Principles of Industrial Engineering
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Lec 02
Introduction- Developments, Objectives, and Functions

Hello, I welcome you all in this presentation related to the subject Principles of Industrial Engineering and we are talking about the introductory aspects related with this subject. In this presentation primarily I will be talking about the chronological developments which have taken place in the field of the Industrial Engineering.

What are the main objectives related to these subjects and the different functions associated with this? In last 2 to 3 centuries, a lot of work has been done and which has led to the current state of the Industrial Engineering. And if we start with the kind of noticeable developments which have taken place.

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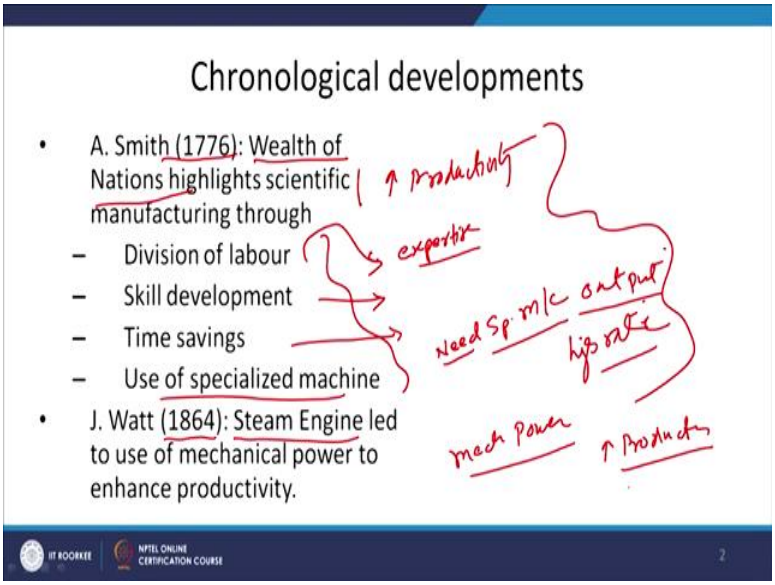

Then like one of the work which was done by A. Smith in 1776. He wrote one book on Wealth of Nations, which highlights the scientific manufacturing for improved productivity. And this he said that can be realized effectively through the division of labour so that the different the people are having the different kinds of expertise is to take the work more effectively so development of expertise as per the need of the work.

Then development of skills. so that the people are able to take up the variety of jobs which are needed, important importance of the time saving like how to reduce the wastages and

ineffective times with regard to time, so the importance of the time saving was highlighted for enhanced productivity. And the need of developing the specialized machines which can give the more output at a high rate at high rate, so use of the specialized machines was highlighted and effort of all this was primarily to enhance the production and increase the productivity.

Thereafter James Watt in 1864, he worked on the mechanical aspects and the developed the steam engine so that the mechanical power can effectively be used to increase the capability of the machine systems and the rate of production. So, mechanical power was effectively used thereafter to increase the production and to increase the productivity so that in less time more can be produced.

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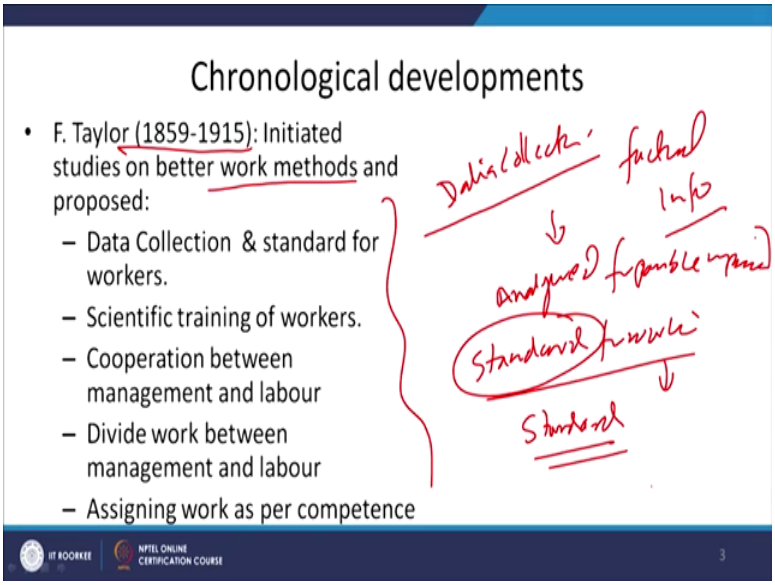

They are after the F. Taylor did a lot of work in the field of the industrial engineering and he initiated various studies related with the work method improvements. And he proposed that we need to use the data collection that is primarily about collecting the factual information about the way by which work is being done so that it can be analyzed, analyzed for possible improvements in the process.

Standard for workers like the conditions the kind of the output which will be there from the workers, so, the standard output and the those which were paid more for the better output with respect to the set standards so, standards for the workers was set and accordingly their efforts were acknowledged for the better, average and the poor performances.

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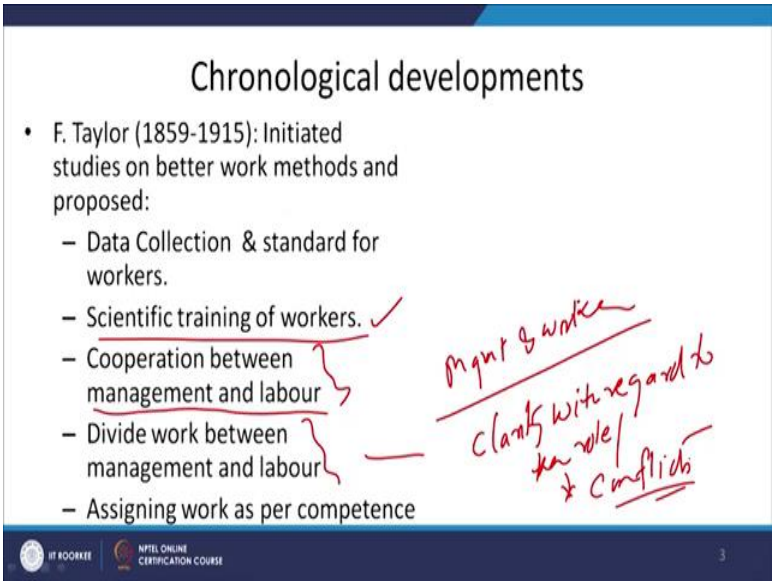

He also underlined the need for the scientific training to the workers so that they understand what is the importance of the scientific approach in undertaking the variety of jobs so that the vestiges of the resources in terms of the material, machine and the time can be reduced, so the scientific training of the workers.

Then to have the more cordial relationship and the positive environment in the industrial environment, he suggested the better cooperation between the management and workers, so that they take care of, management takes care of the interest of the workers and the labour, and the workers do the jobs expected so that the more effective output can be realized. So, he also gave the trust on the cooperation between the management and the labour so that they work together for realizing the objectives of and the goals of the organization.

Then divide the work of between the management and labour. He said that there has to be demarcating line between the management, the kind of things which will be done by the management and the kind of things which will be done by the labour so that there is a clarity with regard to their rules and which would help in reducing the conflicts if there is a proper deviation of the work between the management and the labour.

And he also means F. Taylor also gave the thrust on the assignment of the work as for the competence means considering the ability of the workers, suitable work is assigned, so that they can really give the output effectively as per their abilities and the competence instead of giving the things which either he is not capable or he does not have the required competence

to undertake the work effectively. So, if the work is assigned as per the competence that help to increase the output reduce the wastages.

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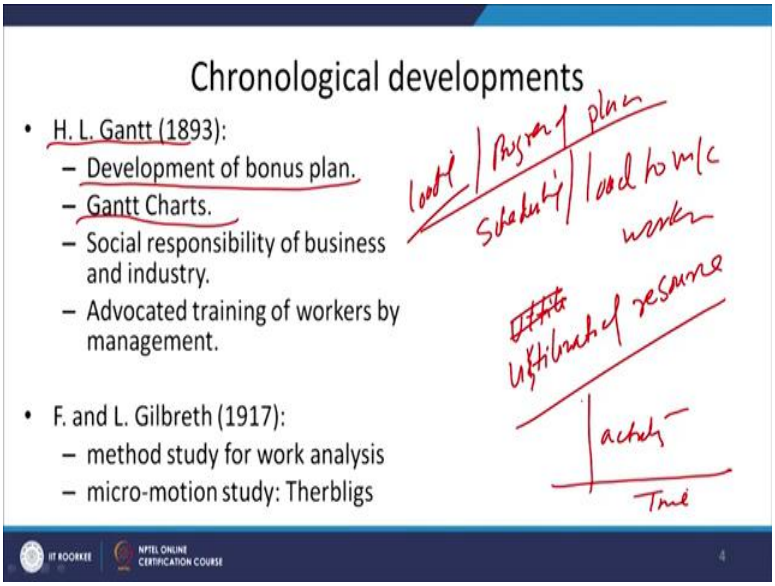

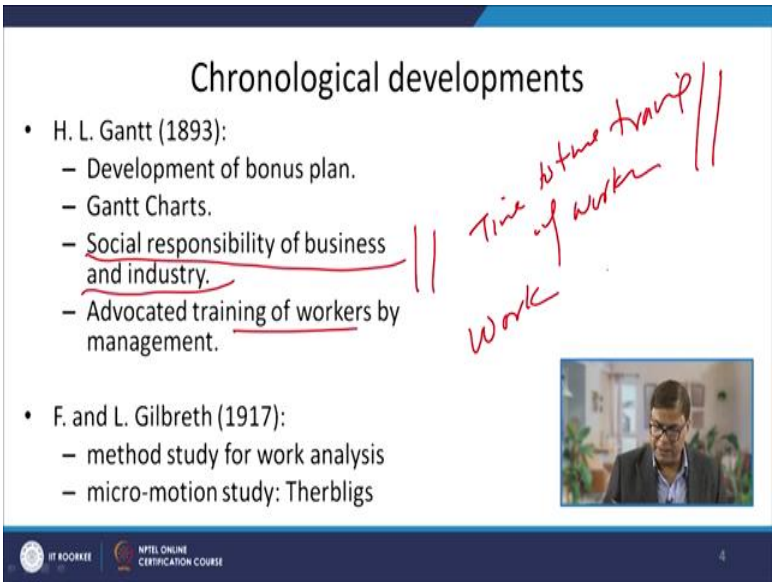

Then another important work which was done by H.L. Gantt, primarily he, he developed, he contributed in so many ways like he developed the bonus plans for those which those workers who were performing good. He developed the Gantt chart to see the kind of for effectively scheduling or giving the load to the different machines and workers so that the utilization index, utilization index of the resources, utilization of the resources in terms of the man and the machines can be realized and it is basically the time versus activity chart.

So, this is basically use it to give the load to the workers as well as machines, so that we know what is the status of any work, at any moment of time. And we will also be able to see

that the time for which any machine or worker is free or it is idle or the percentage of the time for which a man or machine is being utilized.

So, this is basically used for the loading and seeing the progress of the progress of the plan so activity versus the time chart, the Gantt chart was developed by H. L. Gantt. He also underlined the importance of the social responsibilities of the businesses and in industries so that they take care of the responsibilities of the things which are to be done by the society, which are to be done for the society by the business and industrial entities.

He also advocated the need of training to the workers by the management so that time to time training of the worker is important, he highlighted the importance of the training of the workers by the management time to time so that for so that the workers are up to date and they are, their knowledge is updated, their trainings are updated with the development of the technology and the development which are taking place in the different fields.

Then, in the field of the work is study then The Frank and Al Gilbreth worked in 1917 and he especially worked on the work study related aspects, so that the method of working can be method of working can be improved, this was his idea and, so he developed basically he worked on method study for work analysis, so that if there is any ineffective element of work involved in existing procedure, then this can be eliminated. And he also developed the various Therbligs these are called Therbligs, which help in breaking, Therbligs help in breaking down the job into the very-very small elements.

These elements are very-very small in fraction a fraction of seconds so which help in like gripping of something, then positioning of the job, movement of the hand. So, those kind of the, the small events and activities were identified in form of Therbligs by Frank and L Gilbreth. And which he had in breaking down the job into the small elements to identify the presence of the productive and non-productive elements.

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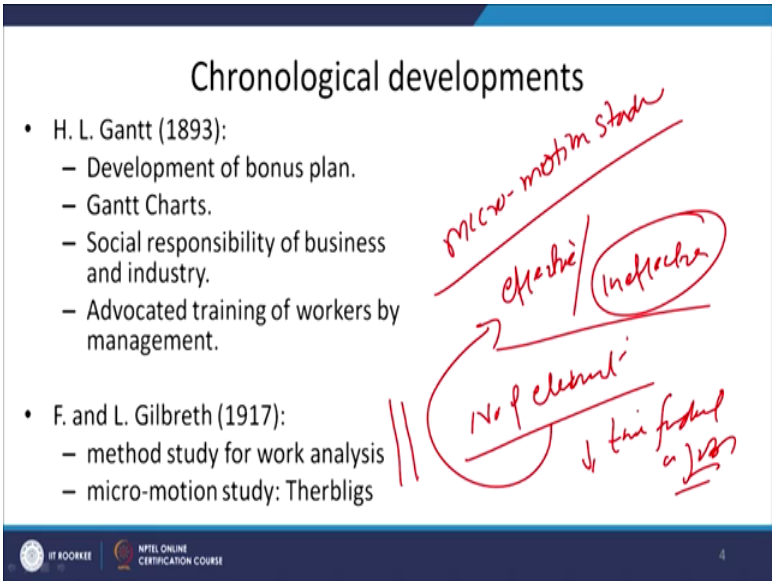

So, this was used for the micro motion studies. Like the small type small jobs like picking up of something and assembling the things which are taking place very short time things which are taking very short time. So, those kind of the jobs were broken down into the very small number of element means very small elements. And then they were analysed to see if all those are effective or some of them are also ineffective.

So the breaking of the small jobs into the number of elements there after their analysis helps to identify effective and ineffective elements and efforts are made to eliminate the ineffective elements so that the job primarily consists of the effective elements in order to reduce the time for doing a job. So in the field of the micro motion study for the work analysis was primarily contributed by the Gilbreth in Frank and L Gilbreth in 1917.

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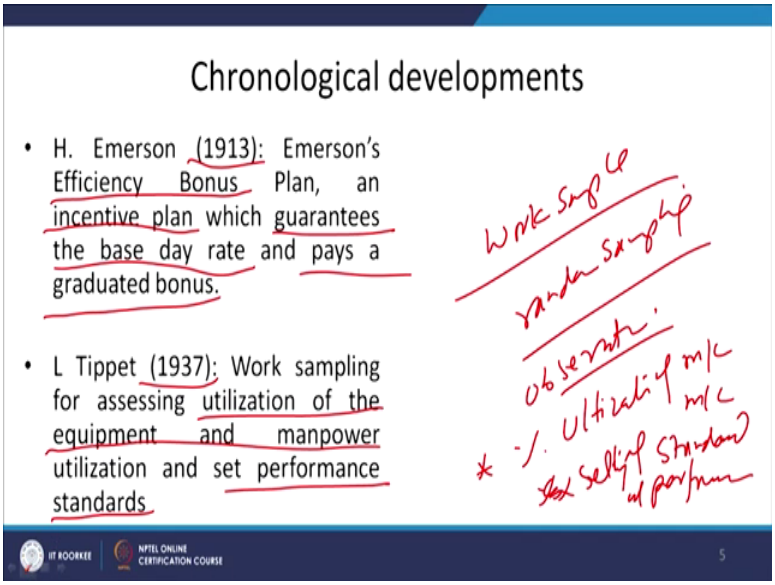

Then, the H. Emerson in 1913, he developed the Emerson's efficiency plan. And according to this plan, those which are doing good, their efforts are acknowledged in form of the additional payments, while guaranteeing some basic payments to the workers. So, the Emerson's efficiency bonus plan and incentive plan which guarantees the base day rate and it pays the graduated bonuses for those who are performing good.

Then L Tippet in 1937, he developed the work sample method. This is basically the random sampling approach, where the observations are made randomly of particular event and activity in which I have to see what is the percentage of the time, the particular event or activity is taking place and that is what is used to identify the percentage utilization of the manpower or machine, or it is also used to identify the percentage of the time particular activity is going on.

So, once we have the percentage utilization of the man or machine it can be used to set the standard setting of standard of performance. So, he basically developed the work sampling method in order to evaluate the utilization of the equipment and manpower and that was used to set the performance standards for the workers and the machines.

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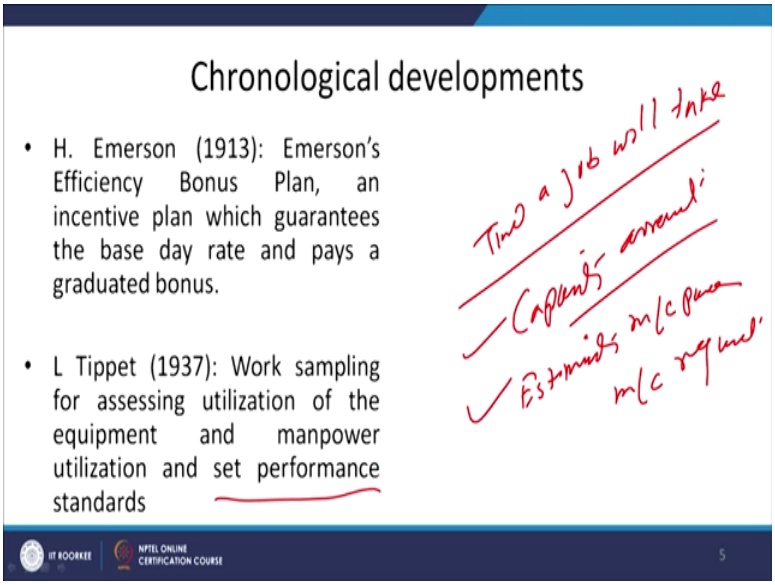

Once the performance standard is set, it would be possible to see that how much time a job will take that can be used to that can be used for capacity assessment. We know that in a one day or in one month, what is the volume that can be produced to in a given setup. It can also be used it to see the kind of estimating the manpower or the machine requirement to satisfy a given target. So, once the capacity assessment or if there is a fluctuating demands then to estimate what kind of manpower and machines will be needed in light of the set standard of performance.

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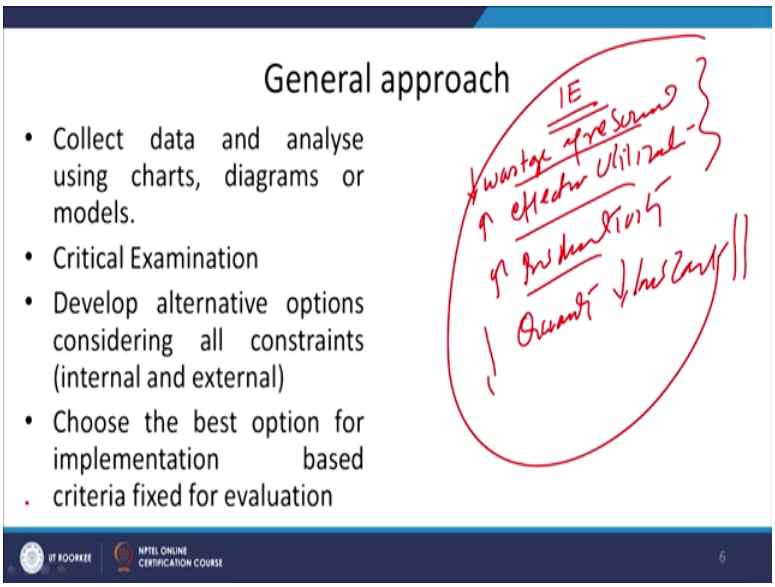

Now, we will see what in which way the industrial engineering generally works. So, the in general approach, in general the idea of the industrial engineering to reduce the wastage of

resources and increase the effective utilization. And the purpose of both these is to increase the productivity, so that where the less resources, more output can be realized and that in turn will be helping in to make the things increased quantity at low cost, so that the more and more the goods and services can be made available to the society, to the public so that their standard of living can be enhanced, this is the main idea behind. But how these wastage can be reduced and the utilization can be enhanced so that there is the improvement of the productivity.

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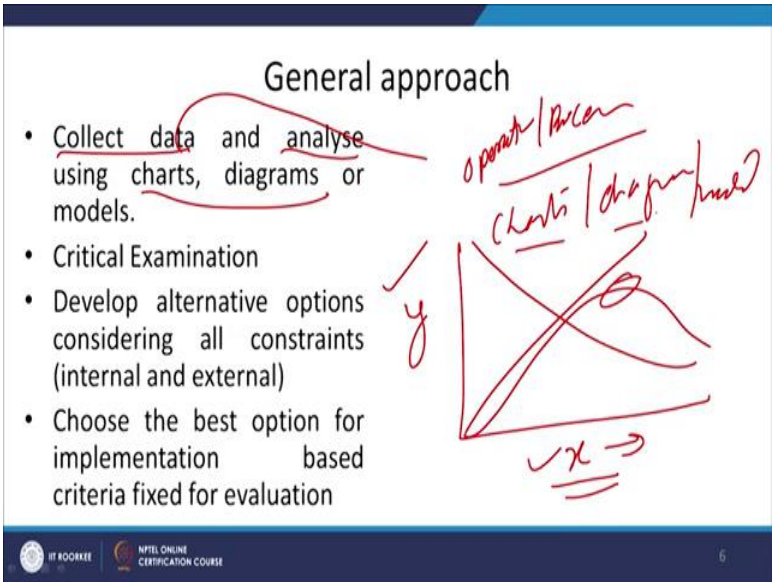

For that there is a general approach which is used, although there are different tools and techniques, but in those tools and techniques related with the industrial engineering, some general approach which is used is the collection of the data about the, about the operation or the process which is being considered and then this data is analysed, for this purpose we can use different charts, different diagrams or models.

Now, these charts may be like this, the data collected showing the effect of the variable x on the output in variable y and it may show trend like this, it may show trend of this kind, it may show that trend reducing. So, there may be optima, there may be increasing, there may be decreasing trend. So, we may have to identify what is the good condition for which the output is best or what we want to reduce, what we want to increase and accordingly we decide which kind of the value of the x will be there for the desired value of the y.

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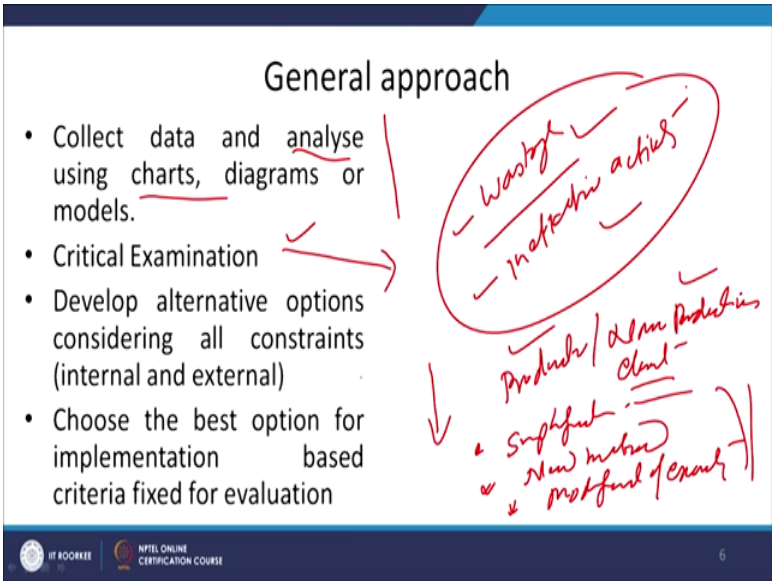

So this is how the charts and diagrams help, and likewise the models are also help in identifying in identifying the zones where the wastages or ineffective activities are taking place. So, once we are able to identify after collecting the data and analysis, things are there with us with the goal to identify the wastages and ineffective activities, we perform the critical examination, critical examination will help us to do to find out what are the redundant activities, what are the undesirable activities, what are the like say idle or ineffective activities, so the, so where wastages are taking place.

So, critical examination will help to identify these wastages and the ineffective activities more precisely and it will give us the productive and the non-productive productive elements involved in any work. And once we know that, we can take suitable action either through the simplification of the job or coming up the new method or the modification of the existing method.

So, these are 3 things which are normally done, once we identify the productive and non-active non-productive activities with the view of eliminating the wastage and ineffective activities that can be done after the critical examination. So, in light of the zones where wastages and ineffective activities or non-productive activities are to be eliminated, will be developing the alternative options.

These alternative options considering the all constants in a given situation these may be internal or external like availability of resources, availability of machines, manpower, equipment, skill and the external factors like the competitors, the customers who are

demanding or the kind of the way by which market is changing as a function of time, so all those things will be kept in mind while developing the solution or options to eliminate the wastages, to reduce the ineffective activities, non-productive activities if they are there through the simplification coming at coming up with the newer methods or modification of the existing methods.

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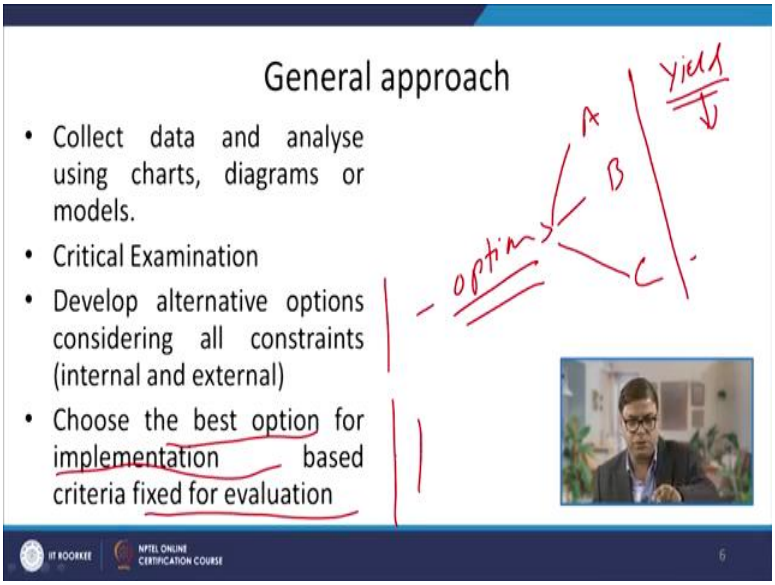

So, various options are developed under three, we come out with a number of options considering the constraints present and these options are say in form of A, B, C to eliminate the wastages, increase the productivity. Out of these we will further evaluate these options to see out of these three which one will yield the results in real yield the better results in terms of the output or the kind of input which will be needed.

So, after the proper analysis of these three options or these options which have been developed, we choose the best option for implementation based on the criteria fixed for evaluation. So like what is the target based on that what we want to realize based on that we assess all the options which have been developed or which are available and out of those best one is chosen.

So, this is one of the general approaches which means the general this is the general approach which is used for used in industrial engineering. So, first, we collect the factual information about the existing things which are being done. We analyse and present the data in graphical form or in chart and form of charts and the models, and then critical analysis is done to find out the productive and non-productive activities and which can be used to simplify the

methods, to come up the new method or to modify the existing methods so that the non-productive elements and activities can be eliminated.

And then then we develop, out of the developed options in light of the constraints present, we try to choose the best option available so that it can improve the situation in more effective manner.

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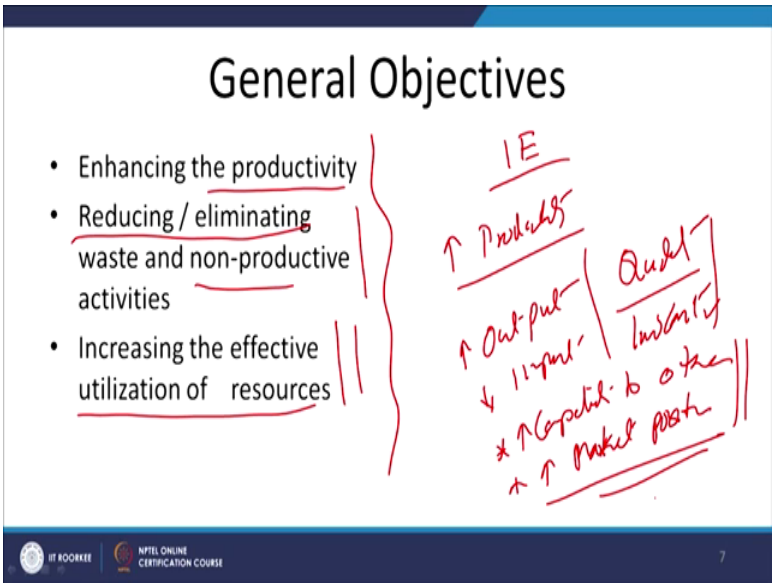

Considering the general approach and the main objective behind the industrial engineering I have said, main idea behind the industrial engineering is to increase the productivity so that using less resources, more output can be realized so that it can be made available to the users in form of goods and services. And this is done through the reduction in reduction or eliminating the wastages and non-productive activities.

And once this is realized, it helps in increasing the effective utilization of the resources. So, basically the idea is to increase the productivity by reducing the wastages and non-productive activities and so that effective utilization of the resources can be done. Once these things are realized, we will be able to have the desired or increased output with the reduced input, and if this is realized it will help in providing the goods of the required quality at low cost.

And if it is made means increased output at low cost is made available, then it will help to give the increased competition to the others, it will consolidate the market position because the increased output at the low cost of the quality products will certainly help in giving the competition to the competitors more effectively will that will help in consolidating the market position of the organization and the industry.

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If we see the more specific objectives, then specific objectives I will like to see the improved efficiency and effectiveness of the organization, so that by giving the less inputs more output can be realized. And this this objective is realized through the number of aspects like the development of the procedures for administration and operations, so that it has increased utilization, reduced wastage and increased output.

Development of the tools, such that tools and equipment both such that they take less efforts of the manpower, less energy, increased output, means the rate of production is more so the newer equipments and the tools are developed in such a way that the efforts are reduced, energy consumption is reduced, output is increased, wastage is reduced. Then the work methods are developed in such a way that they take less time and the less efforts of workers, all redundant activities and in a non-productive activities are eliminated.

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Then we have the workplace, the it also helps in designing of the workplace in such a way that there is a proper comfortable work environment maybe in terms of the light, vibrations, height of the workplace or the standing or sitting postures or the kind of the seating which is being provided, the placement of the tools and controls and their readability of the, all panels which are there. So, these things are done in such a way that workers need minimum effort to do the job so that he is he is feeling less fatigue so, there is less fatigue and he is able to contribute for increased output effectively, so that the output of the organization can be enhanced.

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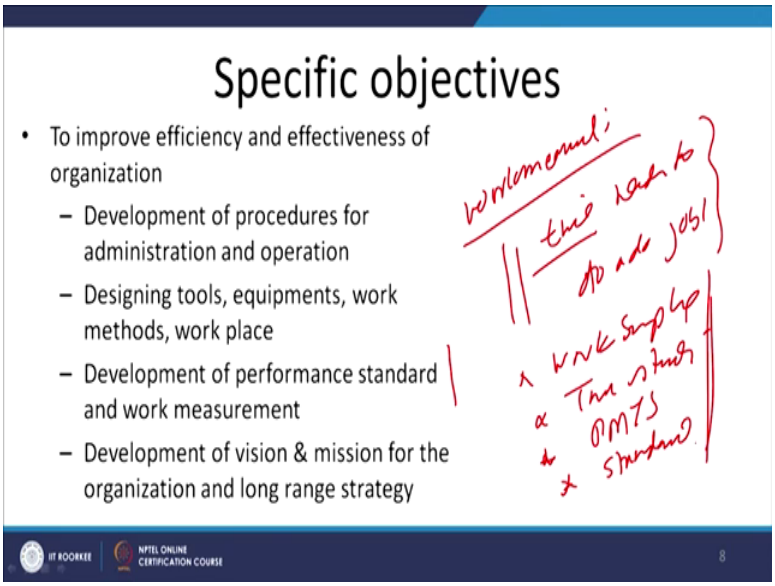

Then the development of performance standards and the work measurement. Performance is standards, are means these are the tis one aspect only like work measurement basically involves that kind of the time it needs to do a job. There are various methods for setting the for work measurement or identification of the time a job will take, it may be in form of work sampling, it may be in form of time study or it may be like a Predetermined Motion Time Studies – PMTS or Standard Data Method. So, these are the four methods which are used to set the time to identify the time standards which are needed.

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And once this the time is known through these different methods. So that time actually needed for a given job plus the kind of allowances which are given to deal with the various requirements like the worker is not trained or the management wants to give something more in form of the additional payments so that workers can live the reasonably good life or the time is given for fulfilling the basic needs.

So, the time determined for doing a particular job plus the allowances some of these help us in setting the standard time for the job and that is what we will say that the standard of performance is set for doing the job, it will take, a worker should take this much time and that is considered as standard of performance and with respect to that only we, the different the plans for the payment of the workers are developed.

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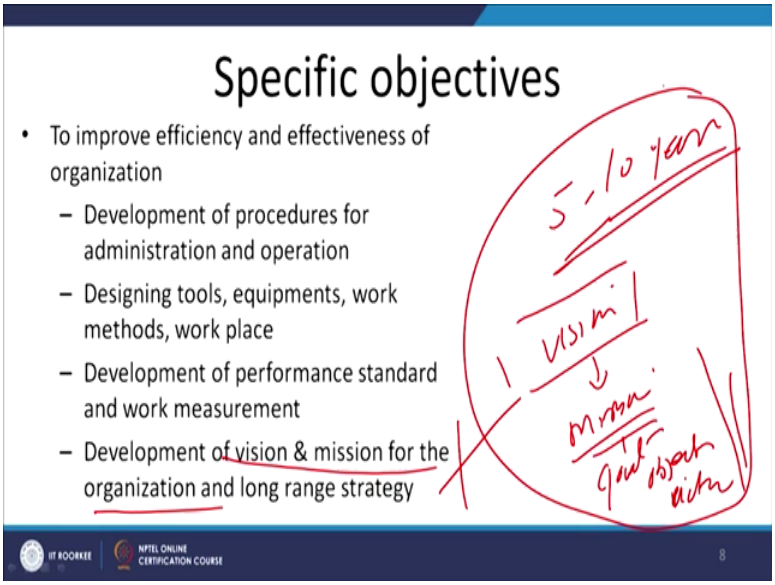

Another important aspect related with improving efficiency and effectiveness of the organisation through the development of the vision and mission for the organization and the long term strategies. So, what an organization will be after 5 to 10 years that is what is a dream of that is set and accordingly the different activities and the plans for the organization are developed, so that it can really grow and develop in future accordingly.

So setting the vision for 5, 10, 15 years and in light of the vision, the identification of the various missions to realize the vision set and then there will be various goals, objectives and actions which will be needed to realize that. So, to set the long term strategy for the organization, so that it can plan the things to be done in future effectively in order to take the organising in future as per the vision or the dream, which is there related with the particular organization.

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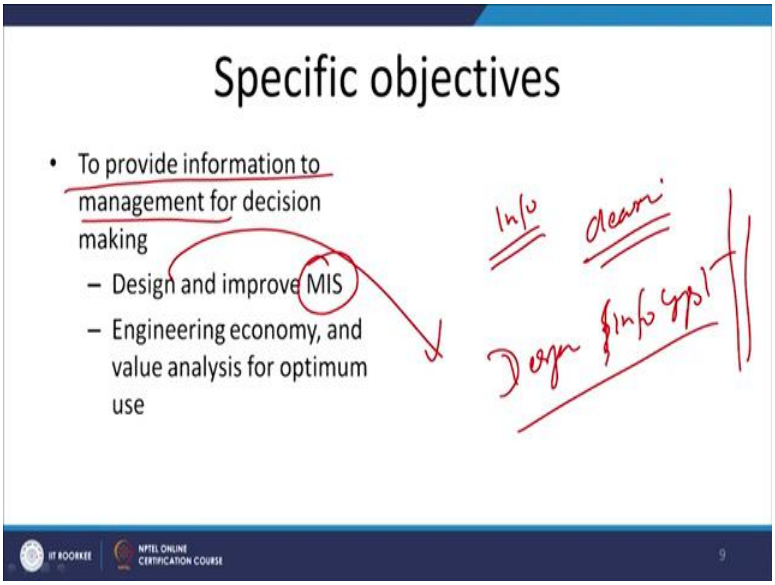

Then another specific objective related to the industrial engineering is to provide the information to the management for decision making. Like all of us know about the importance of the information. Information helps in taking the decisions or well informed decisions. So now, one of the objective of the Industrial Engineering is to design the Information System, design the information system, so that the management is aware of the kind of the factual situation at any moment of time.

So, designing and improving the management information system, so that it can take the decisions regarding the resources. The regarding the various aspects related with the production and the strategies to be used for distribution under the kind of the decisions or the actions which will be decisions to be taken regarding the action for realizing the goal of the organization.

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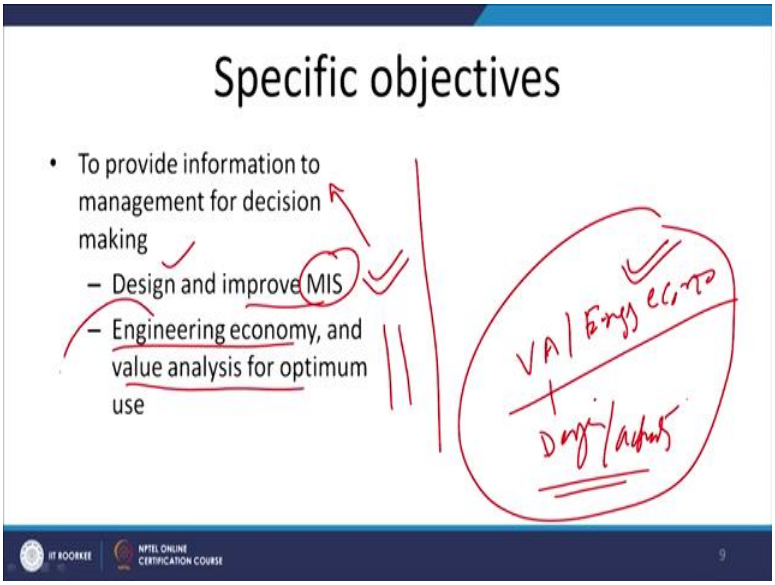

So, basically here is to design and improve the management information system so that it can take well informed decision. Then engineering economy and the value analysis also helps in to see what are the things needed for reducing the cost of the equipments and what are the venues where the efforts can be made for reducing the cost of the production or the cost of the different activities which are being undertaken by the organization, so that it can provide the services to the customers at the low cost.

So, the first is about the develop, design and the improvement of the management information system and the second is the value analysis and the engineering economy. Both these will help in to see how to come up with the design and the different activities related with the particular product or the service so that it can be provided at the low cost. And likewise, how to, what are the activities need to be optimized and they need to be done accordingly so that the cost of the production can be reduced.

So, basically the second point is related with the making the things available at the low cost through the economy, engineering economy or through the value analysis for optimum use of the resources.

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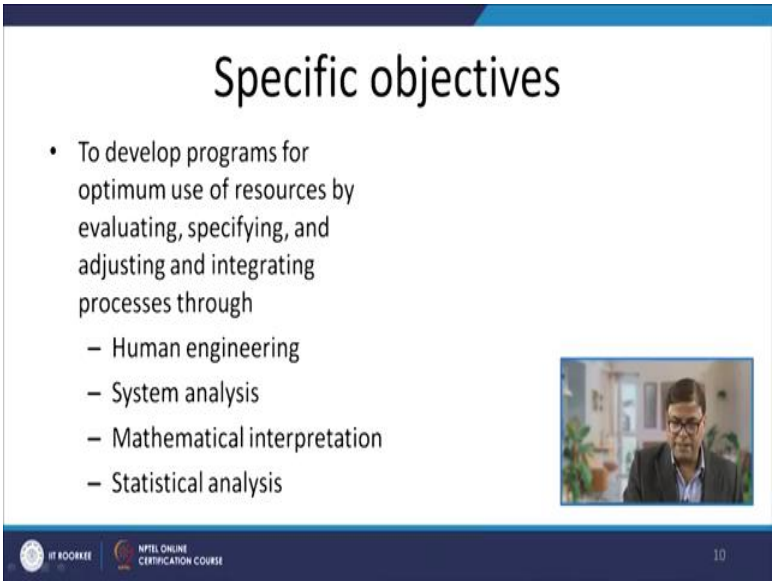

Then develop the program for the optimum use of the resources by evaluating, specifying, adjusting and integrating the processes through the human engineering. This is about the ergonomic aspect through the system analysis. This is about analysing the different steps with respect to the entire system and to see what kind of changes needed.

And then the mathematical interpretation of the particular situation so that the well informed decision about the different actions, parameters can be taken and the statistical analysis of the different tab. The environmental conditions, the different factors that are affecting the output so that well informed decisions can be taken.

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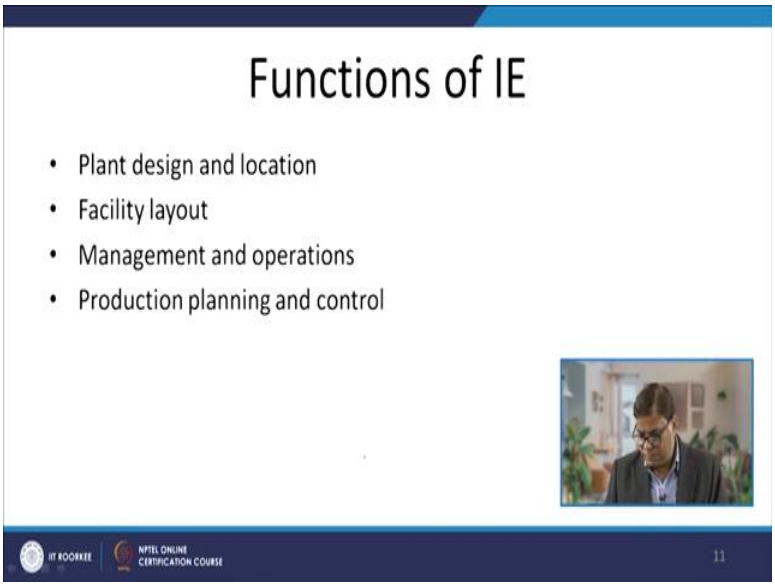

The next one is the functions of the Industrial Engineering. About this I will talk in the next presentation. Here I will summarize this presentation. In this presentation basically, I have talked about the kind of the developments which have taken place in the field of the industrial engineering and what is the general approach of the industrial engineering and what are the main objectives associated with the industrial engineering. Thank you for your attention.