Applied Ergonomics
Prof. Shantanu Bhattacharya
Department of Mechanical Engineering
Indian Institute of Technology, Kanpur
Dr. Ankur Gupta
School of Mechanical Sciences
Indian Institute of Technology, Bhubaneswar
Dr. Sanjay Kumar, PhD Scholar
Department of Mechanical Engineering
Indian Institute of Technology, Kanpur

Module – 05
Lecture – 23

Hello this is Sanjay Kumar. And I am course to for this course applied ergonomics. And I will in a following section in flowing lecture module. I will try to solve some problem numericals, I will solve some numerical based on the productivity and motion time, time study; whatever you have studied in earlier week lectures. So, I am just here I am comparing all the lecture numericals problem in this following lecture modules.

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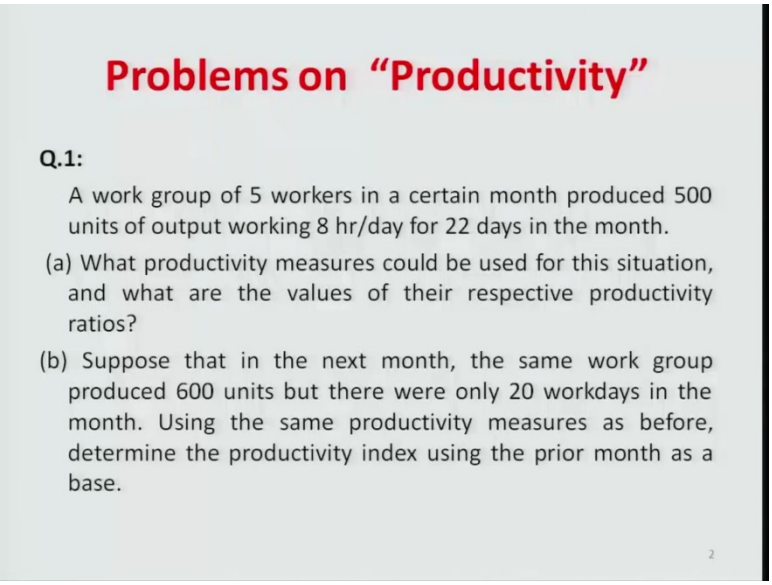

I will first start problem solving problem on the productivity. Now there is a one problem. That problem statement is that a work group of 5 workers in a certain month produced 500 unit of output working 8 hours in a day for 22 days in the month. So, problem is asking what productivity measures could be used for this situation.

So, you know that the productivity, productivity what is productivity? Is defined as the output versus input or the output to the input. It means that you are going to optimise or maximise the output. So, here what problem is saying that there is a certain amount of product is going to produced, and number of product is there is a 500 number of product produced, how much? Is equal to 500.

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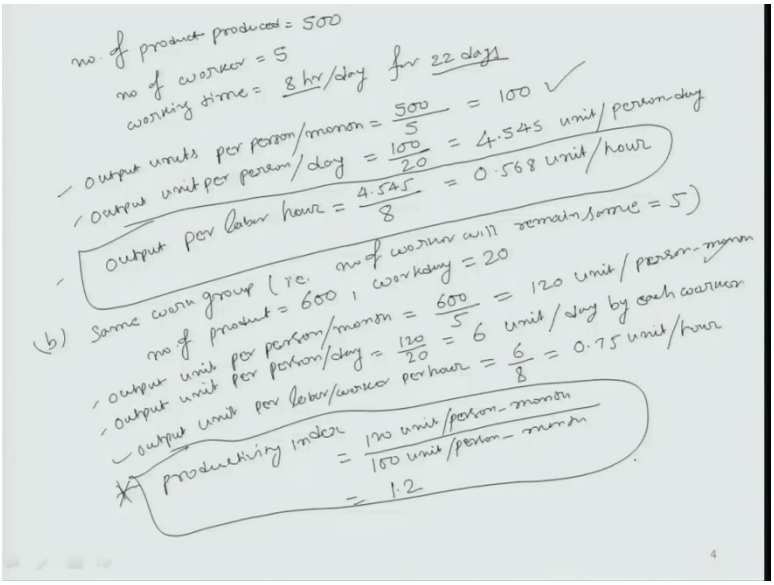

Now, what you saying there is a 5 workers are continuously working to produce this amount of product. Number of worker is equal to five. How much time they are working? Working time 8 hour per day and for 22 days. So, question is asking that what are the value for their passive productivity ratio. Then what will be the productivity ratio? So, first we will calculate, output unit per person per month that is called output units per person per month. What is that? It will be actually there is a total number of product is 500. And how many workers are working? Five, So, what will be? It will be hundred.

So, each worker producing 100 products in 22 days. Then we will calculate output unit per person per day. how many days they have worked? 22 days. So, we will do 100 divided by 20. So, it is approximately it will be 5.4545 unit per person per day. Now we are going to calculate output per labor hour. And since in one-day worker is going to work for 8 hours. So, there will be 4.545 unit per person per day divided by 8, 8 hours. means zero point568 unit per hour.

$$output\ per\ labor\ hour = \frac{4.545}{8} = 0.568\ unit/hour$$

So, first question what they it is it has asked, what are the values of their spectrum productivity ratio. So, our goal is to major the output units. So, we have just to recalculated output per labour per labour per hour. So, this is the 0.568. Now second in second question, b what they are asking? Suppose that in the next month the same work group produce 600 unit. Same work group and means? That means, number of worker will remain same, means 5. And now number of product is equal to 600, and working day has been changed work day is equal to 20 ok.

Working time will remain same, because this is the standard time 8 hour per day. It has been invokely defined the working time for each labour for one day. Now what we will calculate? Again same thing we will do like this one for this case again output unit per person per month. Then what will be? Now this time number of product is 600 and worker is same. So, there is a 120 unit produced by one worker for one month.

Again we I will calculate output unit per person per day. Means, now how many working day in a month 20. So, we will divide it again 120 by 20; that means, 6 units per day by each worker. So, again we will calculate output unit per labour either you are saying or worker per hour. That will be 6 divided by 8. So, 0.75 unit per hour. Now you can compare these things with our previous calculated values.

So, what you are we are question is asked we will have to calculate productivity index prior to the month as a base. So, the base is month what will be the productivity index will be, it will be now it as 120 units per person per month, because month is base. So, we will we I we selected this one again in previous case what work we had calculated 100, 100 units per person per month. So, there will be 1.2. That is the productivity index we have evaluated now.

$$Productivity\ index = \frac{120\ unit/person-month}{100\ unit/person-month} = 1.2$$

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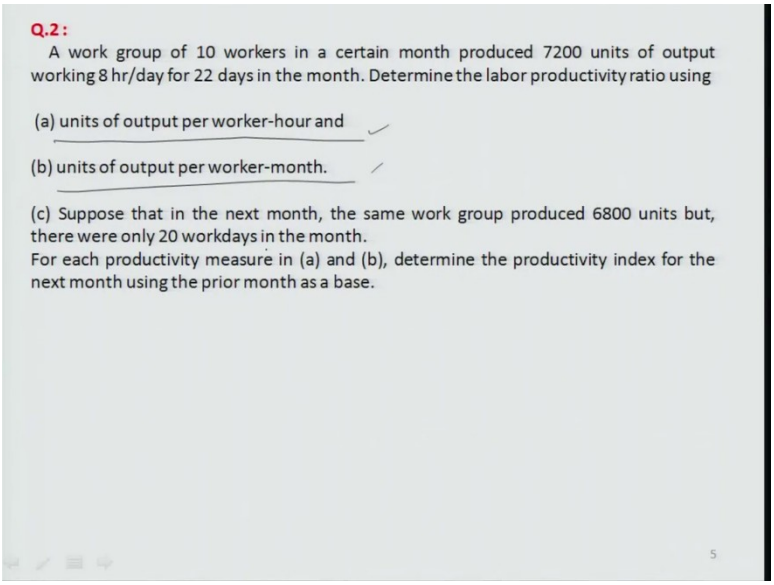

So now I moved I am moving to next question. Second question is that and again this question is based on the productivity. In this problem statement is as follows a work group of 10 workers in a certain month produced 7200 of output working 8 hours per day for 22 in the month. Determine the labor productivity ratio using the unit of output per worker hour and unit of output per worker per month.

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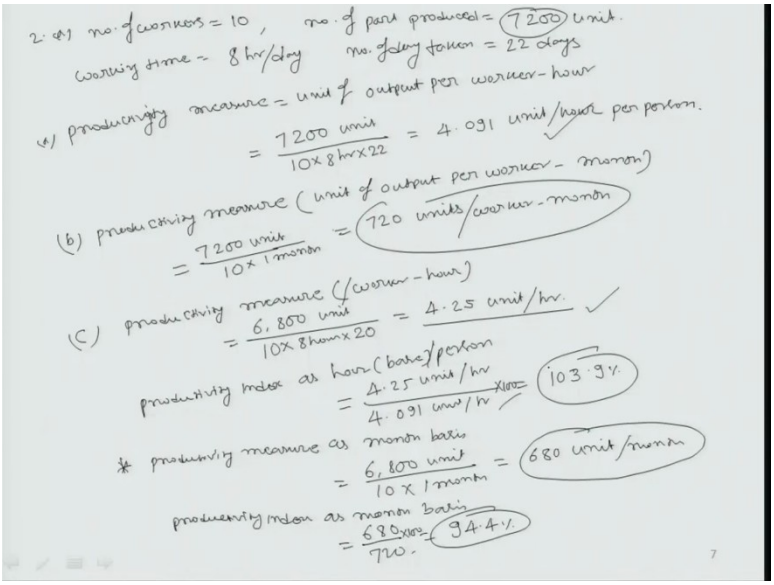

Then third question is supposed that the next month the same. So, first I will solve this one this one then we will come to once again third question. In this question how many

workers? Number of workers is equal to 10. And number of part is produced 7200 units. Working hour again it is this is this is a standard time, and it is equal to 8 hours per day and how many day? Number of day taken to produce 7200 units is 22 days.

So, first we will calculate we will have to calculate labor productivity ratio. So, again unit. So, again is the our productivity measure productivity measure is the unit of output per hour. So, what will be? We have 7200-unit total produced by 10 workers. So, if I will divide this amount by 10. So, what will be? It will be unit per person. So, again one person is working 8 hours in a day for 22 days. So, 8 hours in a day for 22 days.

So, again this will be finally, 4.091 unit per hour per person.

$$(a)\ Productivity\ measure = \frac{7200\ units}{10 * 8\ hr * 22} = 4.091\ unit\ per\ hour\ per\ person$$

Now we will calculate productivity measure in sense of per worker per month. So, productivity measure per month. So, how we will calculate? We have total number of part we it has 7200 units has been produced. And how many worker? 10 workers and for 22 day. Means approximately actually in a one month it is standard time the 22 day a person can work. So, for one month means 720 units per worker per month.

$$(b)\ Productivity\ measure = \frac{7200\ units}{10 * 1\ month} = 720\ unit\ per\ worker\ per\ month$$

Now, we will move to third part. What you are saying? Suppose that in the next month same work group produced 6800 units, same work group means 10 group of 10 workers 6800 units, but there were only 20 work day in the month. Now work day has been reduced means from 22 days to 20 day. For each productivity measure in we have calculated that in above (a) and (b), determine the productivity index for the next month using the prior month has a base.

Again what will be base? Prior month. So, if we will calculate productivity measure, means worker per hour, per worker per hour and what will be now we have total number of part they are produced 6800 units. And 10 workers then this is the number of units produced by one worker. And each worker has worked for 8 hours for 20 days. So, this will be 4.25 units per hour.

$$(c)\ Productivity\ measure = \frac{6800\ units}{10 * 8\ hr * 20} = 4.25\ unit\ per\ hour$$

So, if we if you if you want to calculate productivity index has hour. This is the base, then what will be productivity index 4.25 unit per hour. Now you can see that there is in both case there are 10 workers, and they have number of parts has produced is different in this case 6800 and in that case 7200 and working day is also changed. So but our productivity in this case is greater than this one. So, what will be we will divide 4.25 to 4.091 unit per hour, and this is the per person.

$$Productivity\ index\ aas\ hour\ per\ person = \frac{4.25 unit\ per\ hour}{4.091 unit\ per\ hour} * 100 = 103.9$$

So, this one is you can see that productivity has been increased by 3.9 percent. Again if we want to calculate productivity measure as month basis. And what will be? 6800 unit divided by 10 worker worked for one month. It means 680 units per one month.

$$Productivity\ measure\ as\ month\ basis = \frac{6800\ units}{10 * 1\ month} = 680\ units/month$$

Now again we if we will calculate productivity index has month basis. Then what will be? Now you can see in this case the productivity is has been reduced has compared to previous 1. So now, this time productivity index will be 680 by 720. So, that is equal to 94.4 percent ok.

$$Productivity\ index\ as\ month\ basis = \frac{680}{720} = 94.4$$

You can multiply by 100 to get value in percentage for this case and this case also. So, this is the final result. Now we move to third question. Again this question is based on productivity.

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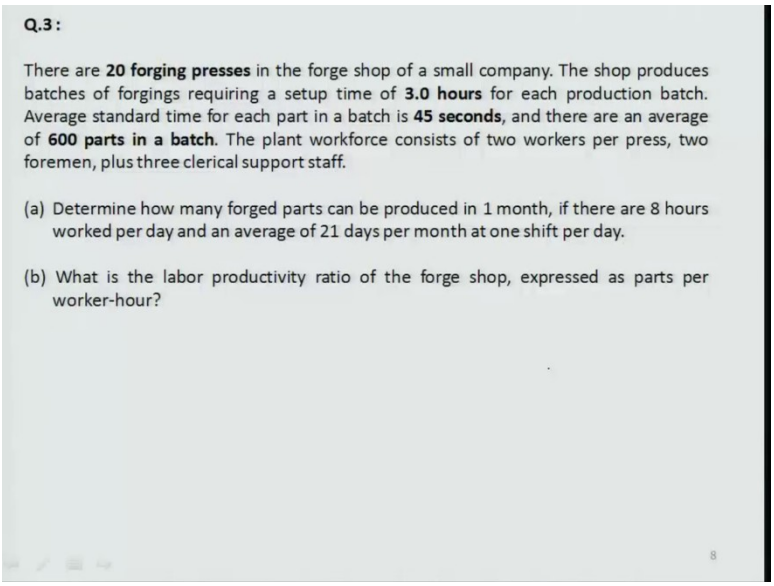

Now, I am reading the problem statement. There are 20 forging presses in the forge shop of a small company. The shop produces batches of forging requiring a setup time of 3 hours for each production batch ok.

Average standard time for each part in a batch is 45 seconds. And there is an average of 600 part in a batch. So, the plant workforce consists of 2 workers per press, 2 workers per press 2 foremen and plus 3 clerical support staff. So, determine how many forged part can be produced in one month, if there are 8 hour worked per day and an average of 21 days per month at one shift per day ok.

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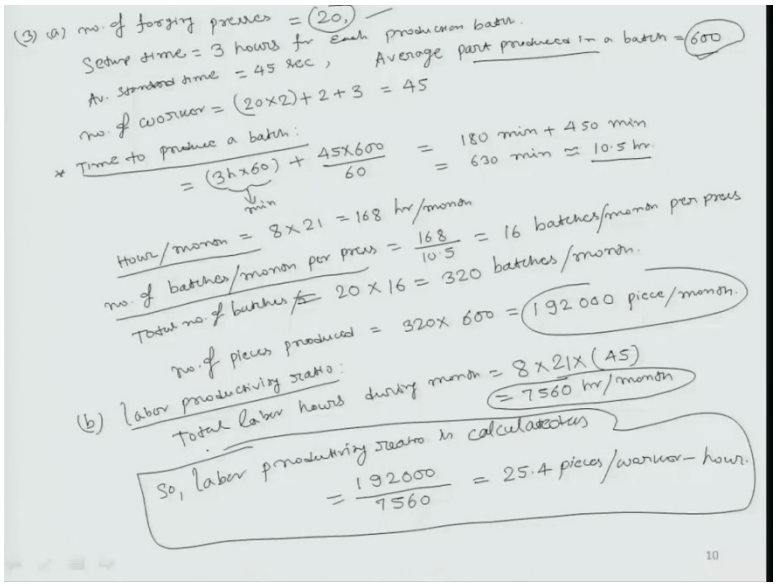

So, how many presses are there. Number of forging presses is equal to 20. And setup time is 3 hours for each production batch, for and average. Average standard time for each part in a batch is 45 second average 45 second. And how many product is produced in a batch that is the 600, average in a one each batch. Now number of work for worker. Problem statements that 2, 2 workers is allotted for each press and 2 for plus 2 foremen plus 3 clerical support staff. Means total there is if 20 forging press and 2 workers is assigned to each press. So, how many worker 20 into 2 plus, there is extra 2 foremen, foremen plus 3 clerical support staff.

$$No.\,of\ workers = (20*2)+2+3=45$$

So, if you will add this one how much it will be that will be 45. So now, I am going to calculate time to produce a batch, our it goes to how much time it will take to produce a batch. So, how it I will calculate? 3 setup time is 3 hours for each production batch. So, setup time is 3 hours into 60, that will be that will be in minute plus that is the setup time for machining to start working. Plus, how many how many workers are working? 45 workers [FL] into and how many part will be produced? 600 and divided by 60.

$$Time\ to\ produce\ a\ batch = (3\,hr*60)+\left(\frac{45*600}{60}\right)=10.5\,hr$$

So, this will be again 180 minute plus 450 minute. That is equal to 630 minute and if you convert it in hour then it will be 10.5 hour. So, if we suppose again we are if we want to convert this for in a working on time producing time in a month. So, what will be hour per month? Will be 8 hours per 21 days. That is the 168 hour for a month.

So, number of batches per month per press will be equal to number of batches per month per press. What will be we have hour per month is 168 hours per month; that means, 168 divided by again we have a time to produce a batch equal to 10, 10.5 hour. So, that will be equal to 16 batches per month per press. This is the number of batches per month per press, but we have 20 press. So, total number of batches is equal to 20 into 60 that will be equal to 320 batches per month ok.

So, total batch is given as 600 total batch. So, if you want to calculate number of batches how many required, then it will be number of produced is equal to 320 batches per month into 600. That is the equal to 1,92,000 piece per month. Now second part what this is saying? What is the labor productivity ratio of the forge shop expressed as parts per worker hour?

$$No\ of\ pieces\ produced = 320 * 600 = 192000\ pieces/month$$

We have to calculate labor productivity ratio. So, if we want to calculate labor productivity ratio, it means the productivity is related to the labor. So, how much time they have spent in the work shop? Total labor hour during month how much it will be? 8 hours for a day, and how many work days they have work? 21 and how many workers total number of workers? Is 45, if you will solve this one this will be 7560 hours per month.

So, labor productivity ratio is calculated as the total number of pieces produced divided by working hour by labor, 192,000 divided by 7560. And that is equal to 25.4 pieces per worker per hour. Now we have calculated solved this one, labor productivity ratio.

$$Labor\ productivity\ ratio = \frac{192000}{7560} = 25.4\ \frac{pieces}{workers}\ perhour$$

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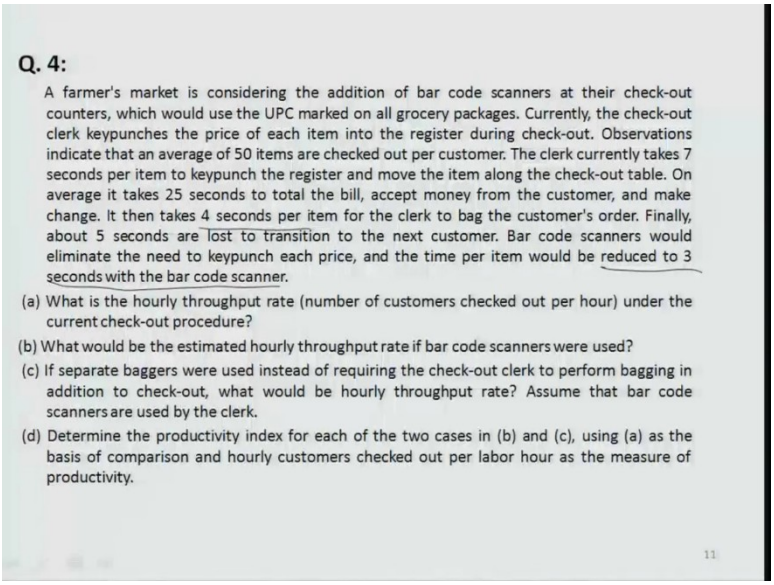

Now, we will move to forth question. In this question problem statement as follows. If farmer farmers market is considering the addition of bar code scanner at their checkout counter which would use the UPC market on all grocery packages currently, the checkout clerk keupunches the price of each item into the register during check out. Observation indicates that an average of 50 items are checked out per customer. The clerk currently takes 7 second per items to keypunch the register, and move the item along the check out table.

One average it takes 25 seconds to total the bill accept money from the customer and make change. It then takes 4 seconds per item for the clerk to bag t he customers order. Finally, about 5 seconds are lost to transition to the next customer. Bar code scanners would eliminate the need to keypunch each prices and the time per item would be reduced to 3 second with the bar code scanners. It means company is wanted to want to install bar code scanners to reduce the working time, ideal time sorry. What is the, So what we will calculate? What is the hourly throughout rate number of customers checked out per hour under the current check out procedure?

Second part is what would be the estimated hourly throughout rate if bar code scanners were used. If and third part is if separate baggers were used instead of requiring the checkout clerk to perform bagging in addition to check out, what would be hourly throughout rate assume that bar code scanners are used by the clerk? And forth part the

last part each determine the productivity index for each of the two cases in we have solved that we will solve in [b] and [c] using [a] on the basis of comparison and hourly customer checked out per labor per hour as the measure of productivity.

So, we have we will have to calculate several things in this problem. So, first we will start solving current check out procedure first we will check, how much time currently installed process is taking.

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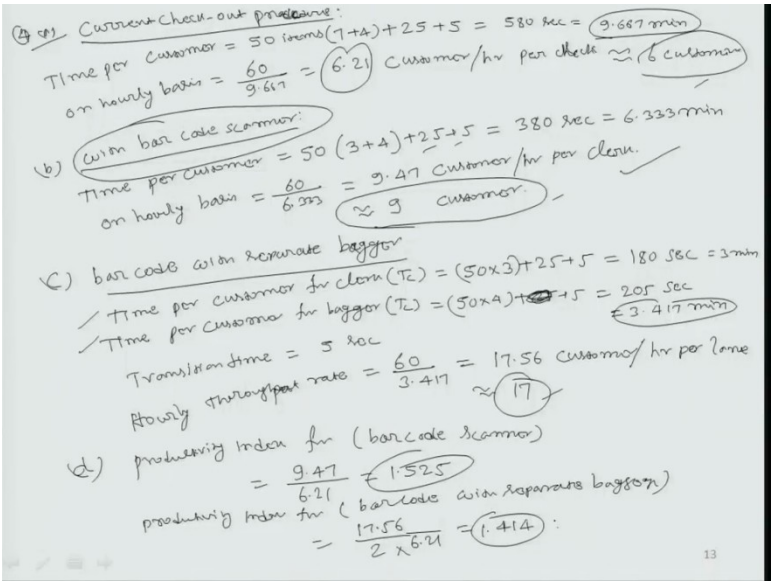

Current check out procedure. Time per customer, first we will calculate how much time is taking to handle per customer. That is 50 items average 50 items are checked out per customer. Means number of items is 50 items 7 plus 4 because it takes 7 second per item and it takes 4 second per item to collect to the bagged customers order where total time is 7 plus 4 is equal to 11 and plus 25 plus 5 that is equal to 580 second that is the 9.667 minute. It means per handling each customer, per handling each customer total time required is 9 point approximately 9.667 minute.

$$¿\, per\ customer = 50\ items\,(7+4) + 25 + 5 = 580\ sec\ ¿\, 9.667\ min$$

If we will calculate hourly basis on hourly basis then, 60 divide by 9.667. That will be equal to 6.21 customer per hour per check. It means in current system in a one hour 6 point 21 minute approximately 6 customers.

$$on\ hourly\ basis = \frac{60}{9.667} = 6.21\ customer\ per\ hour$$

They handle 6 customers in a one hour. Now we will calculate with bar code scanners, how much time will require? Time per customer.

Process time is reduced 3 second with bar code. So, item is constant 50 item. And now this one is 3 plus 4 and plus this is the fix time we cannot reduce this one this one. So, 380 second; that means, 6.33 minute. If we will calculate on hourly basis, what will be? 60 divide by 6.33, 9.47 customer per hour per clerk. Means approximately 9 customers.

$$¿\ per\ customer = 50(3+4)+25+5 = 380\ sec\ ¿\ 6.333\ min$$

$$on\ hourly\ basis = \frac{60}{6.333} = 9.47\ customer\ per\ hour \approx 10$$

So, we can see that if that store if they use bar code scanners then number of customer is handled by in a in a one hour is increased from 6 customer to 9 customer. Now in third case if again we will calculate bar code with separate bagger. Time per customer for clerk what will be? T c suppose that if you signify with T c then 50 into 3 plus 25 plus 5, that is equal to 180 second, means 3 minute.

$$¿\ per\ customer\ for\ clerk = 50*3+25+5 = 180\ sec\ ¿\ 3\ min$$

Time per customer for bagger who bag the items either T c is equal to 50 into 4 plus 25 plus 5. Or sorry in this case 25 will not include. That it will be 2 second, 3.417 minute. And transition time is given as 5 second. Then if we will calculate hourly throughput rate that will be 60 divided by 3.1417 minute this one. So, that is the 17.56 customer per hour per lane, approximately it will be 17.

$$¿\ per\ customer\ for\ baggage = 50*4+5 = 205\ sec\ ¿\ 3.417\ min$$

Now, you can compare 17.56. So, this problem says that if that store if you use bar code with separate bagger, then they can handle 17 customers in a one hour. Now last one what the problem now last part was asked determine the productivity index. So, productivity index for bar code scanner, what will be? 9.47 this one divided by 6.21, this one that is equal to 1.525. Again productivity index for bar code with separate baggage that is equal to 17.56. Since two people is involved in this process. So, there will be divided by 2 and divided by 6.21. That is the 1.414.

$$on\ hourly\ basis = \frac{60}{3.417} = 17.56\ customer\ per\ hour \approx 17$$

$$Productivity\ index\left(for\ c\bar{o}de\ scanner\right) = \frac{9.47}{6.21} = 1.525$$

$$Productivity\ index\left(for\ c\bar{o}de\ with\ separate\ beggage\right) = \frac{17.56}{2 * 6.21} = 1.414$$

Now, thank you and in the next module I will solve problems on now on productivity. Then I will try to I will move on to motion study, and time study. Thank you.

Thank you very much.