Work System Design
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Lecture - 51
Ergonomics: Basic Concept

Namaskar friends. So today we are going to start the discussion for the 11th week of our course on Work System Design and 3 important modules we have already completed. We have completed the discussion on productivity, we have completed the discussion on method study, we have completed the discussion on work measurement. Now we are switching over to an important aspect which is very, very important from the worker's safety, workers well-being as well as worker's efficiency point of view.

So we want to improve the efficiency with which the workers perform their task and if you we can improve that automatically our overall productivity of the organization is also going to increase. So as you can see on your screen the topic of Ergonomics is very, very important and I must mention here that this topic is so relevant in all spheres of our life that we have already covered Ergonomics if you see in our courses on product design and development.

Whenever we are designing a product we have to keep in mind, we have to take into account the Ergonomic aspects that how the person or the user or the customer is going to use the product. We have also covered this in the topic operations management that when the person is performing the task on the shop floor how to design the work so that it is comfortable for the worker.

So today we are going to start again the concept of Ergonomics which is even more relevant in the design of the work system. So whenever we are designing a work system we have to fit, we have to maybe design the work system in such a way that the worker feels comfortable, he is not injured or he is not feeling unsafe. We provide him a safe environment for working. We fit the job to the capabilities of the worker.

So that is the basic concept of Ergonomics and there are maybe different types of Ergonomics, different constituents of Ergonomics. Designs may vary based upon the anthropometric data maybe if we are designing for a particular country we may need to take

the average data for that particular country as soon as the geographical regions change, the anthropometric data also changes and the design also has to be tweaked as per the requirement.

So we will see that how to design the system in such a way that ergonomically it is a good design that is it is good from the point of view of the worker because it facilitates for him an easy work, it facilitates easy working for the workers. The worker does not feel fatigued out, the worker does not feel tired after performing the task which has been assigned to him. Now we already know 2 things we can easily do.

We can find out the best method of doing the work using method study, we can find out the time required to do that work using the work measurement or the stop watch time study, we can do work sampling or predetermined motion time system we can use to find out how much time is required for the worker to perform the task. So 2 things we have done now we have to see that how to design this man work interaction.

So that the worker does not get injured he feels safe, the environment is good for him to deliver what he has been asked to do. So Ergonomics helps us to design the system in such way that the efficiency, productivity, effectiveness of the workers improves. So let us see what is the basic concept of Ergonomics. So as we have seen in our previous session also.

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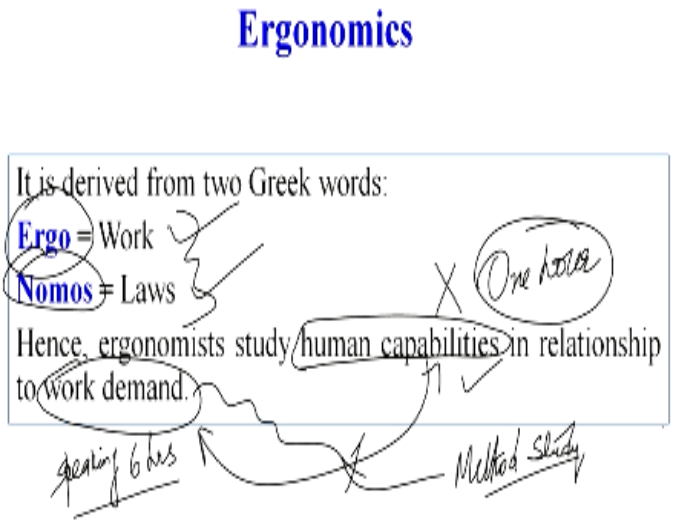

Ergonomics is made up of two words Ergo and the Nomos which means work and the laws. Hence ergonomist study human capabilities in relation to the work demand. So there are 2

important things the human capabilities and the work demand. Now suppose somebody asks me that you have to speak for 6 hours without stopping. So human capability may not allow me to continuously speak for 6 hours at the same pitch, at the same volume.

Maybe I may feel tired after speaking for one and half hour or two hours. So my human capability is not matching the work demand. The work demand is speaking for 6 hours continuously. So this is not being matched, but if you want to deliver a good lecture then maybe the human capability is that you can speak for one hour at a very pleasing volume as well as you can use your brain, your mental faculties to come up with new ideas.

New examples, new case studies. You are able to explain the things in a much better manner if you speak for one hour. So we have a human capability and the work demand should also be such that it matches with the human capability. If the work demand is such that the human capability is exceeded beyond maybe the tolerable limits or beyond the limits therefore the interrelationship between the capability and the work demand will not be good or will not be judicious or will not be helpful for the organization.

So as a Ergonomists or as a industrial engineer it is the duty of every scientist or engineer to ensure that we design the system in such a way that we take best advantage of the human capabilities so we design the work in such a way that we are able to use the human capabilities in the best possible manner so that is the target. So we are not going to our method study we have seen that how to do the work in the best possible manner.

In method study already we have seen that we have to design the work which is efficient, which is effective or the technique for doing the work which is efficient and effective. Now we will see that how to ensure that the work is being done making best use of the human capabilities. Now this is a slightly maybe a definition which once we read we may not be able to comprehend it.

But if we go step-by-step we will be able to understand this definition of Ergonomics. So this is the source for this definition is international ergonomics association.

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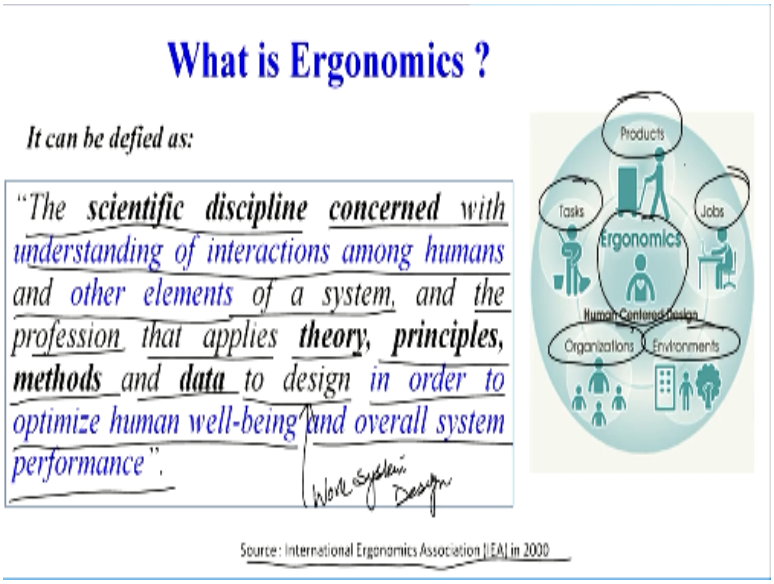

So let us see now what is Ergonomics? The scientific discipline so it is a scientific discipline it is taught in various UG curriculum, PG curriculum. It is a scientific discipline concerned with understanding of the interaction among the humans and the other elements of a system. So there is a system which comprises of the humans and the other elements the other elements can be machine, equipment, tools, the environment, the air, the sound all these things they are other elements and the humans.

So it is a scientific discipline concerned with the humans like me and the other elements and the profession that applies this is also a profession that applies theory, principles, methods and data to design in order to optimize the human well-being and overall system performance. So it is also a profession which will use the various theories, principles, methods, data as I have already given an example of an anthropometric data.

So there can be different theory also. So theory principle, methods and data will be used for designing the title of our course also is Work System Design. So we our focus primarily is to design with an objective now. What is an objective? We have to design in order to optimize the human well-being. In the previous slide I have shown we need not require to overshoot the critical ability of a human.

Suppose he can easily lift 50 kg to 60 kg of load we must not enforce that you have to lift 100 kg load. So whatever is the human capability we have to design the work, design the systems in such a way that he is able to perform his task to the best of his ability. So the design has to ensure the optimized human well-being and overall system performance. So we do not want

to comprise with the system performance also.

For example, the system has to produce 500 cars in a week we do not want to comprise on that. We want to deliver 500 cars a week because that is what is the demand in the market and the company has planned for producing 500 cars in a week so that need not be comprised. The human capabilities also have to be taken into account. Now how to design this interaction between the humans and the machines equipment.

And the other elements of the system in such a way that we are able to meet, we are able to satisfy the system level performance or the systems requirement. So basically what I perceive from this definition is that we have to understand the human capabilities and the demand of the work and then try to match these 2 things up without comprising the systems performance or leading to enhanced or improved system performance.

So once again I will read this definition for you. The scientific discipline concerned with understanding of interactions among humans and other elements of a system and the profession that applies theory, principles, methods and data to design in order to optimize human well-being and overall system performance. So we have to optimize the human well-being and the overall system performance.

How by using the various tools, method, theories, principle so that we are able to achieve our targets. So optimization of human well-being and system performance is very, very important. Now previous slide once again I will go. So Ergonomics you can see here it is a very, very generic concept. It can be applied to products also, the various tasks also, it can be applied to organizations, environments, jobs.

So Ergonomics has a universal presence. So in each and every aspect of our life we can apply the principles, theory as well as the method of Ergonomics. So here also in the recording studio we can apply the principle of Ergonomics and ensure that the human capability that if a professor or a speaker can speak for one and half hours to 2 hours at a stretch or maybe in a span of 3 hours.

We must provide the environment in such a way that he is able to speak for those hours or those many numbers of hours. It must not happen that maybe the lighting system is affecting

his performance or the air conditioning system is affecting his performance or the acoustic is affecting his performance, so all these are system elements. So we have to design the system elements in such a way that as per the human capability if a professor is ready to speak for 3 hours or 4 hours at a stretch maybe in the morning session our system must facilitate that.

And that is the basic concept of Ergonomics and it can be applied the example has been given in order to emphasize the importance of this field of science that it can be applied at each and every place even a driver who is driving a bus in that system also the driver is a human being or maybe he is the subject and then the various system elements, the controls, the (()) (13:23) in front of him the gear shift lever maybe overall environment of the bus, his chamber, his cabin.

All that comes under the aspects or concepts of Ergonomics. So there also we can apply the theory of Ergonomics to ensure that if the human can drive for 10 hours at a stretch with a single break of 15 minutes we can take advantage of that human capability and he is able to drive for that much distance which can be covered in 8 to 10 hours' duration. So with these 2 examples what I want to emphasize is that is it not a very specific concept which can be applied only on the shop floor.

But it can have applied across disciplines, across different application areas. Now what is Ergonomics? Already we have seen the definition I think all of you have understand the basic concept.

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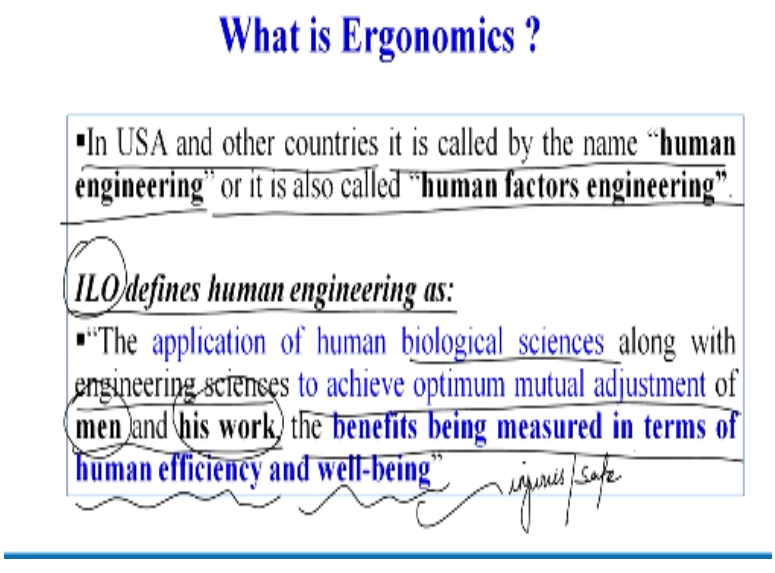

In USA and other countries, it is called by the name human engineering or it is also called human factors engineering. So human factor engineering is also maybe one form of Ergonomics only. Now ILO defines human engineering as per the ILO also we have referred to the book also. The application of human biological sciences along with engineering sciences.

So the biological sciences along with the engineering sciences to achieve optimum mutual adjustment of the men and his work. So again the focus is the men and his work. So we have to find out the mutual adjustment between the two. The benefits being measured in terms of human efficiency as I have already given an example just now and his well-being. Now well-being can be that he is not prone to injuries. We are able to provide him safe working environment.

So his well-being has to be ensured as well as the maximum efficiency as per the maybe just I have been using that word again and again the human capability. So whatever capability the human being possess we have to take maximum advantage of that capability by designing the interaction between the human and the elements of the system in such a way that the system performance is also improved and the human capability is also optimally utilized.

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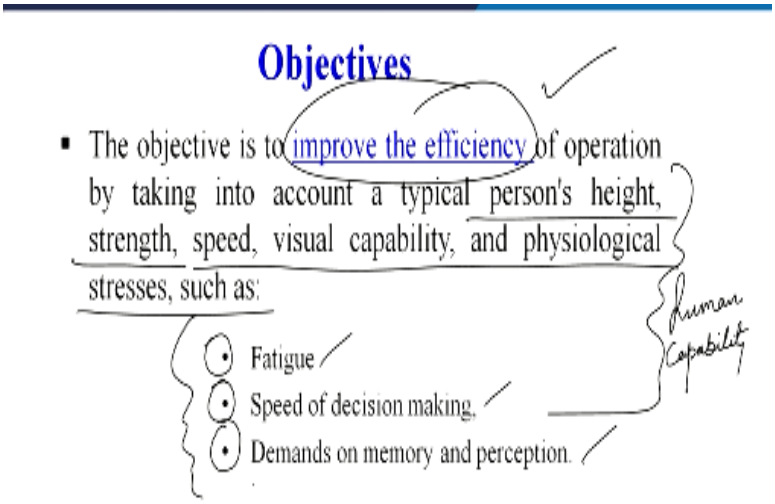

Now what are the objectives of ergonomics let us see. The objective is to improve the efficiency of operations by taking into account a typical person's height maybe anthropometric data is (()) (16:01) in the strength, speed, visual capability and physiological stresses etcetera such as fatigue, speed of decision-making, demand on memory and

perception.

So basically the target is to improve the efficiency of the operation. What we have to take into account? We have to take into account all this will fall under the human capability. So we have to ensure that we are able to improve the efficiency of operations by taking into account the human capability. So fatigue very important parameter, speed of decision-making maybe one part of cognitive Ergonomics demands on memory and perceptions.

So all these things have to be taken into account when we are studying Ergonomics and using this understanding we will try to improve the efficiency of the operations.

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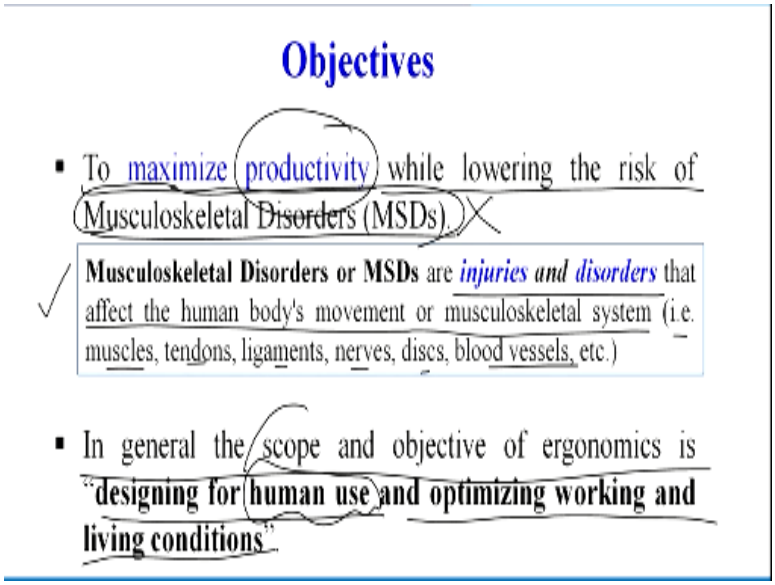

Now to maximize the productivity this is also an objective of Ergonomics while lowering the risk of musculoskeletal disorders. So this is a very important term musculoskeletal disorder this we have to ensure that we are able to remove or mitigate. Now what are musculoskeletal disorders we must also try to understand? The musculoskeletal disorders or MSDs are injuries and disorders that affect the human body's movement or musculoskeletal system.

What is that system? That is muscles, tendons, ligaments, nerves, discs, blood vessels etcetera. So we have to ensure that this MSDs are avoided when the worker is doing the repetitive task again and again and this will lead to increase or improvement in the productivity of the organization which is an important objective for every organization which is an important goal of an organization to improve its productivity.

And this word if you can refer back to our discussion we have had ample discussion on productivity. So our overall objective is to maximize the productivity while lowering the risk of MSD and this musculoskeletal disorders we will have a session on Industrial Ergonomics in which we will try to understand the musculoskeletal disorders in slightly more detailed as well as in depth.

So in general the scope and objective of Ergonomics is designing for human use and optimizing working and living condition. So we have to design the system in such a way that human being is able to use it by implying the best of his capabilities and optimizing the working and the living conditions. So this is the general scope and objective of the Ergonomics, concept of Ergonomics.

So if we are able to achieve the objectives which we have laid out that we are able to provide a safe, fatigue free, good working condition environment for the workers and we are able to design the work in such a way that it matches with the human capability. It is going to lead to different types of advantages or the benefits. One example can be that if we see that initially we used to have the gear shift levers which were quite cumbersome or tiresome to operate.

Then the system was so designed that these days we have gear levers which are very easy to operate. Now the next technologies that you need not even change the gear levers directly you can control the speed and the break, there is no need of a clutch auto transmission. So we have seen the transition of the system and now how this has benefited? This has benefited that now the person who is driving the car, who initially used to find it difficult to change the lever apply lot of force while changing the lever.

Then graduated into a smaller lever, easy to operate then graduated into the next level that is auto transmission no need of the lever. So this is the interaction between the person and the system or the element of the system in such a way that the human capability is taken into account number one. The work is designed in such a way that the worker enjoys doing that work.

It does not cause any or does not cause any harm to the workers as well as it improves the efficiency of the workers as well as the productivity of the system. So that is very, very important now because the interaction between the man and the machine has to be designed

in a much simplified manner. So if we are able to do that this is one of the advantages or one of the benefits of the concept of Ergonomics.

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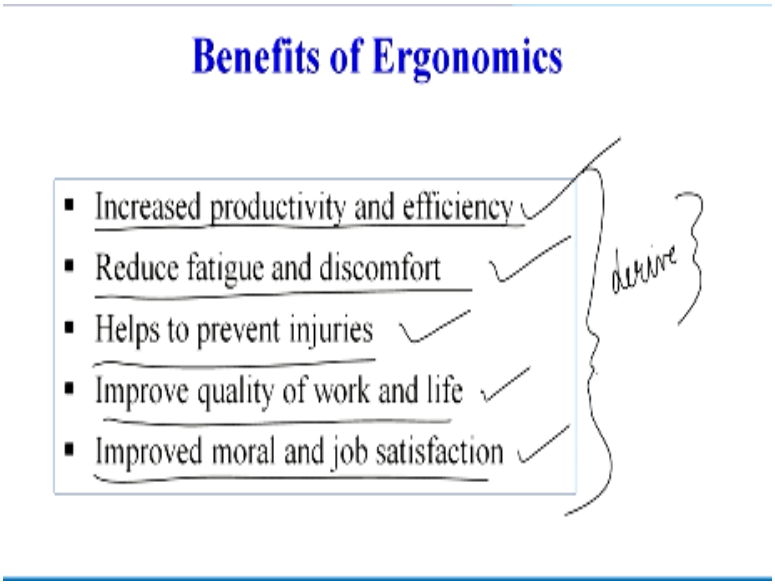

Now let us see the benefits of the Ergonomics already we have seen it will lead to increased productivity and efficiency well established, reduces fatigue and discomfort yes, helps to prevent injures surely in the next session we will see the musculoskeletal disorders, improve the quality of work and life for the worker because if he is not injured he feels safe while performing his task automatically it will improve his quality of work and life.

Improved moral and job satisfaction for the worker. So if we are able to apply the concept of Ergonomics and able to justify the objectives of Ergonomics we are definitely going to derive all these benefits of Ergonomics. So it is not difficult we can easily derive these benefits if we are able to apply the theory principle methods and data for the design of the work system.

In order to ensure excellent system performance as well as the human efficiency or efficiency of the operations being done by the human beings or the workers. Now there are different types of Ergonomics I think maybe in the last 15, 20 minutes I have been able to emphasize on the concept of Ergonomics.

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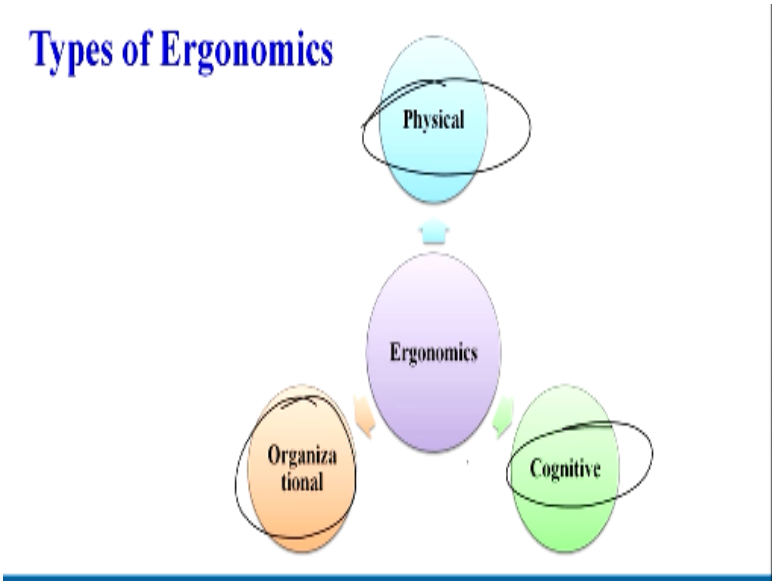

Now there are different types of ergonomics. We can have a physical Ergonomics, we can have organizational Ergonomics and cognitive Ergonomics. So we will see that what are the 3 types of Ergonomics one by one.

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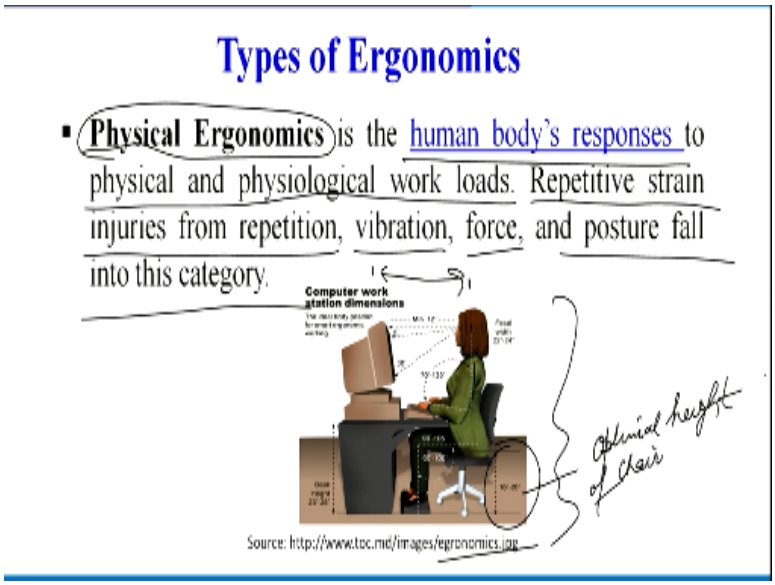

First one is a physical ergonomics. In the physical ergonomics we deal about the human body responses or the physical ergonomics is the human body's responses to physical and physiological work load, repetitive strain injuries from repetition, vibration, force and posture fall into this category. So we need to avoid all these repetitive strain injuries from repetition, vibration, force and posture.

So this is something related to the physical well-being of the worker and here one example is taken this is from a website. Here you can see computer work station so most of the work in

industry or the software industries is done on computers. So this system of interaction between the worker and the system has to be designed making use of the principles, theory, and data and data here you can see different angles.

The distances between the human eye and the keyboard is important which is given here. Then this posture is very, very important you can see the spine has to be straight then the design of the chair also is important where you are getting seated, what must be the optimal height of the chair on which you are sitting, optimal height of chair that is also important. So basically you can see that here our focus is to ensure that the repetitive strain injuries are avoided.

So the physical discomfort to the worker is avoided. We must design the system in such a way that the worker's performance is enhanced. It is not maybe kind of affected by the repetitive strain injury. So that is the crux of physical ergonomics. So we have to take into account the human body responses to physical and physiological work load. So the work here will be physical and physiological in nature.

So that work has to be done by the worker. So this interaction has to ensure that repetitive injuries do not happen or do not take place while the worker is performing his task.

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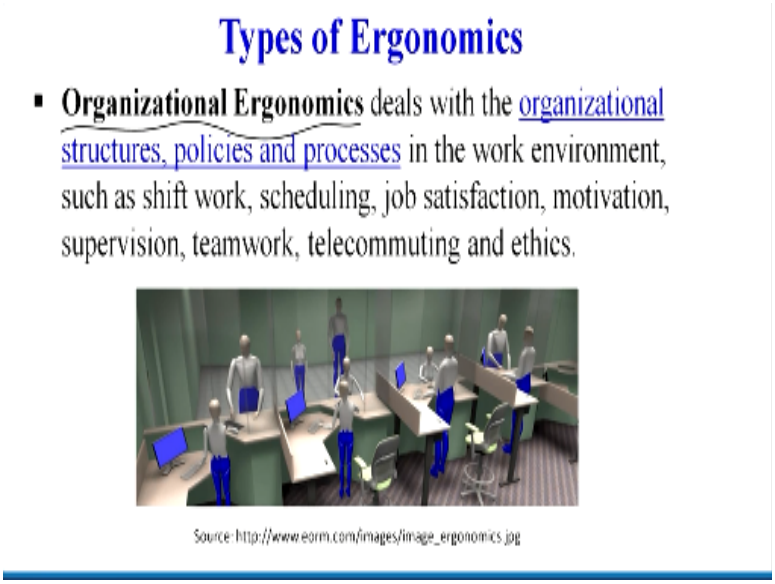

Then we have the organizational ergonomics. Most of the studies that we see are focused on physical ergonomics only. Organizational Ergonomics deals with organizational structures, policies and processes in the work environment. Such as shift work, scheduling, job

satisfaction, motivation, supervision, team work, telecommuting and ethics. So from organizational point of view also we can have the concept of Ergonomics.

That we design the interaction between the man and the organization in such a way the policies are framed in such a way that the worker feels motivated to be associated with the organization that will certainly affect his performance. And his performance will definitely affect the productivity of the organization. So we have to ensure that the organizational structures, policies and processes are so designed that the worker enjoys coming to the organization and working for the organization.

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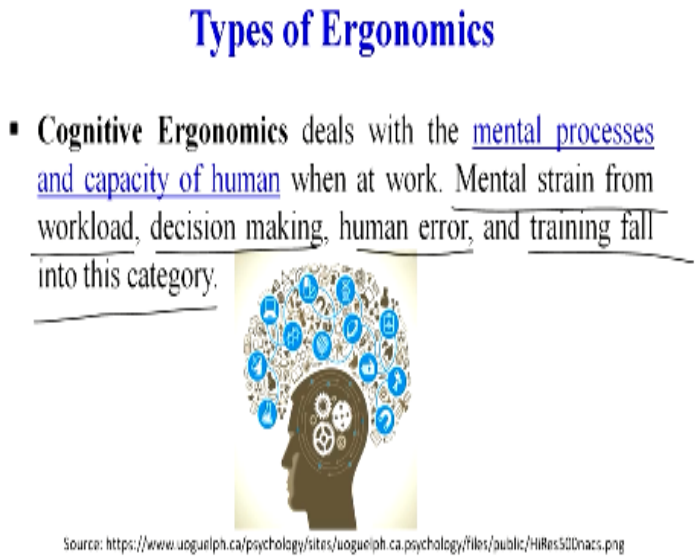

Then the Cognitive Ergonomics deals with the mental processes and capacity of human when at work. So we have seen the physical is related to the physical and physiological load that is given to the worker. Cognitive is related to the mental processes and capacity of human or the mental capacity of human when at work. So mental strain from workload, decision making, human error and training fall into this category.

So we have to take into account the training of the brain or the training of the mind of the worker in such a way that it is not overstressed, it is not strained in such a manner that he is not able to perform his task for the satisfaction of his superior. So that cognitive Ergonomics also is very, very important from the point of view of the system performance as well as the human efficiency.

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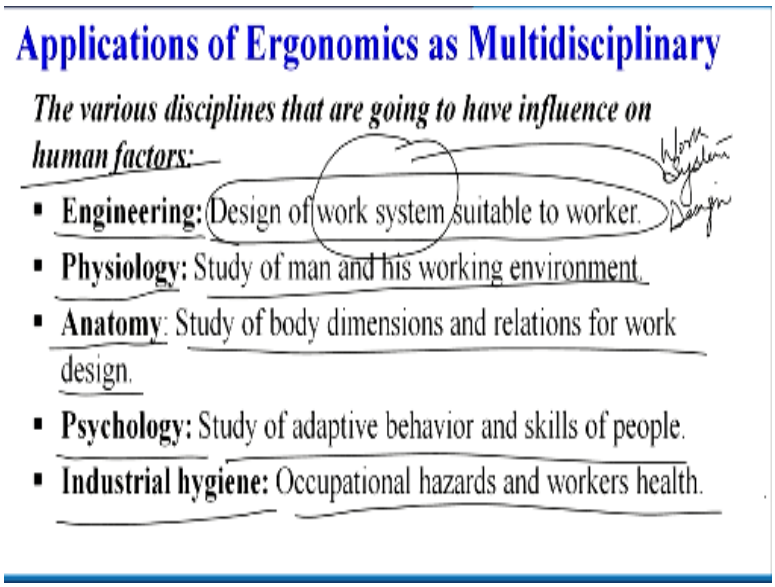

Now applications of ergonomics it has multidisciplinary concepts. The various disciplines that are going to have influence on the human factors let us see now engineering. Design of the work system suitable to the worker so again the word we are I think I have said last maybe in the 50 sessions I may have used this word more than 200 times Work System Design. So from the engineering point of view we have to understand that how to design this interaction between the man the machine so that we are able to achieve our targets.

Then the physiology study of man and his working environment anatomy. Study of body dimension and relations for work design the Anthropometric data, psychology, study of adaptive behavior and skills of the people, industrial hygiene, occupational hazards and worker's health. So here you can see that Ergonomics is a multidisciplinary area. So we need to have the knowledge about the anthropometric data also.

We need to have knowledge about engineering also, the various theories and principles of engineering, the various materials that have to be used for making the various systems, how the human body will interact when you are providing a particular system for the human. For example, you are designing a chair for a human being or for a worker who has to sit for 8 hours in a day we cannot design a chair on which he or she feels uncomfortable.

So what should be the material, what should the foam, whether it should be foamed chair or it should be a wooden chair or it should be a plastic chair. So depending upon the requirement we have to design the system in such a way that the worker feels comfortable. So multi-disciplinarity means that we must have knowledge of engineering, we much have knowledge

of psychology, we must have knowledge of anatomy.

We must have knowledge of hygiene or the various rules, regulations act that govern the industrial safety or occupational hazards and safety. So there has to be a multidisciplinary concept when we are designing the system under the Work System Design. So with this, we conclude the today's session and we will start the next session in which we will focus on Industrial Ergonomics. Thank you.