Work System Design
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Lecture – 08
Productivity Improvement Techniques

Namaskar friends, welcome to session 8 in our course on work system design, we are currently in the second week of our discussion in our course and the focus is productivity. In week one also, we have discussed the basic aspects of productivity, we had 5 sessions of 2 and 1/2 hours and in week 2 also, we have 5 sessions of 2 1/2 hours' duration and today we are into the eighth session of the course and third session of week 2.

And our target today is to identify, to understand, to discuss, to deliberate the productivity improvement techniques and if you see in this particular week, our focus has been on key areas which we need to focus on. In session 6, we discuss the factors affecting productivity, in session 7, we focused on causes of low productivity and today we are trying to identify the techniques that can help us to improve the productivity.

So, all these 3 sessions are correlated to each other, they are not independent of each other, they are dependent on each other that is if we know that these are the causes, we try to look for the remedies, we try to look for the improvements, we try to look for the areas in which we can work to eliminate these causes of low productivity. If you know the factors that are going to affect our productivity, we can be proactive.

We can focus on those factors and try to find out means and mechanisms, ways and remedies which can help us to identify that these are the important areas of improvement, here there is the scope of improvement, these are the factors if taken into consideration can help us to improve the productivity of our organisation. So, all these discussions or all these sessions are not independent islands, they are combined to one another.

This will help us in defining our thought process in a way that whenever we are in any organisation, we will be able to identify that where we must focus, so that our overall

productivity improves. For example, as teachers we are associated with academic institutes, academic institutions, so if we understand the concept of productivity, we will be able to find out that within our organisation where we need to focus.

There are basically 3 stakeholders in our institution; the students, the faculty members and the staff members. Now, we have to see that from the human resource perspective what actions must be taken, so that the faculty is happy, motivated in high morale, they are doing their task religiously, they are doing the task diligently, they are working hard for earning a reputation for themselves as well as for the organisation.

So, we have to focus on the faculty, we have to focus on the students that they are motivated, they want to do something for their institute, they want to bring laurels for themselves, their parents and the Institute, similarly for the staffers, so from the human resource perspective, we know that in order to be among the top 100 universities or institutes in the world, we need to focus on our human resource.

Then, we need to focus on our processes and procedures, we need to focus on the latest tools and equipment and the technology that can be used for conducting research as well as for the teaching learning process, so technology is an important parameter, human resource is an important parameter, the equipment machines are an important parameter, the processes and procedures are an important parameter, our branding is important parameters for defining the productivity of our organisation.

So, I have just taken a random case study of an educational institute that where our educational institute must focus in order to improve its productivity. Similarly, each and every organisation, it may be involved in different types of work or different types of operations can identify factors, can identify causes, can identify actionable areas where they can put their efforts and try to improve the productivity of their enterprise.

And their productivity or improvement in the productivity will not only benefit them but it will benefit the society at large and also help in improving the GDP of the country, so with this

background, let us try to just summarise, I am saying summarise because in 25 to 30 minutes of discussion, we cannot have an overall; we can say policy which can help any organisation to improve its productivity.

But certainly we can pinpoint the actionable areas and try to see that what has to be taken into account in a specific area, which can help the organisation to improve its productivity, so one by one we will try to see that actionable inputs that can be used to improve the productivity of the organisation, so this is whatever is available in literature there can be other areas also, people may be conducting research and finding out other areas of research, other areas of may be improvement which can lead to increase in the productivity.

But here we have tried to highlight some of the areas that if the organisation focus on these areas, the productivity may increase, may I am saying because there can be the flip side of certain points also that if you do not do our standard maybe you can say procedure if you do not follow a standard procedure we are lacking in our know how of application of any one of these techniques, we may not be able to increase the productivity or even may go to loss also.

So, the cost benefit analyses also have to be done, the effect of one parameter has to be investigated, has to be understood, has to be seen on the other factors or other parameters also in; may be in our urge, in our desire to increase the productivity of our organisation, if we focus only on one particular actionable area, we do not focus or we neglect its effect on the other areas, then sometimes we may also have adverse effects.

And actionable area may not yield the desired results and may often lead to decrease in the productivity also, so we must be very, very cautious when we focus our attention on any one of these area, so the first area that is highlighted here is the most important in the 21st century that is technology.

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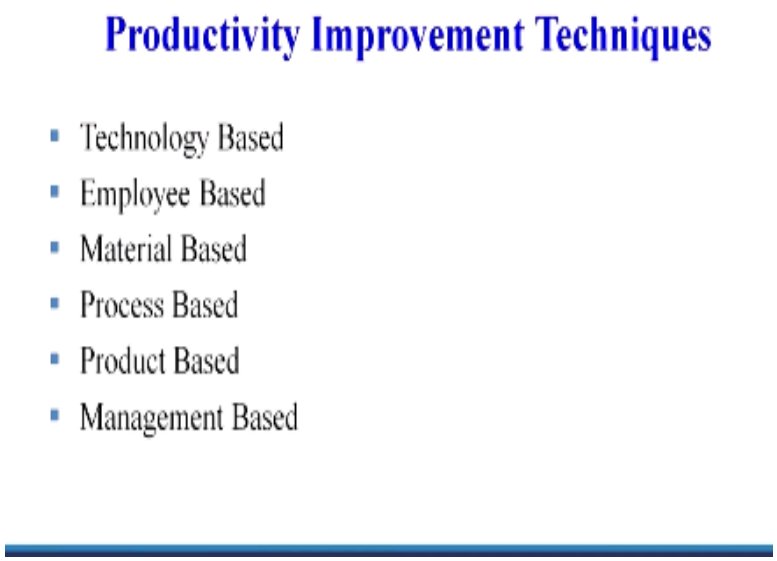

And we have seen one of the causes of low productivity is that we are still using the outdated systems, so the company must see that what type of systems they are using, what is the latest technology available in that particular activities fair or in that particular area and try to orient its thinking in that particular or that advanced technology only in the other words, we can say try to mobilise the resources to procure that technology, so that is one important thing.

So, the first thing or first important thing is that in order to improve the productivity of any organisation, technology must be the key focus area, there is a famous saying I think I have already said it once in this course that if you do not obsolete your product you will be obsoleted from the market in place of product, we can change the technology. If we do not obsolete our technology, we will be obsoleted from the market which means that every now and then we must do or check that whether the technology that we are using is the latest or not.

Whether we are using the outdated technology and how it is affecting our productivity, then we must see that if we adopt the new technology, the latest technology, the advanced technology how it is going to affect our productivity, so the first important parameter is the technology. The second is employee, third is material, fourth is process, fifth is product, and sixth is management or the management procedures and policies.

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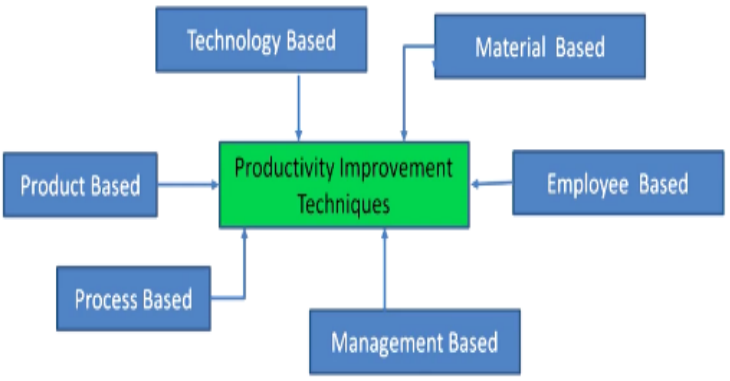

Productivity Improvement Techniques

Source: Industrial Engineering and Production Management by M. Telsang, S. Chand Publica

So, I have just spoken on technology, we will see each one of these one by one, so this is just graphical or a pictorial representation of the various improvement methodologies improvement techniques for productivity, so we can see productivity improvement techniques all different whatever was listed in the previous slide have been highlighted here. So, if we follow each one of these may be in different proportions definitely, the productivity is going to improve.

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Technology Based

- CAD(Computer Aided Design), CAM(Computer Aided Manufacturing) and CIM(Computer-Integrated Manufacturing)
- Robotics
- Laser technology
- Modern maintenance techniques
- Energy technology
- Flexible technology

Now, let us see the first one that is technology based, one example is taken for your reference, computer aided design; CAD, computer aided manufacturing and computer integrated manufacturing. Since, I am a mechanical engineer, I have taken this example of CAD, CAM and CIM, if an electronics engineer is doing this course, he may have; his understanding of the latest

technology in the electronics industry, so he may have an emphasis on another may be latest technology that how technology has improved the productivity in a particular area of specialisation in electronics and communication industry.

But specifically, in mechanical engineering CAD, CAM and CIM has revolutionised the way manufacturing is being conducted or manufacturing is being done in today's century. We see that there is a complete, you can say agreement among the designers, the manufacturing engineers, the marketing professionals, the legal experts, the IPR people, so a team effort is there these days for launching a product in the market.

So, this has completely revolutionised how our design is done, maybe 30 years, 40 years back most of the designs were in the form of engineering drawings but today CAD is used, it is easy to learn, then the changes can be easily done in the CAD file, the CAD file is normally used as an input in the other prototyping machines for example, the rapid prototyping machine, most of the rapid prototyping machines will require a CAD file.

So, CAD and CAM, rapid prototyping computer integrated manufacturing, all these has become the buzzwords today in the manufacturing scenario and most of the industries are following these latest technologies for improvising their functions of manufacturing and trying to improve the productivity of the organisation, so then robotics technology is another technology, complete automation of the industries are being carried out using the concept of robotics.

Then, laser technology is another advanced technology, then there are modern maintenance techniques, energy technology, flexible technology, so if we see there is a long list of technologies, so whatever technologies we have listed here are more or less related to mechanical engineering, manufacturing engineering, production engineering.

But if we go to the other specialisations of engineering like electrical engineering, electronics engineering, textile, chemical each sub discipline has got of each such discipline has got the latest technologies these days which the companies must follow, if they want to increase the productivity of their organisation.

Some of the examples maybe I can explain each one of these points highlighted here but they are just you can say the points related to mechanical engineering for example, if you take energy technology, in energy most of us study as engineers that there is a hydroelectric power generation, there is thermal power generation using coal but these days there is a lot of focus on the non-conventional energy resources.

So, conventional energy resources are our thermal based, hydroelectric based but non-conventional or maybe the renewable resources of energy or renewable sources of energy for example, wind; we can have solar power also, so we can do a may be benchmarking or comparison among the conventional sources of energy and unconventional or nonconventional sources of energy and see that which one is going to help us in our productivity.

For example, in our productivity calculations, we take output by input and energy used is one of the inputs, so if we are able to increase sorry; decrease the energy input in terms of the money spent on energy, our productivity is definitely going to increase, so we must focus that whether we should use the hydroelectric energy or hydroelectric power or we should use the wind energy or we must use a solar energy for our energy inputs.

And try to compare that how the productivity is going to affect, if we are using the conventional or a nonconventional source of energy. Similarly, the flexible technology; flexible manufacturing systems, FMS is a well-known name in mechanical engineering these days in a manufacturing engineering, this is one of the key developments which has taken place, why a flexible manufacturing machines must be used?

Because they are highly productive machines, why they are productive? Because they are flexible in nature, why do we call them flexible? Because they can adapt to the changes in the product design very quickly, now what is the problem in today's scenario? Each and every customer wants variety, each and every company wants to come up with a new product every now and then.

So, if you want to change your product at a regular base at a regular interval of time, you require the technology which can convert your concepts into the product, which must be flexible, if you have a rigid technology or the rigid machine available with you, you will have to buy a new machine to adapt to the product change, whereas if have a flexible machine, it can easily adapt to the change in the shape of the product, change in the profile of the products.

So, flexible technology has also helped companies to be more productive in their operations and has been helpful for the companies to incorporate the design changes in the minimum possible time, so we can discuss each and every point here but I think the major highlight is that the companies must focus on adapting the latest technology, so that they are able to compete with the competitors and they are one among the best, one among the most productive, more efficient organisations.

So, the first and the foremost point is technology, second is the employee, as I have taken an example of an educational institute, so the employee, staff, faculty members are the key stakeholders, so from an employee's point of view, I think I need not explain again each one of you know that how the employee will get motivated, how the employee will help in the productive or help in the improvement in the productivity of an organisation or help in improving the productivity of an organisation.

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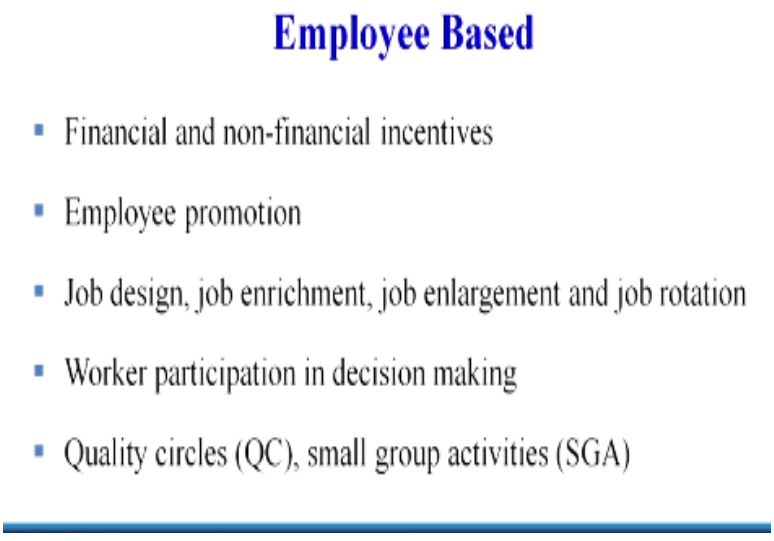

It is possible by giving financial and non-financial incentives to the employees, employees promotion must be regular, must be quality based, must be merit based, then job design, job enrichment, job enlargement and job rotation, so we can see that all these techniques will give high morale, high motivation to the employee, he will enjoy doing his work. For example, when we designed the system using ergonomic aspects, we try to fit the job to the person.

On the contrary, if you try to fit the person to the job, then maybe the person may not feel that happy that we used to try as mechanical engineers to try to fit the job, change the way the job has to be done, so that it suits the worker. So, if a job design is important, then job rotation, job enlargement, job enrichment, so we have to see that the employee feels motivated satisfies; satisfied and he enjoys doing the task that is assigned to him.

If he enjoys his task, he will be more productive, he will be more useful for the organisation just may be there are few terms, which may be new to some of the learner job design I have already explained with the example of ergonomics, we must design the job in such a way that the worker feels comfortable, safe in doing his task or in doing the job. Job enrichment means that he is enjoying his job, he is a part of the decision making process related to his job.

Then, job enlargement means at the same level, if his operator is operating one machine, he can be given 3 different types of machines but his level remains the same that same level now he is doing work on 3 different machines on a maybe a weekly basis or on a monthly basis. Job rotation means that we are transferring the employee among different sections, so that his job does not becomes monotonous.

So, for making an employee feel important in the organisation, we can use or we can follow these particular job satisfaction techniques for the workers like job rotation, job enlargement, job enrichment which will help him to improve his mental health, which will help him to improve his mental status, maybe the main focus has to be that he must feel happy in doing the task which has been assigned to him.

Then, worker participation in decision making already I have told this that job enrichment will ensure that the worker participates in the decision making process regarding the work which has been assigned to him. Then quality circles; small group activities, SGA can also help the worker in achieving his targets or being feel or feeling important part of an organisation. So, 2 things we have seen; technology and the employee.

So, if we have the latest technology, our employees are satisfied, they are happy, they are enjoyed doing their task, they feel an important part of the organisation, they feel the organisation as their family automatically, the productivity will improve. So, we need to focus on technology, we need to focus on employee, then we need to focus on material that we are using.

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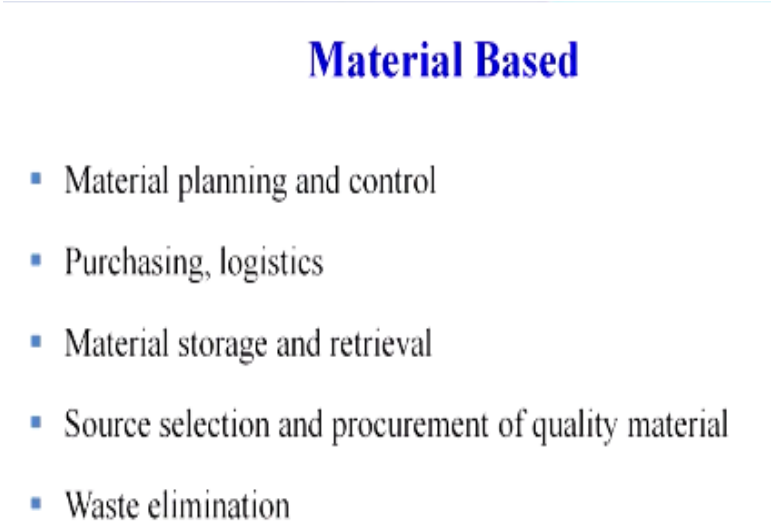

So, from the material point of view, we must use the latest technologies available, the material requirement planning, materials planning and control, inventory management techniques do exist, there are standard mathematical tools which can be used for managing the materials flow within the organisation, so that can be used, purchasing is an important part, then the purchasing of materials as we have seen in one of the previous sessions that our vendor management must be very good.

We should have multiple suppliers, multiple vendors which can help us in the art of need, then the logistics of material flow is also very, very important, material storage and retrieval can be

automated sorry; material storage maybe we can ensure that there is no wastage of material during the storage, many times we see in most of the places, the material is wasted, it is destroyed by maybe rodents or some other types of animals.

So that we must ensure that the material is stored properly, there is no wastage of the material, there is no deterioration of the material, there is no sudden change in temperatures which affect the perishable goods similarly, when we have to retrieve the material, it must be automatic system, easy to retrieve effective manners are not lost, then also we must ensure a proper may be placing of the material, so that the retrieval is easy.

Many times we see, you go and order a tool from a tool crate, the person starts looking that where the tool is placed, if there are designated space for each and every tool, each and every (()) (23:33), each and every fixture in the organisation, a retrieval becomes easier, it saves a lot of time for the workers and you are able to trace the things easily, so that is also one good practice which can be followed which saves a lot of time.

Source selection and procurement of good quality material, which is already highlighted in purchasing that when we are focusing on material, we must always focus on good quality material because good quality material will get converted into a good quality product, then already this is one of the main causes of low productivity that is waste, so we must try to eliminate the waste to the maximum possible extent.

Any wastage in terms of material, in terms of time, in terms of money is definitely going to adversely affect our productivity, so the wastage has to be minimised. The 3 important things we have seen that if we focus on these 3 things, the productivity is definitely going to increase. Now, what are these 3 things? The technology, the second one is the employees; the third one is the material that we are using for making our product.

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Process Based

- Methods engineering and work simplification
- Job design, job evaluation, job safety
- Human factors in engineering

The fourth one is the process that is being followed, so in process we can see there will be a sequence of processes or sequence of operations which will be done on the product and we must optimise this route that the product will follow within the organisation, so methods engineering which is one of the important modules of our course on work system design, we will see different types of process charts.

And how this process charts can be used for improving our process flow within the organisation or how we can identify areas where the efforts must be done in order to optimise our method of doing the job. So, the methods engineering and work simplification are techniques which are based on the process, job design, job evaluation, job safety and other catchwords, human factors in engineering as I have already told ergonomics.

We can try to design the process in such a way that the person who is performing the task may feel at ease he does not feel tired, he does not feel a lot of fatigue, he is may be happy when he goes home from the industry or from the organisation, so basically the process; the whole process of converting our raw material into the final product must be such that it is safe, it is easy; it is easy to understand, easy to implement.

And the workers also feel comfortable doing this process or doing the process of conversion from the raw material to the final product, so that is basically important, so we have seen? We

have seen the raw material that is coming must be good quality, we must have different vendor, our logistics must be optimised, so we have focused on the material, we have focused on the process through which this material is going and getting converted into the final product.

We have focused on overall on the technology that our technology must be latest, we have also focused on the person who is going to undertake this conversion process from the raw material to the final product, so all in all we are; we have identified the areas where we can put efforts to increase the productivity of an organisation, the material, the men, the machines or equipment, the technology, the employees so everything is important when we want to look at the productivity improvements.

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Product Based

- Value analysis and value engineering
- Product diversification
- Standardisation and simplification
- Reliability engineering
- Product mix and promotion

So, the next is product, what you are going to produce; so from the product point of view, we must focus on value analysis and value engineering. If you remember, I have already conducted one course on product design and development in which we had lot of discussion on this topic of value engineering and we are still planning that we can have another 10 or course on value engineering.

So, we will try to emphasise the aspect of value engineering which is very, very important into today's scenario, so from the product point of view, we must focus on the definition of value engineering for every product, it must be able to satisfy the desired function reliably at a

minimum cost, so desired function is the function for which the purposes for which we are buying the product.

Now suppose, let us take an example, I am using this pen, I have used this pen or I have bought this pen for a particular purpose, so that purpose is the function of this product, so the value engineering says that the purpose, the desired function for which the product has been bought must be delivered to the customer reliably at the minimum cost, so value analysis and value engineering are keywords in case of products.

So, if we do value engineering, value analysis, the product that we design will be good, the cost will be optimal or it will be minimal, so if the cost is controlled, cost will go into the input in one of the models if you remember we have seen, cost is an important input. If we are able to minimise the cost, your productivity is automatically going to increase, so product diversification may be giving offering variety to the customer.

Then, standardisation and simplification if you use a standard part in your product automatically you can save the cost and if you save the cost, your productivity will be higher. Reliability; I have already told the desired function reliably at the minimal cost, so the product must be reliable, then product mix and promotions or the advertisements regarding the product are also going to improve the productivity.

Now, productivity if we say in the numerator in the calculation, we have the output in terms of the volume of products produced or the volume of products sold in the market, so your products sold also depend upon the marketing or the promotions that have been done for the product. So, from product point of view also we need to work, we need to identify key areas of improvement, so we; I think, we have tried to focus on key areas.

So, whatever you are producing is important, who is producing it is important, which machine is producing it is important, which employ sorry; who is producing already we have covered, then we can also see what is the material which is used for producing that product, so all these factors

if we take into account and we try to use the best possible technology, best possible skills of the workers, best possible materials available and we apply the concepts of value engineering.

Because sometimes it is also some of you may argue, some of you may debate that if you use the best materials, you use the best processes, you use the best people, you used, so everything is best, the cost of the product will also be high, I totally agree with you in this point but in this particular slide if you see, value analysis and value engineering, we have to see that what is the desired function that we have to meet.

And if the desired function is met by our product reliably at the minimum cost, then our product will be successful, now how to ensure the minimum cost that is where the redesigning the product, looking at the alternate materials, looking at the best processes that can convert those materials into the final product. So, basically the product is also a key focus area for improving the productivity of any organisation.

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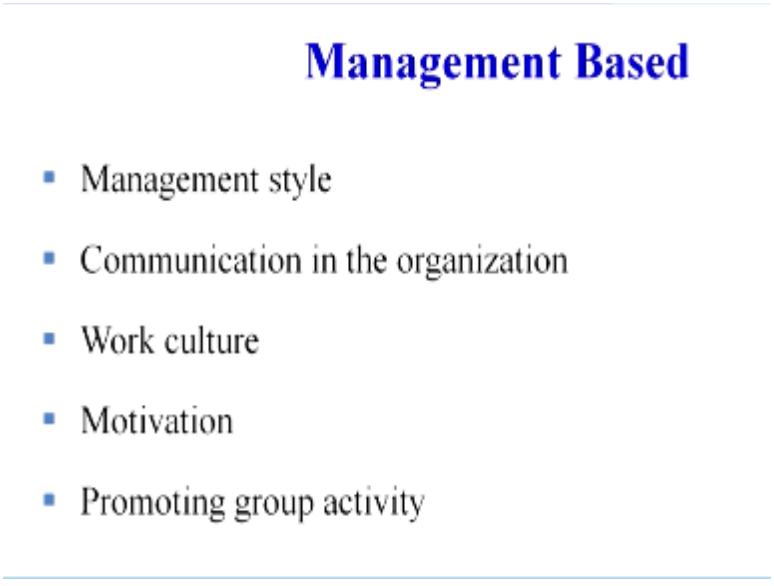

And the last one is the management, from management point of view we can say the style of management, the communication in the or the communication channels in the management many times it is just top down, from top the orders are issued, the juniors or maybe the lower staff have no say in the decision making process. So, productivity may not be that higher in that case, why

because if do not include, if you do not may be taken into confidence each and every stakeholder of an organisation into the decision making process, the productivity may be lower.

Then the work culture within the organisation, the motivation level of the employees or the top management, promoting group activity may be one of the sources for including or for inclusive decision making among the organisation or among the employees of the organisation. So, we can say that how the company is being managed is also an important point, is also an important point which will dictate the productivity of the organisation.

So, this is the last point that we needed to discuss today and to summarise what we have covered I think it is all connected, it is all interrelated, so starting from the product to the technology to the material to the person, each and every aspect of the manufacturing activity has to be taken into account and we must try to optimally utilise the resources, optimally utilise the expertise, optimally utilise the time, so that we can be productive.

And we can use our resources for improving the productivity of our organisation, in the last 2 sessions for this week or may be for the discussion on productivity, we will try to emphasise on certain numerical aspects, certain numerical problems we will try to solve and try to understand this concept by taking into account some of the case studies, where the product change has led to productivity improvements, where the process change may have led to productivity improvements.

Or the manpower change or the human resource change has led to the productivity improvement, we will try to see that how much we can address in the last 2 sessions and then once our productivity discussion is over, we will focus on the other important aspects of work system design such as a work study, then we will focus on methods study, time study and finally, we will focus on ergonomics. Thank you.