Work System Design
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Lecture - 10
Case Studies on Productivity

Namaskar friends welcome to session 10 of our course on Work System Design. Our current focus is on productivity and today is the last session for week #2. This course is of 12 weeks' duration and our target is to understand the nitty-gritty and intricacies of the topic Work System Design. Why productivity is important in work system design we must try to understand that.

Whatever work is being done, maybe I am recording this lecture today, this is also a work which is being done, now that we must be productive in each and every task that we are undertaking. Now suppose I am recording this lecture. If a 30 minutes' slot or half an hour slot is allocated for this recording purpose, I must try to optimally utilize this time that is the input in order to convert it into a tangible output that is the final recording of the video or the final data which is having the video lecture.

So basically everywhere this word productivity is important. Now suppose I am going to teach in a class, it is a classroom lecture, in classroom lecture if 55 minutes is assigned to me I must try to make use of those 55 minutes to cover the topic that has been assigned for that particular lecture, so I will be productive. Now suppose that I am not able to cover the topic in 55 minutes.

I may have to stretch to some other lecture or may be in a next lecture I will have to complete the topic and therefore that syllabus may get delayed so the productivity is not important from theoretical point of view that we are discussing in our sessions, but it is also important from the practicality point of view.

And if you remember in session 9, our total target, our complete target, our focus was on trying to highlight some numerical problems or some practical problems in which we can use the concepts of productivity and try to improve our productivity by adapting to various

productivity improvement techniques. Now what are the various productivity and improvement techniques that we have already covered as I believe in session #08.

And we have seen that is we focus on the key factors affecting productivity. We can certainly improve our productivity. Now what are the various stakeholders when we are converting the raw materials into the final product. There is material, there is process, there is technology, there are people, there are we can say other tangible inputs, it can be money, it can be the work force.

So different tangible inputs if we are able to focus on as well as focus on our output and try to improve optimal utilize our resources there will be a positive effect on the productivity and in today's session our target primarily is to understand that how we can improve the productivity.

So the case studies that we are going to discuss today will help us to understand that how the productivity has increased for various organization when they have employed the basic concepts of productivity improvement in terms of change in technology, in terms of change in design, in terms of employee morale, in terms of employee motivation, so quickly we will try to understand that various case study which has led to productivity improvement.

And if you go back in our discussion we have already discussed that there are various measures of productivity like we have different labour productivity is one example of partial productivity. So we can have a partial productivity measure, we can have a total factor productivity measure, total productivity measures, multifactor productivity measure, so different types of measures are there which can be used to calculate the productivity of an individual or of a system or of a company or of an organization.

So we will see that how different factors or different measures of productivity can be used to calculate the productivity and in different scenarios how the productivity can be improved. Now let us quickly move forward, this is one example of very famous company Walmart improves it is productivity by increasing efficiency.

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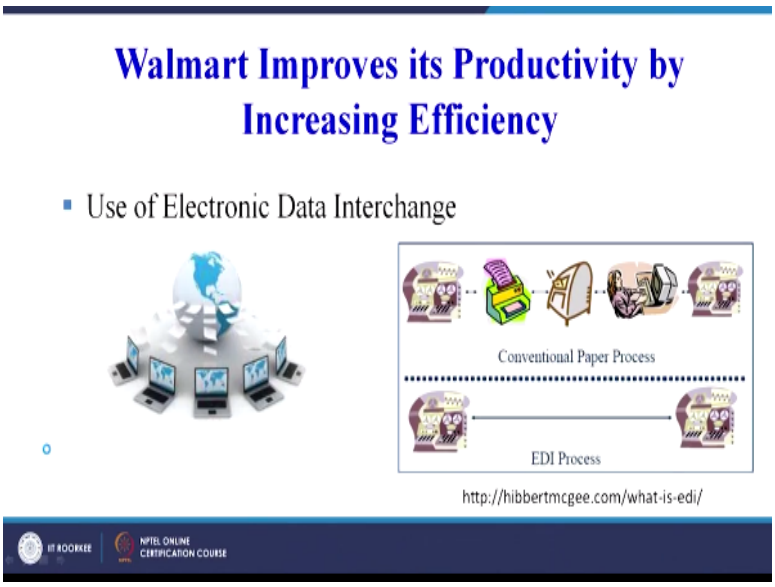

So we will see and today I will try to because we have to close our discussion on this topic productivity because it is here marked for the first 2 weeks only, I will just try to differentiate with the help of a common joke between efficiency and productivity towards the end of today's session, but let us first see that how the productivity is improving by increasing the efficiency.

So on your screen you can see that use of electronic data interchange. So this is adopting to the new technology. So we have seen that there are different ways in which we can improve the productivity and one of the important ways is the use of the latest technology. So if we use the latest technology our productivity can increase. So here we see in the conventional process which is being followed.

There are maybe 5 steps of data exchange or data interchange, so using the new technology that is the EDI process we can improve this electronic data exchange and there can be a direct data exchange between the 2 places. So using the technology the productivity has improved. So maybe the time which was as an input in case of normal conventional paper process the time has reduced.

So time has reduced which means the productivity has increased because the input has reduced so output because it is inversely proportional to the productivity. If you remember productivity = output/input so input if we are able to somehow manipulate the input in a way so that the productivity increases this is one such example where we are minimizing the time required for the data interchange by the adoption of technology.

So the Walmart has adopted this technology. So the second point is Google improves it is productivity by motivating the employees.

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So first parameter or improvement technique which Walmart has adopted is adopting or switching over to a new technology. So technology is one important keyword in improving the productivity and efficiency, then the second important we can say focus area can be the employees of an organization as I have highlighted 2-3 times earlier also that it is the employees or the people or men or women who are really responsible for the success of an organization.

So Google improves it is productivity by motivating the employees. Now what are the various, maybe focus area or how they have been able to do this by giving the fringe benefits to the employees, by ensuring medical insurance, body care services, maybe there can be a gym, local gym inside the office or there can be other body care facilities provided inside the office then entertainment services and the household services.

There can be a kind of crèche for the children who are young who are not going to school and the parents can work and the children can be put in a crèche those kinds of facility. So if you are able to make your employees happy, if you are able to take care of the issues challenges of your employees then the employees will certainly feel associated.

They will have a feeling of belongingness with the organization and will definitely work, put their heart and soul for the success of the organization. So 2 examples we have seen. In one example technology has helped to improve the productivity and efficiency, second example the motivation and morale of the employees have helped to improve the productivity of an organization.

Now let us see another example or a case study of GEA16092 Aluminum Sheet, a product of General Electric.

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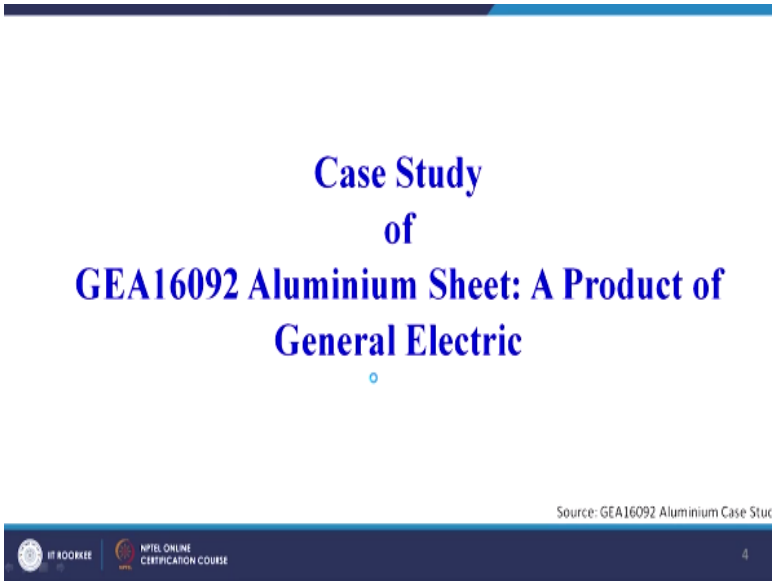

So let us see that how the process change has helped to improve the productivity of the organization. So we have seen 2 examples, in first case it is a technology or an electronic data interchange which has helped EDI to improve the productivity, the second case was how the employee morale has helped to improve the productivity. Now let us see how the process change has tried to or helped the company to improve the productivity. Now what is the background for this case study?

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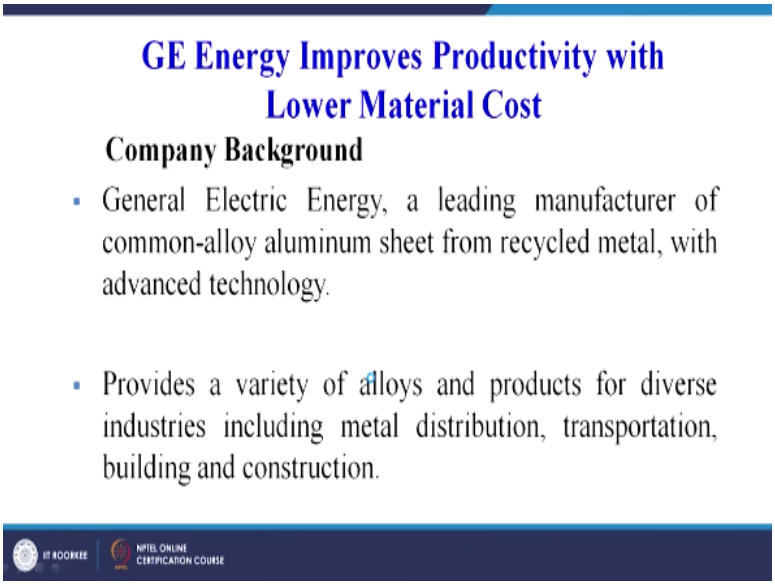

General electric energy a leading manufacturer of common alloy aluminum sheet from recycled metal with advanced technology, so name of the company is given, the name of the product is also given, it is the common alloy aluminium sheet. It provides a variety of alloys and products for diverse industries including metal distribution, transportation, building and construction, which shows that this product has got wide application so maybe the volume of production is bound to be large.

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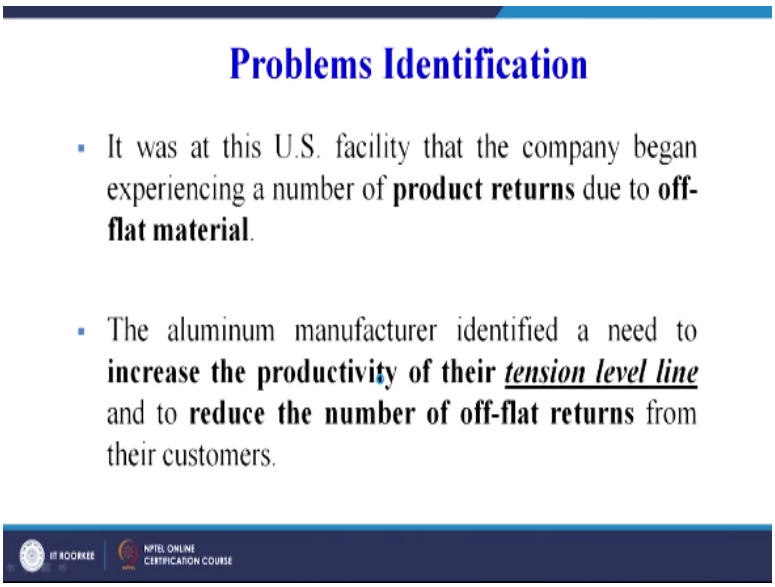

Now it was at this U.S. facility that the company began experiencing a number of product returns due to off-flat material. So now there is a problem with the company that the material is being returned by the customers why the reason is also identified. The reason is off-flat material that is the quality of the material is not good.

So with this 3 point we can conclude that it is the well-known company. The volume of production is large and now there is an issue that the material is being returned because of a specific issue that is off-flat material. Now what the company has to do that is you can say one of the major advantage is of the big companies of the well-known companies of the branded companies that they adapt to the change quite quickly and try to find out the figure in order to satisfy the customers.

They want to improve the productivity and remove this defect or the off-flat material problem which has risen now, which has taken place now. The aluminium manufacturer identified a need to increase the productivity of their tension level line and to reduce the number of off-flat returns from their customers. So the remedy was also quickly found out that the tension level line has to be taken into account and to increase the productivity they have to focus on their tension level line.

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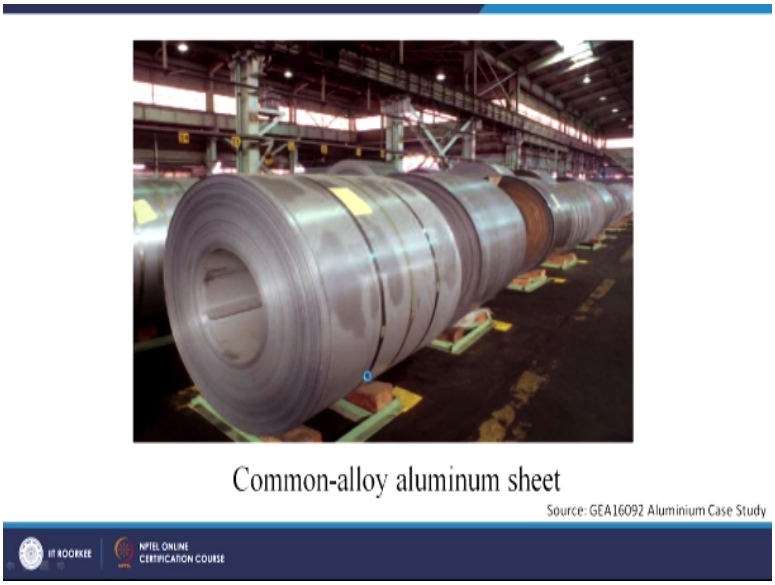

Now this is on your screen common alloy aluminium sheet which is the product of the company. Now what is the proposal to rectify the problem, now I think all of you have understood that what is the problem. Now what is the common area where they need to focus, what is the proposal to rectify the problem.

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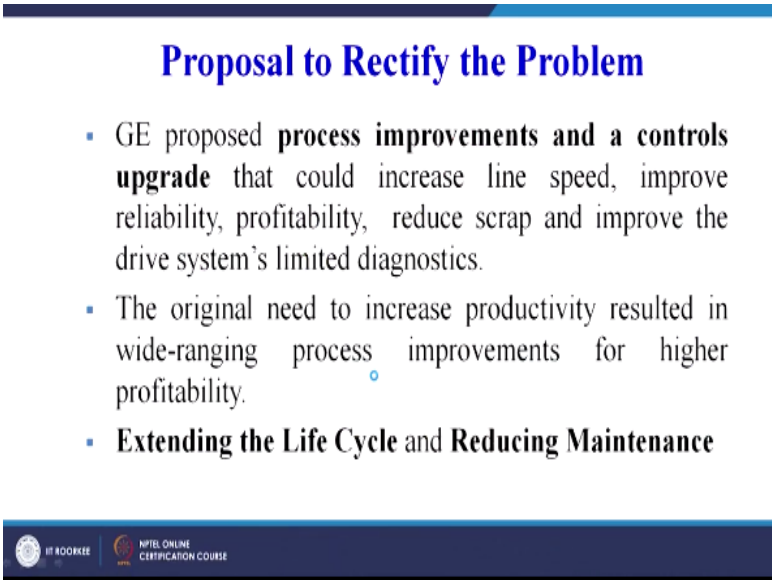

GE proposed process improvements and controls upgrade that could increase line speed, improve reliability. We can see what is the focus increase line speed that is one, improve reliability second, it will lead to increase in profitability third, it will reduce the scrap which is also going to lead to the profitability and improve the drive systems limited diagnostics, that is they want to keep a regular check on the complete drive system.

So they want to diagnose the issues and fix them as quickly as possible. Now if you see that the process improvement is the target of the company. Now they proposed a process improvement and control upgrade because if you remember maybe, if you have studied engineering or if you have studied management, control is an important parameter which effects the quality of the product.

Now whenever there is a process you are producing a product you need to keep a check on the quality, how you will check that by exercising control. It can be online control system, or it can be offline control system, you can be checking the quality while the product is being manufactured or you can check the quality once the product has finally been stored in the ware house.

So there can be different polices of the companies for maintaining or for checking or for inspecting the quality of their product. So here the company also wants to focus on the diagnostics so that they are able to identify the problems and rectify it as quickly as possible. So once again this is important this is a focus area because when we are able to improve the reliability we are able to increase the line speed.

We are able to reduce the scrap, we are able to identify the problem and rectify them quickly all these steps are going to improve the overall productivity of our organization and that has happened in this case also. So GE proposed process improvement, so they focused on the process of making these sheet and a control upgrade so they focused on the process. They focused on the control mechanism also.

And then it led to whatever improvements I have already highlighted and underlined on the screen. The original lead to increase the productivity resulted in wide range process improvements for higher profitability. So the need of diagnosing, the need of improving the process led to profitability. It also led to the extending the life cycle of the plant as well as it also led to the reducing the maintenance required to keep the plant up and running.

So these were the additional benefits of process improvements and upgrade in the control diagnostics. Now what were the attempts to rectify the problem, we have seen that there was a problem of off-flat material now that was taken care of by changing the process improving the diagnostic system or the control diagnostic system now upgraded controls and improved diagnostic.

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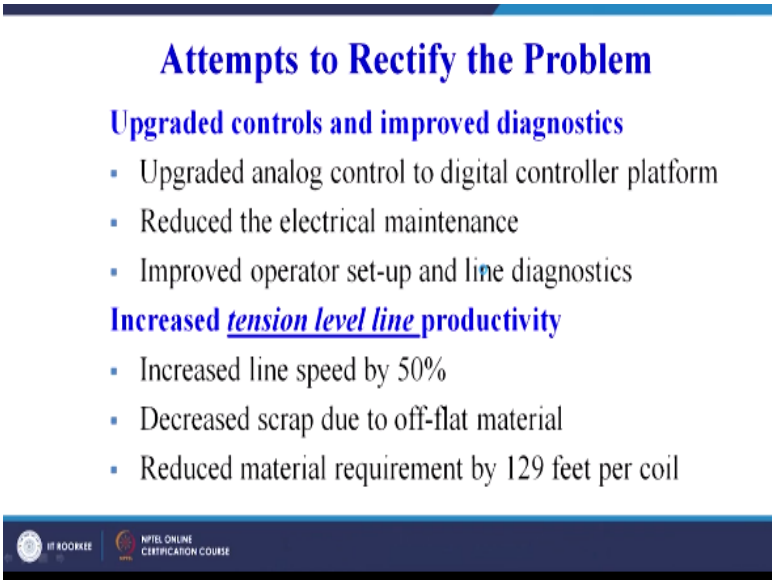

Upgraded analog control to digital controller platform. So first change which was put into action was from analog control system it was shifted to the digital control system which seems to be a better option than reduced the electrical maintenance improved operator set-up

and line diagnostics so this is from the control and diagnostic point of view these steps were taken.

Then increased the tension level line productivity, though line speed as I already told was increased by 50%, decreased scrap due to off-flat material because we have already improved our diagnostic system, line speed has been increased so off-flat material also got reduced 50% improvement was seen and the material requirement was also reduced by 129 feet per coil. So I have shown the coils in the one of the figures in today's session, big aluminum rolls of coil. Now what were the results, now let us quickly see.

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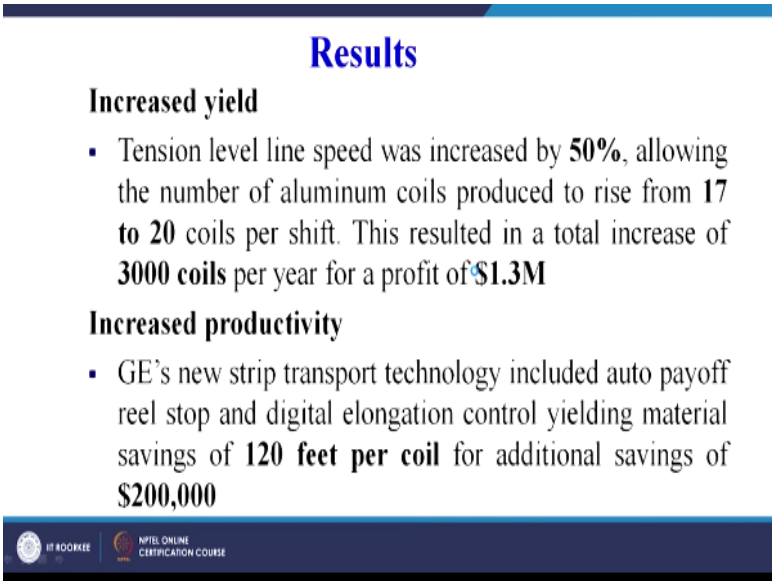

So the increased yield, tension level line speed was increased by 50% allowing the number of aluminum coils produced to rise from 17-20 coils per shift. So per shift earlier with the current method they were able to produce 17, now they are able to produce with the change in the process, change in the line speed, change in the diagnostics they were able to produce 20 coils per shift.

This resulted in a total increase of 3000 coils per year and the profit was $1.3 million. We can see that whatever little change we introduce in the process daily there is an improvement and if you multiply it over the number of working days in a year the improvements are large. The improvements are quite noteworthy, the improvements are substantial, here also the substantial improvement of $1.3 billon was observed by changing the process.

Now increased productivity GE's new strip transport technology included auto payoff reel stop and digital elongation control yielding material savings of 120 feet per coil for additional savings of $200,000. You can see another improvement is there. So what were the 2 important technological changes I believe that all of you may not have an engineering background but maybe just to explain what was done 2 important things are done here.

This is the name of the technology, strip transport technology, it included 2 things, it included auto pay off reel stop this is one major change, and the second change is digital elongation control, this is our second change, so these are the 2 important changes which were introduced and it lead to maybe those who do not have engineering background, can just keep maybe a black box there are some process improvements there.

But those process improvements have led to increase in the material saving 120 feet per coil and it also led to substantial monitory savings. So we can see that by adopting to a new technology, by changing the way the process is being conducted, by changing the adopting to the auto payoff reel stop, so maybe automatically the reel will stop then the digital elongation control that is the elongation of our sheet that is controlled now digitally maybe earlier it was controlled using an analog method.

So analog method maybe less sensitive, maybe less accurate or precise as compared to the digital control system and therefore it led to the improvement in the material usage and the savings of 120 feet per coil was saved. So technically also if we can understand that the changing from analog to digital and using automatic stop system the material was saved, it led to the overall savings for the organization.

So one thing we can conclude from this case study is that if we change the process, we change the way the work is being done automatically it will lead to improvement in the productivity. Now let us see the last improvement that was seen we have seen the results are beneficial, if you see the 2 summaries here increase in yield is the first benefit may be benefit A, increased productivity is benefit B.

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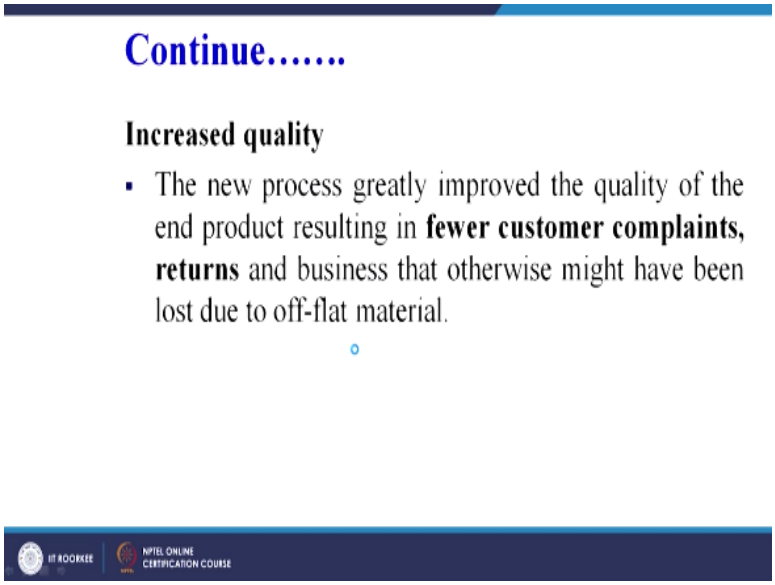

And if you see the third benefit is the increased quality or improved quality of the product that we are producing. The new process greatly improved the quality of the end product resulting in fewer customer complaints, returns and business that otherwise might have been lost due to off-flat material. So the off-flat material was the problem area. Now improved by changing the process by improving the control diagnostics by putting a new technology in place.

So the summary of this case study is that if we have a problem we must focus on that what is the reason for the problem we must be ready to change as in this case the company adopted a new technology, a new process and it was able or modifications in the process were incorporated and it led to the improvement in yield, improvement in the productivity, improvement in the quality and overall maybe profitability of the organization.

So let us take another case study. This is the case study on Design of a Thermal Gunsight Reticle in a US Tank.

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Case Study
on
Design of a Thermal Gunsight Reticle in a US tank

Source: Boothroyd, Dewhurst and Knight (1994)

This is from a book, Boothroyd, Dewhurst and Knight (1994) very good book on design for manufacturing and assembly so from there we have taken this case study. Now here we can see this is the original design for a thermal gunsight reticle in a US tank made by Texas Instruments, Inc.

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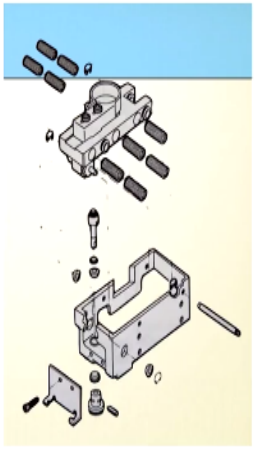
- **Original design** for a thermal gunsight reticle in a US tank, made by Texas Instruments, Inc.
- There are a **large number of fasteners**.



Source: Boothroyd, Dewhurst and Knight (1994)

This is one thing, there are large number of fasteners here you can see a large number of fasteners this is maybe you can see a combination of fasteners here. There are all the fasteners here also and we can see that it will require a lot of assembly operations, lot of time will be spent and there are so many parts individually they have to be manufactured, can we do something how we can improve the productivity of manufacturing this particular gunsight reticle.

Now some design thinking has to go, so what we can do we can try to redesign it by minimizing the requirement for the fasteners so you can see this is the redesigned thermal gunsight reticle which is simpler to assemble and less to go wrong.

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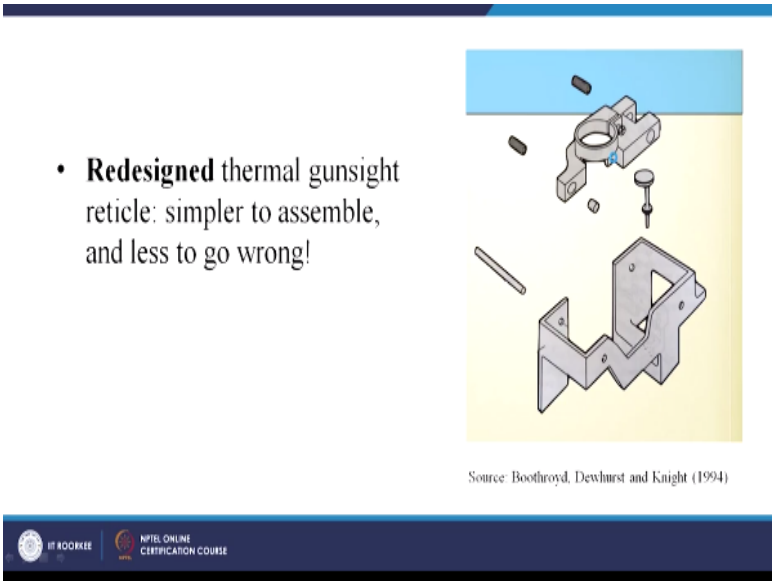

Three are less chances of assembling it in a wrong manner, whereas in the previous case we can see there are chances that we may go wrong during the assembly operation. Now by redesigning this thing what benefits we have got. How our productivity has improved that we can try to understand that if we redesign it what are the advantages? Now this is you can see on your screen.

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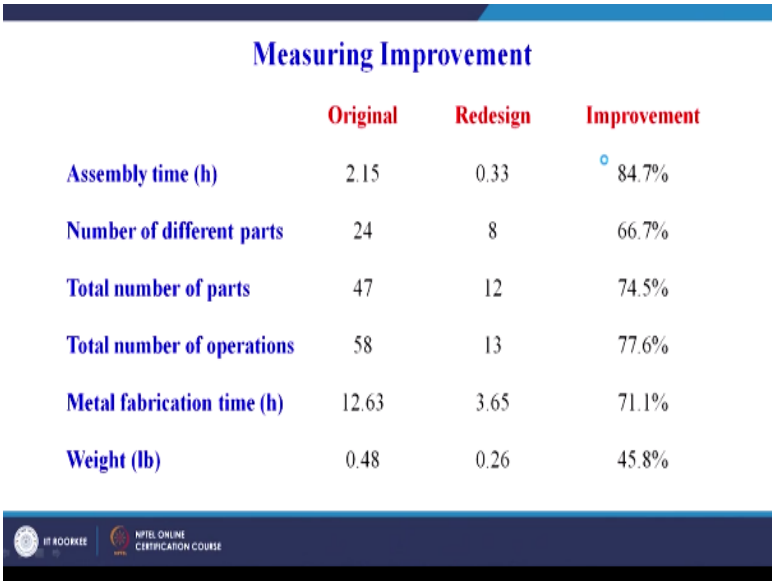

	Original	Redesign	Improvement
Assembly time (h)	2.15	0.33	84.7%
Number of different parts	24	8	66.7%
Total number of parts	47	12	74.5%
Total number of operations	58	13	77.6%
Metal fabrication time (h)	12.63	3.65	71.1%
Weight (lb)	0.48	0.26	45.8%

This is the original data, now this is with the redesign and this is showing the improvement in the percentage. So if you see the assembly time for the original in hours was 2 hours and 15,

2.15 hours and here the redesigned part 0.33 hours only. So you can see 84.7% improvement in the assembly time. Number of different parts earlier where 24, in the redesigned part only 8.

Total number of parts this is number of different parts, 1 part maybe used in 3 numbers also so maybe the total number of parts will be more so in case of original design it was 47, but in the redesigned part there are 12 parts only. Total number of operations which is very important to gauge the productivity of the assembly operations. It was 58 total number of operations whereas in redesigned there are 13 operations only which are required to make this part.

Metal fabrication time 12.63 hours whereas now it has been reduced significantly by 71.1% to 3.65 hours and the weight also has been reduced by 45%. So if you see the redesigned part has led to substantial improvement in the way we are producing the product and the way we are assembling the product and the weight has also reduced without effecting the performance and quality or the functions of the product.

And if you see the percentage is there is a lot of percentage improvement also. So what we can conclude from here now. We can conclude that if we redesign the part, if we change the design of the part still we can improve the productivity of our work. So by changing the design of the part we can see that the total number of parts are less, the assembly time is less, the weight is less, the metal fabrication time is less.

So the redesign of the product has also lead to the significant improvements in the productivity of the manufacturing process for that product. So today by now we have taken 3 or 4 case studies. Now what are these case studies focused on. One case study is focused on the electronic data interchange where the technology has played a significant role in reducing the time used for the current process.

The second was the Google case study where the employees are the focus because the employees are the main stakeholders who are working for the organization. So there are 2 major focus thrust area, the technology and the employees. In case study of Google, Google has tried to maybe keep the employees is high morale and motivation by giving them many benefits so that they feel concerned.

They feel sense of belongingness for the organization, so that was second case study. In third case study we have seen the change in the process. We have seen that in GE there was a problem of off-flat material so the change in the process was incorporated, the diagnostics were improved, the line speed was increased. So the process was worked upon and the results were the increased productivity, increased yield as well as increased quality.

In the fourth case study the design of the product has been changed in order to reduce the time required for fabrication of the product, the time required for assembly of the product lead to the decrease in the weight of the product significantly it will reduce the cost of the product also, so the fourth you can say case study is focused on the design aspects in improving the productivity of an organization.

So we have taken 4 different ways in which the productivity of an organization can be improved and quickly I have just there can be a doubt among the learners that how if we are able to increase our production maybe today we are producing 10 parts if tomorrow we start producing 20 parts our productivity has improved, no.

I have already differentiated between the productivity and performance, but we want to close this discussion on productivity by taking very simple examples to differentiate between productivity and we can say the other thing is the increase in production. So increase in production or production improvement does not necessarily mean productivity improvement.

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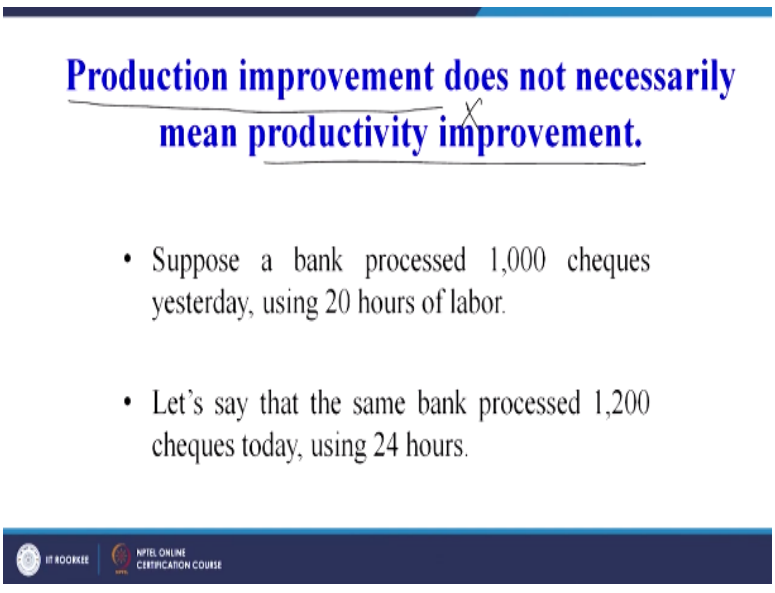

So this production improvement does not necessarily mean productivity improvement. So production improvement can be increased in production we are producing more number of part, but that does not necessarily mean that productivity has also improved. Let us take an example, suppose a bank processed 1000 cheques yesterday using 20 hours of labour. So the output is 1000 cheques and the input is 20 hours of labour.

Now let us say that the same bank processed 1200 cheques today using 24 hours, so maybe we have to compare now. In one case bank has processed 1000 cheques, in the other case the bank has processed 1200 cheques. Definitely the number of cheques issued is more by a difference between 1200 and 1000 that is 200 cheques extra have been issued, but the time required for issuing these cheques have also increased.

Earlier 1000 cheques were issued in 20 hours, 1200 cheques are issued in 24 hours, so 4 hours of extra labour has been put to issue the additional 200 cheques.

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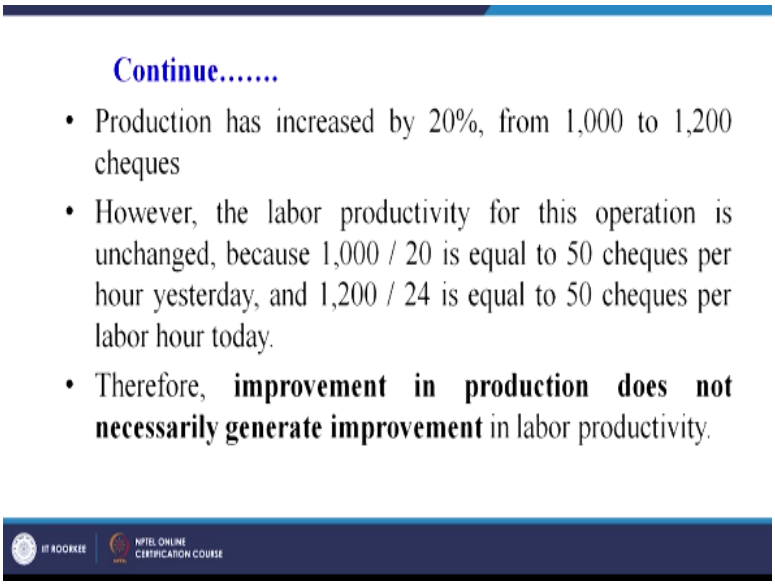

So now let us see what we conclude from here. Production has increased by 20%. So now from 1000 we are now issuing 1200 cheques, from 1000 to 1200 cheques. However, the labour productive for this operation is unchanged because earlier how we can use the partial measures of productivity or partial productivity measures we can calculate the labour productivity by dividing the output by the input manners.

So what is the output? 1000 cheques is the output, the input is 20 labour hours so 1000/20 = 50 cheques per hour yesterday and maybe, now today 1200/24 so that is = 50 cheques per

labour hour today. So although the production has increased or the issuance of cheques has increased by 200 but the productivity has not increased because the input also simultaneously has increased by 4 labour hour.

So we can very easily conclude that increase in production or increase in the output does not necessarily mean that the productivity has increased. Therefore, we need to focus on our input as well.

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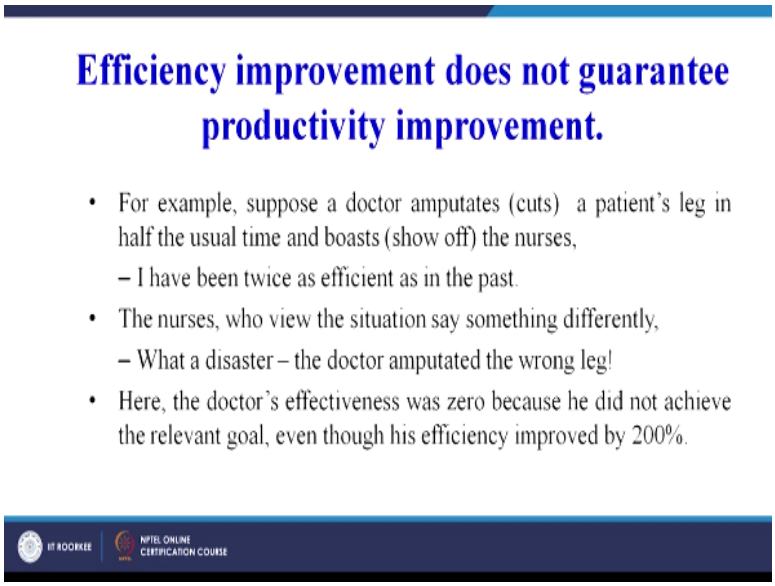

So now let us easily conclude this session on our topic productivity by taking this very very simple example. So on your screen maybe you can see. This is another important thing that we need to understand that efficiency improvement does not guaranty productivity improvement. In previous case we have seen production improvement, increase in production does not guarantee increase in productivity.

Similarly increase in efficiency does not guarantee increase in productivity. So we can see increase in efficiency, let us try to understand this with this simple example. For example, suppose a doctor amputates a patient's leg in half the usual time and boasts off the nurses I have been twice as efficient as in the past. I think all you may have understood this.

Now he takes suppose maybe 1 hour to amputate a leg in normal conditions, today he has been able to amputate the leg in half an hour only earlier he takes 1 hour, now he has done it in half an hour only so he says that I am more efficient, how, because I have done the

operation in half an hour. So this is the one thing. I have twice as efficient as in the past. The nurses who view the situation say something differently.

What a disaster the doctor amputated the wrong leg. So maybe he may have been efficient but we cannot say that he is effective, he is productivity. So because the output that he has produced is not the you can say desired output. Here the doctor's effectiveness was 0 because he did not achieve the relevant goal even though his efficiency improved by 200%. So we can say that although the target was clearly defined the doctor was not able to meet the target although he was efficient.

So basically what we can try to take home from this discussion is that we must be very, very careful when we are emphasizing on the word productivity. So productivity is different from efficiency. Productivity is different from production improvement. Productivity is different from performance, so basically we must focus on the word productivity we must understand the various factors that influence the productivity.

We must also take into account the various causes that lead to decrease in the productivity, we must keep in mind the various productivity improvement techniques and we must be very, very clear in our mind that what exactly productivity means and what exactly represents the improvement in the productivity. We must not be led by such type of hilarious situation where a person may boast off being productive but actually he or she is not.

With this we conclude our discussion on the topic productivity. We have spent approximately 5 hours on this topic productivity, 2 weeks of our discussion is over. We will start a fresh week and the topic will be work study. So now we will see that productivity improvement is important and in case of various situations, various scenarios, various particular cases how we should design our work, how we should motivate our employees.

How we should adopt the technology, how we must change the designs so that the productivity of our work, productivity of our system, productivity of our process, productivity of our employees improves for the betterment of the society as well as for the betterment of our nation. So with this we conclude today's session. Thank you.