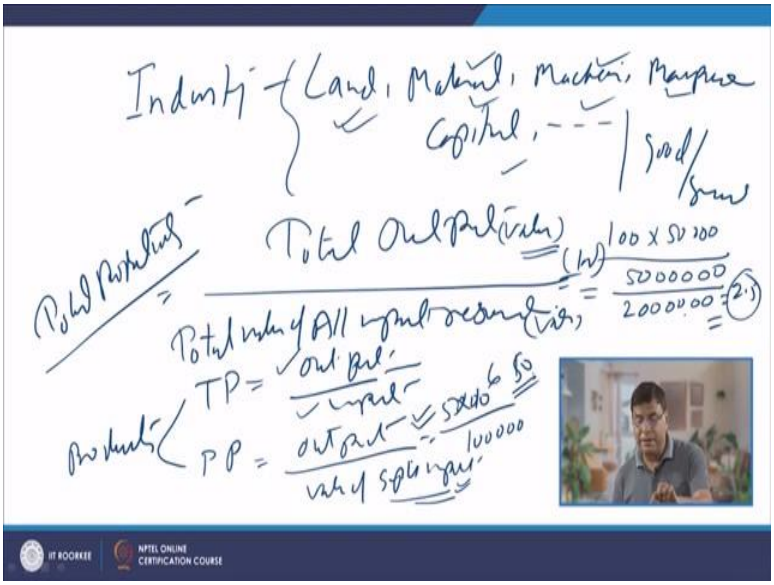

There are ways to measure the productivity and its importance will depend upon the kind of the resources which are being produced. Depending upon the kind of the industry, they may use the variety of the resources which may be in form of land, it may be in form of material or machines, manpower, it may be in form of capital and there can be many input resources.

And the relative importance of these resources may not be equal for all industries in all states in all countries. So, depending upon the relative importance of these input resources to produce the target goods and services, their effective utilization is ensured something which is very precious in form of input resource must be given enough attention for most effective utilization to produce the goods and services.

So considering the total output, which may be in form of any good or services, so this is basically, this may be in form of like the total value of the output which is being produced. Say, the 100 of the motorcycles are being produced and cost of each one is 50,000 then this is how we will be getting the total value of the output which is being

produced, divided by the total value of all input resources. So the total value of the all input resources in form of like say land, material, machines, manpower, capital, etc. all that is also taken into account. So value of that is also taken into account, say if that is coming out to be the, like say this much, then it will be giving us, this ratio will be giving us the total productivity.

In case of the total productivity, what we consider? The value of the this total output divided by the total input, so output may be in different forms, so and likewise input may also be in different forms, so we basically try to convert that output or input in value in terms of the value or the worth which has been produced or the worth of the items which have been used. So in this case, say, it will come out to be 2.5, 2.5 will be the productivities expressed in basically the percentage. So it will be 250 percent will be the productivity.

Now, so there are two ways to measure the productivity, one is the total productivity and another is the partial productivity. So the total productivity is calculated in a simple way wherein the total, value of the total output divided by the value of the total input which is given to produce the given output.

So output divided by the input simply will be giving us whatever in form of output is whatever in form of input is, all that is taken into account to calculate the productivity of organization of department of a section, likewise. And when we consider that whatever is the value of output divided by the value of a single input is considered, like say the output here is still same, 5 into 10 to the power 6 divided by.

Now we will see, we can put the value of land, we can put the value of material, we can put the value of machine. So the value of the single input is given when we determine the ratio of the value of output produced divided by the value of single input being given which maybe, like say 10 to the power 5. So here we will be getting the partial productivity like 50. So depending upon the kind of relative importance of the various input resources, the partial productivity and the total productivity will be giving us the different kind of the ideas.

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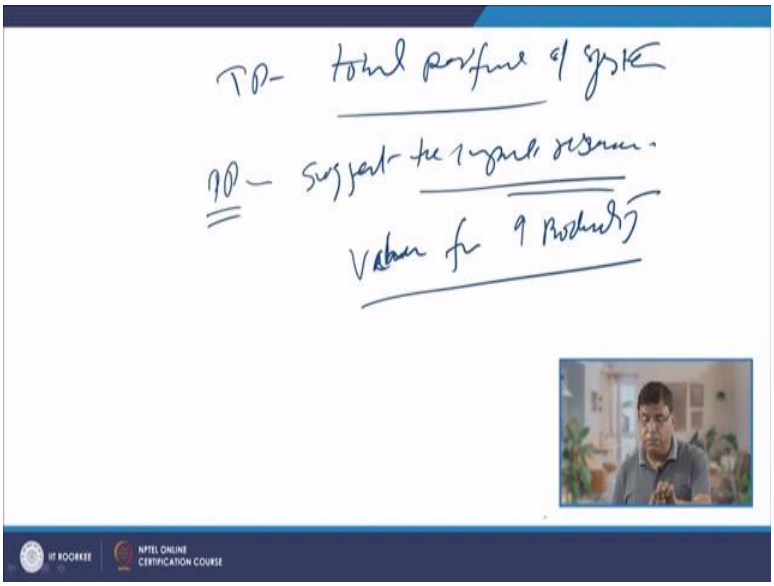

A total productivity gives us the total performance of the system, like how effectively all the resources are being used. While the partial productivity indicates how effective contribution of the particular input resource is, but that may not always give the very useful input but sometimes it suggests which input is really more important than others and which input resource should be given more attention, which input resource requires more careful consideration for increasing the productivity.

So it, partial productivity suggests the kind of input resource that has to be given more importance consideration for enhanced productivity. Basically, partial productivity may give us the venues for improving the productivity. It may suggest the zone, areas kind of input resource where work can be done for enhancing the productivity.

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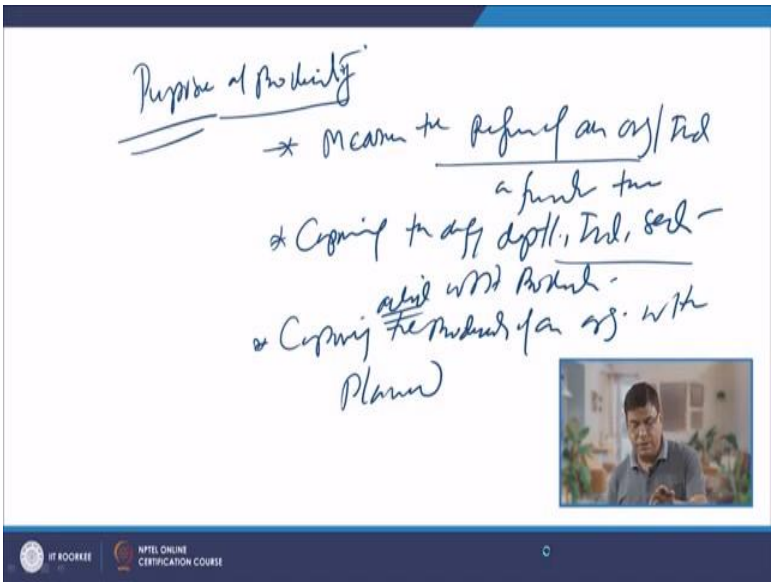

So, what all the situations where the productivity is, what purposes through the calculations of the productivity can be realized. So the first thing is we are able to measure the performance of an organization or industry as a function of time. Like what was the productivity of a particular plant last year or two years before, or what is the current productivity of a particular organization?

Second, it helps in comparing the different departments, different industries, different sections with respect to productivity. And one more thing, if some corrective measures are being taken, so if there has been any improvement in productivity or if there was a target productivity level and then up to what level that productivity has been achieved, that also can be measured.

So basically, comparing the productivity of an organization with the, means comparing the actual productivity, you can say actual productivity of an organization with the planned productivity. So the actual versus planned, comparing the productivity of the various departments, sections, industries are measuring the performance of the organization or the industry as a function of time, what has been the trend of variation in the productivity, how good a particular department is doing or what was the actual productivity as compared to the planned productivity, that is what we can easily get through the productivity measurement.

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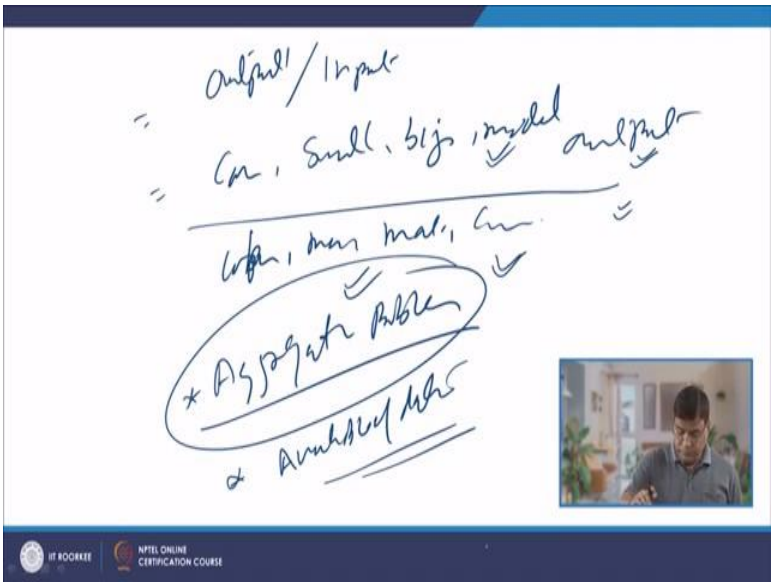

But it looks to be very simple, definition of the productivity looks to be very simple like simple ratio of the output and input. But as we have seen, an industry may be involved in variety of the products, like the cars are being made, then the cars are, the small, big or different models, each model costs, so each model is being produced in the different numbers, their cost is different, the kind of profit being given by the different models of a car are different.

So a company may have the different products, different models, each product may be offering the different profitability, their sale volumes may be different and likewise. So these are the issues related with the output. Output is coming in different forms, in different volumes, similarly the inputs.

Depending upon the output, input resources are also changing in form of the labor, in form of the man expertise, in form of material being used, in form of consumable, power, etc. all these things are very large and very different in nature, so their cost calculations are difficult.

So this kind of the problem where output is in different forms of the different price of different volumes, input is also of the different varieties, in different costs and different volumes. So, this makes the productivity conversion of all these outputs and inputs in

simple numerical terms becomes very difficult and that is what called aggregation problem. It is very difficult to come out to the aggregated values of all outputs and the kind of inputs which are being given to produce the output. So, this is one aggregation problem in calculation of the productivity and the second is the availability of data.

Many times the data and the precise calculations, precise values of the different input resources and different output things which are being produced is not available. So, availability of the data and aggregation of the input and the output values, these are the two major problems related with the productivity.

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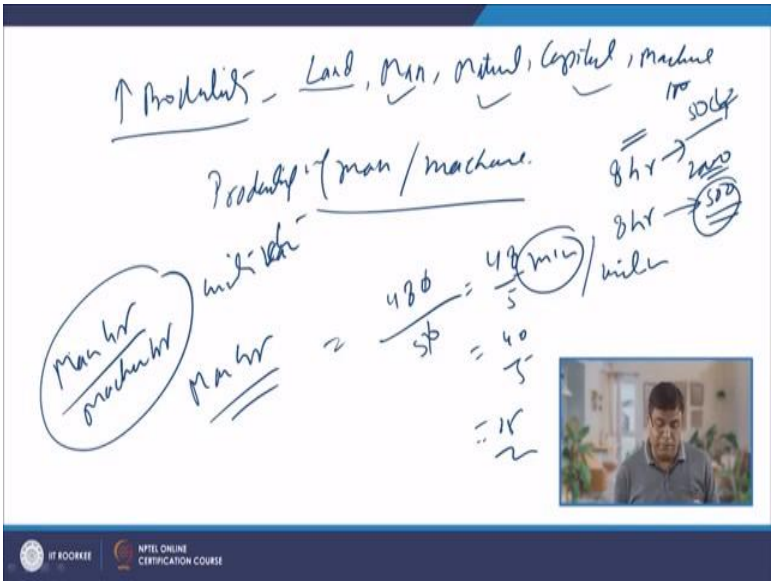

So as I have said for increasing the productivity, we target for, if there land is used then the given land we should try to produce as much as possible or for a given volume we should use as less land is as possible. Likewise, whatever manpower, whatever material is being used, whatever capital is being used or the machinery is being used, in less we should produce more, that is the idea.

So accordingly, we will have the productivity of the man, material, machine, capital, etc. So if we are interested in determining the productivity of the man or machine, means in 8 hours of the job, how many units are being produced by a machine or a man? Like say, if 50 units are being produced by man after 8 hours, while on the other hand the work of the

8 hours of the machine produces 500 units. So there is a lot of difference, the kind of output from a machine and the kind of output from a man.

So how many units are being produced in per unit time or how much time it takes to produce? So if in 8 hours means 480 minutes, 50 units are being produced, like say so 48 by 5 this will be the kind of minutes it, a worker takes to produce per unit item, minutes per unit item. That is the kind of the man hours takes to produce.

So if he starts taking 40 by 5 or 20 by 5, then the number of units that he can produce in 8 hours, that will be increased. Similarly, instead of producing 500 units, if the machine is able to produce 2,000 units, then productivity will be increased by fourfold. Similarly, if the number of units being produced by the man from 50 to 200, sorry 100, then it will be leading to the increase in 200%, increase in productivity of the man.

So the thing is to check the productivity of a man or machine, we need to see really how many man hours or how many machine hours are taken to produce unit item. So the time to produce a unit item indicates the productivity of the man or machine.

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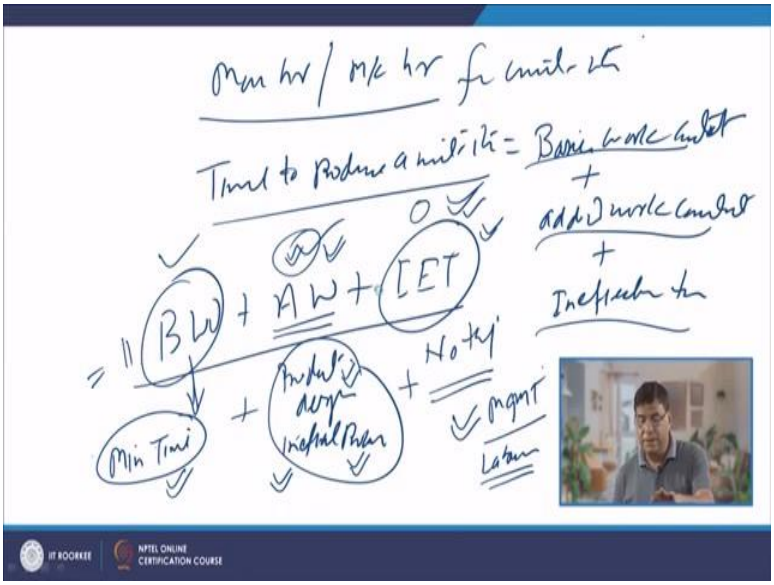

We need to see really this time man hour or machine hour is composed of what? Means what are the factors which lead to the requirement of particular man hour or machine hour to produce a unit item, for unit item. So that we can say the time to produce a unit

item is composed of three things. One is the basic work content plus added work content plus ineffective time. So the time consumed in doing the basic work, time consumed in doing the added work and the time during which nothing is being done. So these are the three things. Basic work plus added work plus ineffective time.

These are the three things. Basic work is the kind of the minimum time that is needed to do this work. Basic work is about the irreducible minimum time that is needed to do the particular job under the prevailing technological conditions. So in a given situation this is the minimum time which will be taken to do the job, whether it is done by a man or whether it is done by a machine.

So this is the time, minimum time which in any case the job will take for its completion, but due to the poor design, due to the poor product design or due to the inefficient process, it takes longer like the machine is not running at the right speed or the product design is such that it does not allow the efficient use of the manufacturing process or it leads to the lot of rejection, it needs a lot of reworking.

So when the design is not perfect or when the process itself is not perfect, then it needs longer time to do the same job, more time is to be spend and that is what is called added work. Machine is not able to run at the required speed or required tooling is not available, worker is not really efficiently working on.

Then, apart from this, so at least in these two situations with the basic work and added work, something is being done during the job for its completion. On the other hand, in ineffective time, there is no, nothing is being done. It is just, everything is idle, neither material is being processed nor man is working, so there is no progress.

So this is simply wastage of time which may be due to the variety of reasons like worker is there but not working, or worker is absent, or machine breakdown has taken place, material is not available to do the job or due to the poor marketing policy frequent changes in the setting is needed. So there can be number of situations which may force to the situation where no work is being done, since the time to produce a unit job comprises the basic work, added work and ineffective time.

So, if you see the time during which nothing is being done is the ineffective time. This may be due to the poor management, like process planning is not poor, material control is not poor, machines are in poor conditions, frequent breakdowns, frequent accidents are taking place.

So we would like to eliminate the ineffective time first through the effective management and the proper training and incentives or motivation to the workers, and thereafter we will be working on effective process planning, effective product design, so that the added work time can be timed for doing the added work can be reduced. So these are the two zones, added work and the ineffective time.

The attack is being made, attack is made first on ineffective time and thereafter on the added work. And we cannot do anything for the basic work to cut down the time further, so basically our, the two techniques in the work study and focused on reducing the added work and ineffective time.

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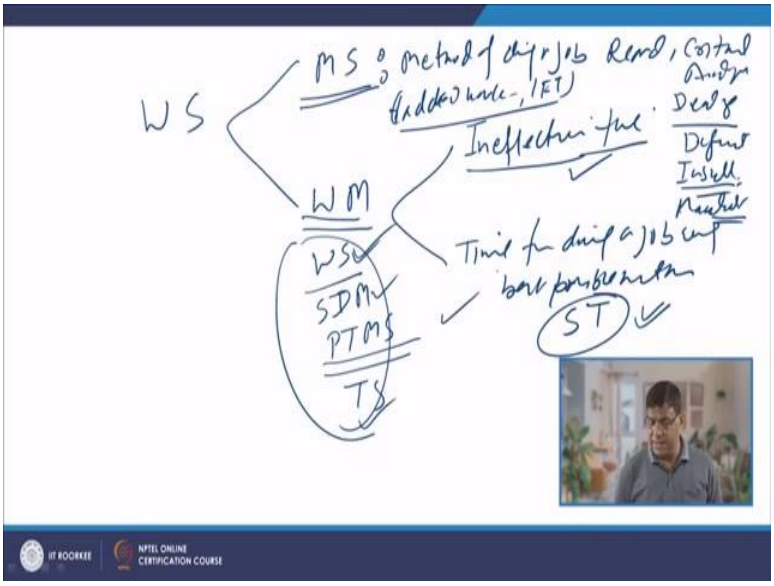

So basically, work study involves the two broad techniques, one is method study and another is work measurement. Work measurement focuses, it is about the quantification of the time using the various techniques, like the work sampling, standard data method, PMTS, predetermined time motion study or time study. So these are the techniques of the

work measurement which are used for two purposes. One is quantification of the presence of ineffective time if it is there. So once the ineffective time is identified in the procedural aspects of the work, then that is eliminated and thereafter the, and another purpose of work measurement is to quantify the time for doing a job using the best possible method, so that standard time for doing the job can be set.

So there are two purposes, setting the standard time and identification of the ineffective time. And this is realized through the work measurement, sorry, work sampling, standard data method, PMTS and time study method. On the other hand, method study primarily focuses on the jobs for improving the method of doing a job, so that all redundant things, all unnecessary things can be eliminated, the efforts of the worker can be reduced and the method is developed in such a way that the job can be completed in the minimum possible time.

So, it basically records the observation, does the critical analysis and accordingly develops the new method for doing the job, thereafter define the method developed for doing the job using the improved method and install it in the shop floor for following the new method and then maintain it, because people have tendency to go back, so maintenance of the new method is needed.

So basically, there are two approaches of the work study, which involves the method study and work measurement. Method study focuses on improving the existing way of doing the things or coming off with the newer methods for improved and effective way of doing things, so that the job can be completed in the minimum possible time. Basically it focuses on reducing the added work and elimination of the ineffective time. And this work measurement helps in identification of the ineffective time and setting the time standard, which can be used for developing the wages and incentive plans.

Now, I will summarize this presentation. In this presentation I have talked about the importance of the productivity, what are the different types of the productivities, what are the issues related with the productivity measurement and what is the purpose of the productivity measurement and how it can be and how the work study can be effectively used for improving the productivity. Thank you for your attention.