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Ergonomic Design for Manufacturing and Assembly
Lecture - 48
Assembly Time Determination with PMTS Methods, Human Factors Principles in DHA

So, dear students and participants we have already covered a number of topics related to Ergonomic Design for Manufacturing and Assembly.

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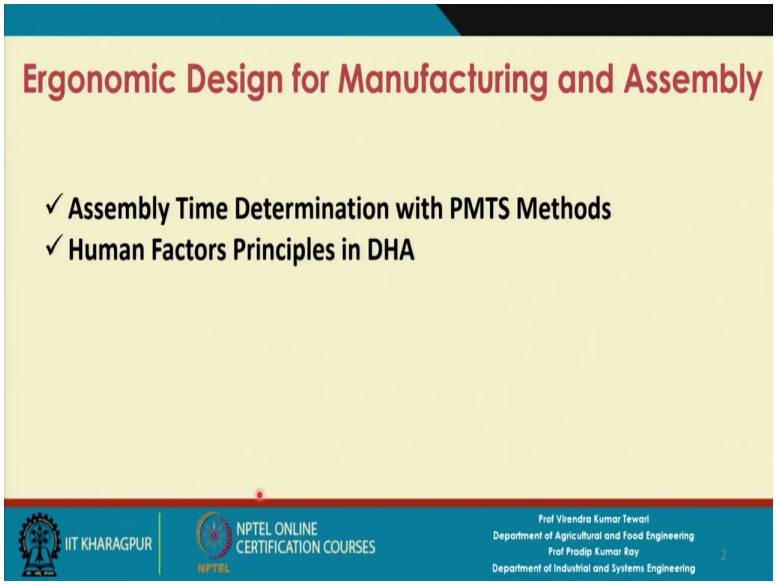

Now this is the third lecture session and in the third lecture session I am going to cover the two important the topics. One is Assembly Time Determination with PMTS Methods. why assembly time determination is an important issue because ultimately what we assume that if the design is ergonomic for the assembly work you will definitely have some advantage in the sense that as a worker, as an operator, assembly worker you will be able to the complete your job very quickly.

And the second topic is Human Factors Principles in DHA.

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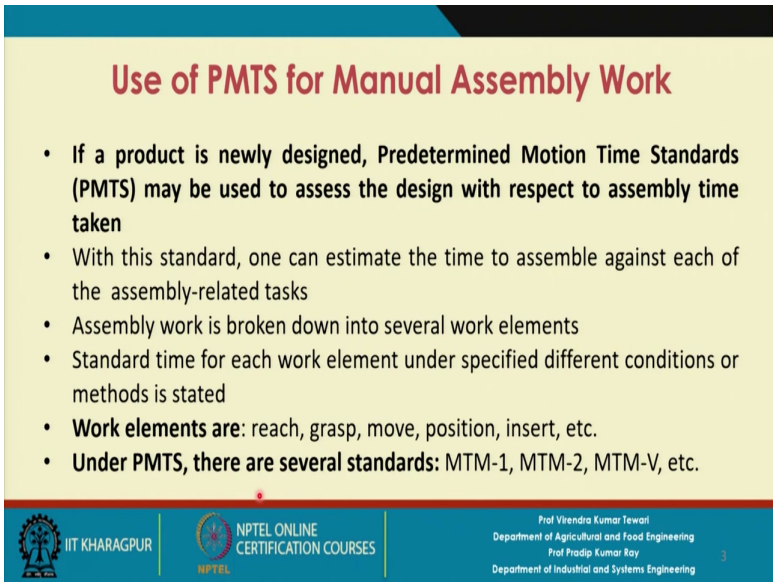

Now let us discuss certain important issues like if a product is newly designed Pre determine motion time standards may be used to assess the design with respect to assembly time taken. So, this is the general method, and there are many organization have proposed different kinds of standards and have identified different kinds of work elements. This is basically a part of the standard time determination and is very important issues. With these standards You try to estimate the time to assemble against each of the assembly related tasks.

So, entire assembly work is divided into number of tasks and for carrying out each task you have to consider several work elements or the activities, suppose there are seven particular work elements against each of this work element under a set of conditions what could be the expected time that is also given in the standard.

So, first you try to define the job in terms of those work elements, in the certain jobs you need some other work elements which are not there in the standard. So, the standard cannot be used, but for many kinds of jobs these work elements are specified in the standards an only be used for doing the assembly work or not for the given job.

Assembly work is broken down into several work elements, standard time for each work element under specified different conditions or methods is stated. Work elements are reach, grasp, move, position, insert, etc. And you will find that most of the assembly work if you want to carry out you have to consider these work elements.

So, that is why the researchers who have developed these standards they have closely observed the assembly work and then the assembly work is defined with respect to certain work elements. And these work elements are the standardized under PMTS (predetermined motion time standards).

There are several standards. Initially it was MTM-1 (method time measurement) that particular organization proposed this standard MTM-1. Later on, they revise the standards they started calling it MTM-2. And today you will find that even MTM-5 that the fifth version is made available and in MTM-1 the number of work elements is more in MTM-2 all these work elements number is reduced, but the against each particular work element there are many conditions, new conditions you can impose. You will find that the number of work elements will be more initially but if you start improving the design you will find the number of work elements is getting reduced.

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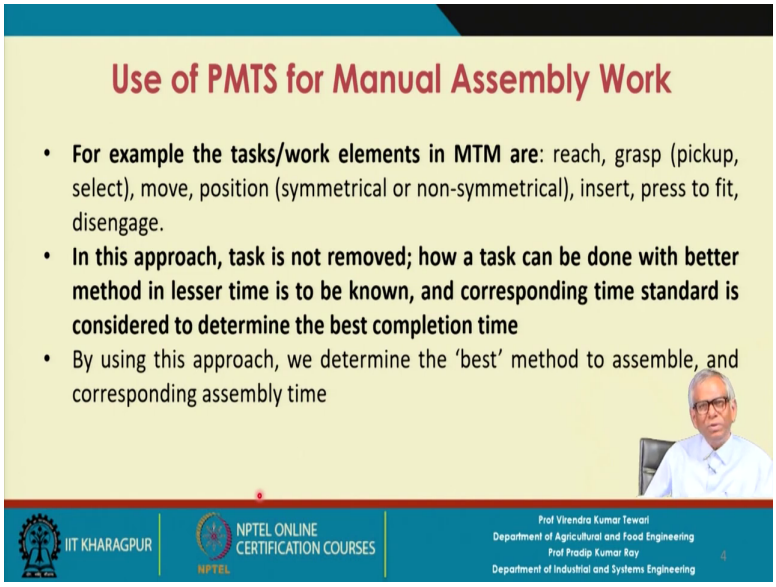

For example, the tasks work elements in MTM are reach, grasp (Within the grasp you pick up the object or pick up the part and you have to select), move position (symmetrical or non-symmetrical), Insert, press to fit, disengage. So, all these details you have to carry out.

In this approach, task is not removed; how a task can be done with better method in lesser time is to be known, and corresponding time standard is considered to determine the best completion time.

By using this approach, we determine the 'best' method to assemble, and corresponding assembly time.

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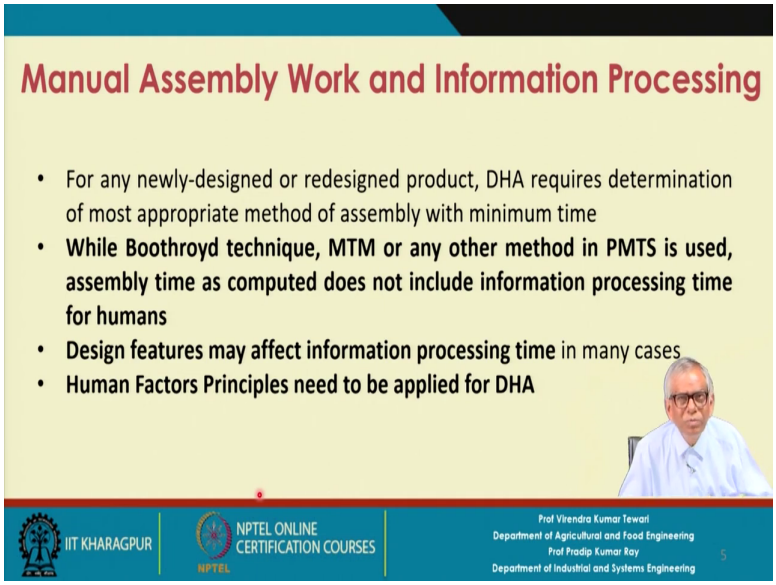

For any newly-designed or redesigned product, DHA requires determination of most appropriate method of assembly with minimum time.

While Boothroyd technique, MTM or any other method in PMTS is used, assembly time as computed does not include information processing time for humans.

Design features may affect information processing time in many cases. Human Factors Principles need to be applied for DHA

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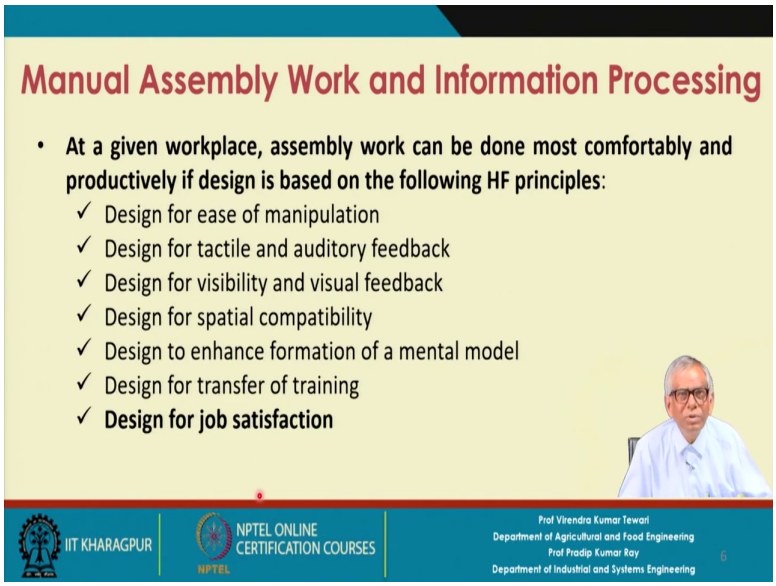

At a given workplace, assembly work can be done most comfortably and productively if design is based on the following HF principles:

1. Design for ease of manipulation
2. Design for tactile and auditory feedback
3. Design for visibility and visual feedback
4. Design for spatial compatibility
5. Design to enhance formation of a mental model
6. Design for transfer of training
7. Design for job satisfaction

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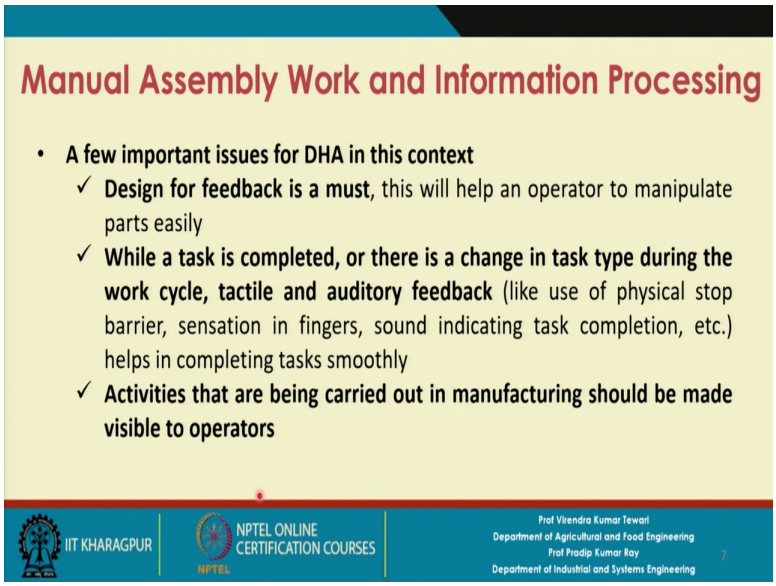

Suppose the two parts are getting assembled and you are doing the symbol two parts. Now there could be many ways you can do, whether you are allowed to work freely or not is the manipulations.

It is not that all the time under the strict rule you have to follow. So, unless it is absolutely needed you have to do but it is better that whether you can do the assembly work as freely as possible that is called flexibility.

Now, there are certain important issues related to all these principles -one is the design for feedback is a must. For example- I am working at the job, the two parts I have joined the third part also have joined, how I am self-assessing whether I am doing the work correctly or not. So, this feedback formation sometimes, there could be visual feedback also you can get it and you yourself will understand whether you are doing it perfectly or not. So, design for feedback is a must this will help an operator to manipulate parts easily.

So, sort of the feedback information must be given, while a task is completed or there is a change in task type during the work cycle, it may so happen that the task is over I have done it in half an hour or there is a change in task type during the work cycle like loading or unloading. So, when while a task is completed or there is a change in task type during the work cycle tactile and auditory feedback is a must. And it helps in completing tasks smoothly like say suppose your operation is a machining operation turning, you have

engaged tool and as soon as you start removing the material and the turning starts, center length you have covered in the cylindrical part and the turning metal removal is also completed. You will find that the tool is disengaged machine is on, but tool is disengaged. So, during the metal cutting operation you get one kind of sound as soon as you find that the sound is changed, immediately you will find that your task is completed.

So, this is basically called the auditory feedback or tactile feedback like use of physical stop barrier on a machine that means, the length is fixed, you have to stop a barrier, there will be a sound, you head the barrier, the setting is done.

Sensation in fingers, suppose you are a drill operator, manual drilling is over. So, you get different kind of sensation while the drilling is on you get one kind of sensation as soon as the drilling is over you get different kind of sensation sound indicating task completion. There are several examples you try to find out. So, just look at a particular process and the one particular machine is engaged, you must know that how a particular machine is used with respect to a particular job and particular operation. So, between two tasks there could be the auditory feedback. And for the same task you carry out for the entire cycle you will be getting in majority of the cases almost the same level of sound.

The activities that are being carried out in manufacturing should be made visible to operators.

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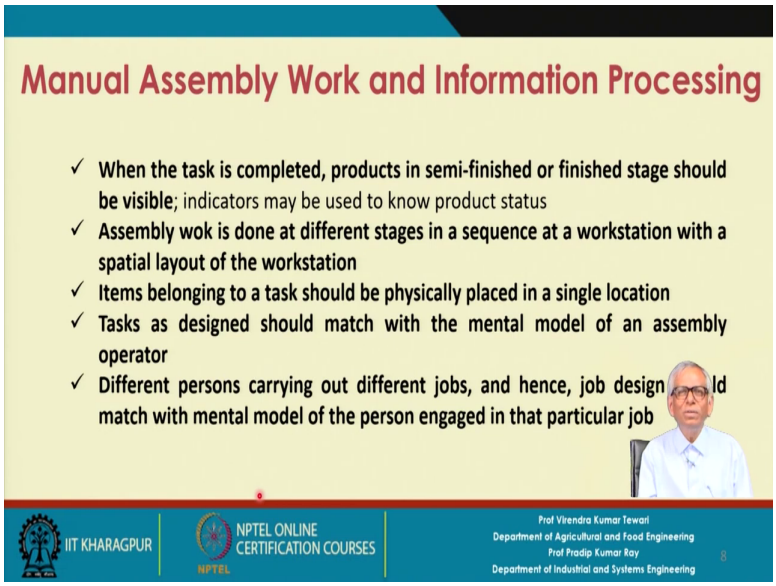

When the task is completed products in semi-finished or finished stage there are number of stages you have to consider. So, either you are in the finish stage or in the semi-finished stage should be made visible like indicators may be used to know product status.

Whether you are at the third stage where two more operations are remaining, this sort of information know and constantly the shape and size of the object is changing or a greater number of the items getting assembled.

Assembly work is done at different stages in a sequence at a workstation with a spatial layout of the workstation. There must be physical visual feedback.

With a spatial layout of the workstation like particularly when part 1 is to be picked up first then part 2, then part 3. So, there will be work table, you should keep all these parts in a sequence.

So, as per the sequence of the operations or as per the sequence of the assembly work you do, you place or keep the parts in that particular location and the last part in assembly should be on the right-hand side whereas, the first part should be kept in the on the left-hand side at one extreme.

So, this is basically called the spatial compatibility.

Items belonging to a task should be physically placed in a single location. So, all part 1 should be placed in a one particular container or particular bin. Task, as designed should match with the mental model of an assembly operator.

like if I am looking at an object as designer my mental model is one type; suppose I do the programming part, I found that someone is working on CNC machine. So, I may the look at the job or the job design from the programming perspective or someone is working in the assembly zone, he is looking at the job from the assembly point of view is it not from the design point of view. That means, for carrying out the assembly work what sort of activities he is supposed to do, from that point of view you are assessing the design.

So, the different persons carrying out different jobs and hence job design should match with the mental model of the person engaged in that particular job.

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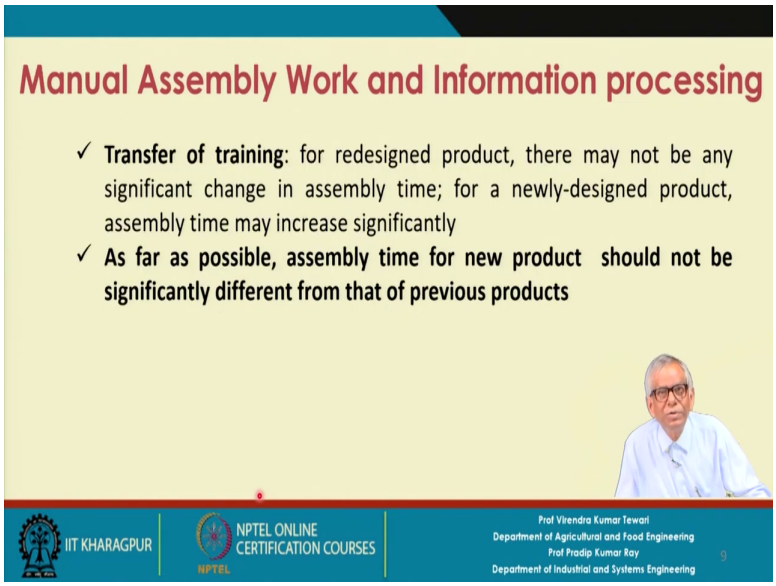

So, the interface design or ergonomic design another important issue is the transfer of training for redesigned product. Transfer of training: for redesigned product, there may not be any significant change in assembly time; for a newly-designed product, assembly time may increase significantly.

As far as possible, assembly time for new product should not be significantly different from that of previous products.

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