Automation in Production Systems and Management
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Cellular Manufacturing System
Lecture - 31
Concept of Definition of Cellular Manufacturing Systems (CMS)

So, during this week the 7th week, we are going to discuss many important issues and problems related to Cellular Manufacturing System.

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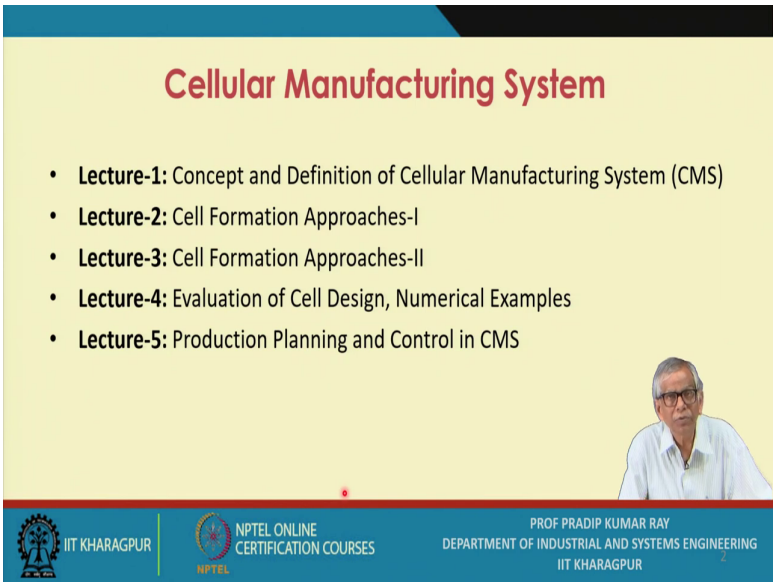

And we have mentioned that by implementing the group technology in a batch manufacturing system, primarily you can create a new kind of manufacturing system called cellular manufacturing system.

And several manufacturing systems will help you creating a flexible manufacturing system as well as the flexible production system, and that is why it is stated that Cellular Manufacturing System or in short CMS is application of GT. The GT principles are known and apply those principles systematically and all the important issues to be considered and the kinds of the problems you face like part family formation.The decision variable, constraints should be

known and then when you formulate the problem, and search for its solution or some algorithm.

The part family is formed with this say n number of part families out of a N population size of the parts. Now to create a cellular manufacturing system, against one particular part family or a or if number of part families you have to create a particular machine cell or cell is to be created.

During this week I will be focusing on few important topics.

Lecture-1: Concept and Definition of Cellular Manufacturing System (CMS)

Lecture-2: Cell Formation Approaches-I

Lecture-3: Cell Formation Approaches-II

Lecture-4: Evaluation of Cell Design, Numerical Examples

Lecture-5: Production Planning and Control in CMS

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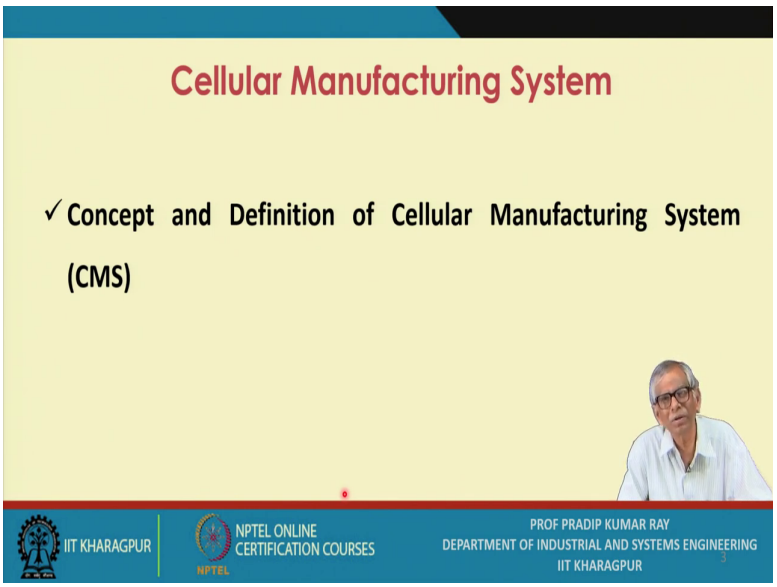

Because production planning and control is the key and your production related or production is very dependent on the quality of production, quality of conformance is very dependent on how strong you are in developing your production planning and control cell.

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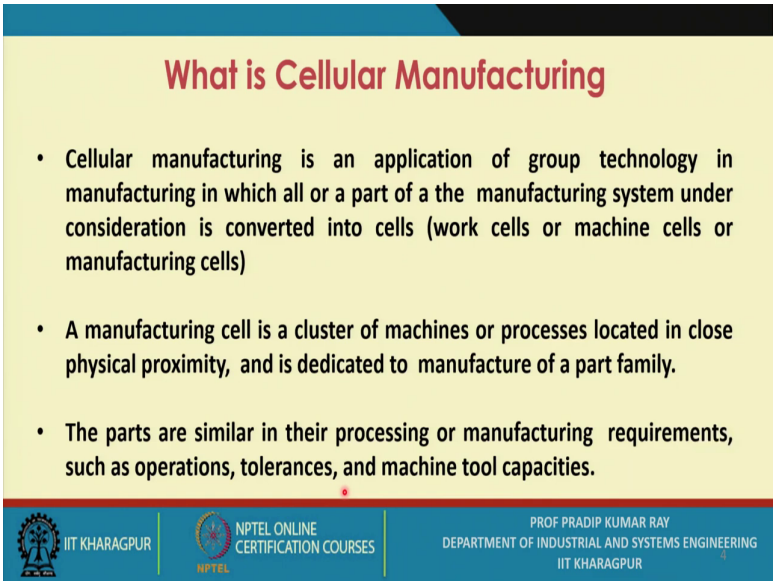

Cellular manufacturing is an application of group technology in manufacturing in which all part of the manufacturing system under consideration is converted into cells. The cells are normally referred to as the work cells or the machine cells or manufacturing cells.

It consists of group of machines essentially machine tools in close installed in the close physical proximity, and then one particular machine cell is dedicated to either one part family or a number of part families.

Dedicated to manufacturing of parts of a part family or a number of part families, manufacturing cell is a cluster of machines, a group of machines cluster and or processes located in close physical proximity. In some cases, you can also manufacture another part family, making some changes and all in a particular production run.

Machine cell has to be made very flexible also.

The parts are similar in their processing or manufacturing requirements such as operations tolerances and machine tool capabilities because already you have looked into the similarities of the parts with respect to the design attributes and process plans, with respect to their process plan.

As per the process plan requirements for a group of parts or the family of parts, now you check whether the number of operations or the types of operations and the kinds of tolerances that in to consider and the machine, cool machine tool capability capacities are enough or sufficient. So, you have to check to what extend these sufficient conditions are made.

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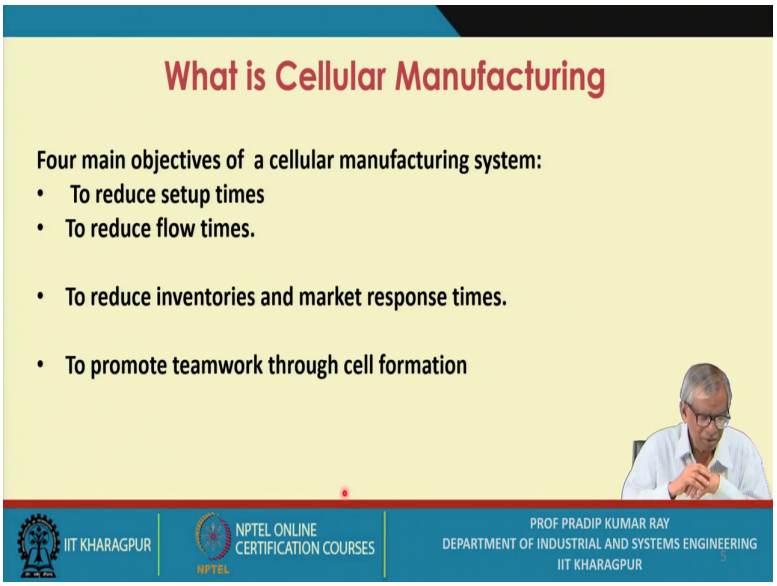

The four main objectives of a cellular manufacturing system, First one is the reduce setup times because individually all the machines have its own setup.

There could be group tooling, there could be group fixturing and there could be also the group set up difficult. The setting up you do and then the fixturing there could be the group fixturing is also very important.

The set up time is to be reduced setup refers to a set of activities and these activities these are classified under two categories. One type of activities refers to the internal setup and the second type of activities are referred to as external setup.

Activities which you have to carry out, and it defined basically say the productivity or the performance of the machine tool is the internal setup.

Whereas, there would be many external setups, those activities are not direct related to the productivity or the performance of the machine tool.

Japan have proposed one approach called SMED, Single Minute Exchange of Dice, So, they are simplified. Advantage is you will come to know in detail what is your design requirements, what is your manufacturing requirements in specific terms and immediately you check whether the existing set of related activities are able to fulfilling those activities or not or to what extent some extra activities unnecessarily you are carrying out.

This is very important when you look at the performance of your machine tool, now the design is in your mind, as well as the manufacturing requirements or the manufacturing features also in your mind and you are linking try to link the set up related activities with these two important aspects.

The first advantage is objective is to reduce set of time, second one is to reduce flow times. The flow time is actually the starting time of a part. It is joining the system manufacturing system at certain point in time and it leaves the system at certain other point in time So, the difference between these two time periods. So, t 1 minus t 0 is basically called flow time.

Third one is to reduce inventories and market response times. If you apply, if you create cellular manufacturing system, ultimately you will find that the quality of flow pattern of materials related to the materials as you will improve and obviously there will be smooth flow of materials within the production system, and the smooth flow and as a uniform rate. That is your goal.

The second advantage is market response time basically the manufacturing lead time. So, if you have manufacturing lead time, you do not control, you do not have any control on the manufacturing time.

The manufacturing lead time will increase and if the manufacturing lead time or the throughput time increases.

The last objective is to promote team work through cell formation.

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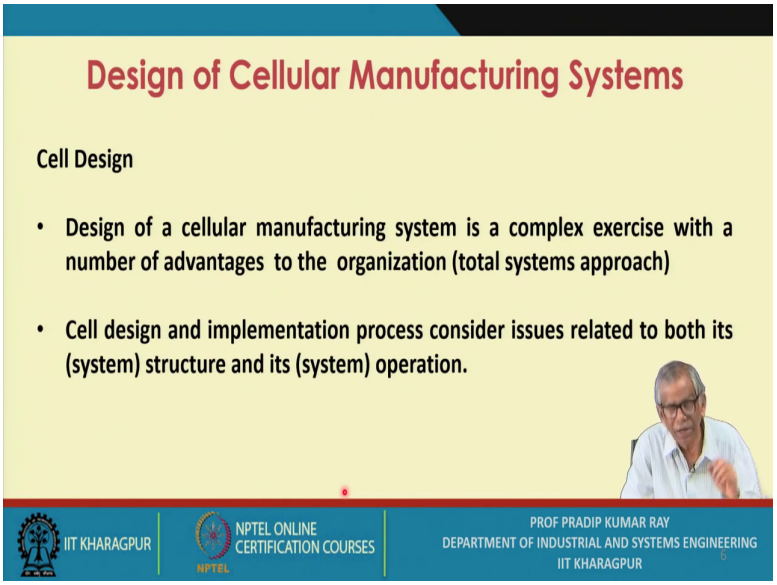

First stage is the cell creation. That is why the cell is to be designed first. So, while you design the cell a particular say machine cell what are the resources you require, what are the resources are required, so that you have to the bring in while you when you create the cell, and the next what you do that you must be able to analyze whether this design is good or not.

That means, how do you assess the design related performance this is the first important issue you should consider. Next you will work on this particular design. Total systems approach is required, you are not creating a several manufacturing systems. Initially definitely it will be a pilot project, but then again whatever the knowledge you gain through implementing the pilot project, that knowledge you must be able to use, for creating cellular manufacturing system for your entire plant.

Cell design and implementation process. Implementation means that when you start operating, the system implementation process considers issues related to both its system structure and its systems operation. So, these are the technical terms like you have a system structure you have to develop and then, you look at the system operation.

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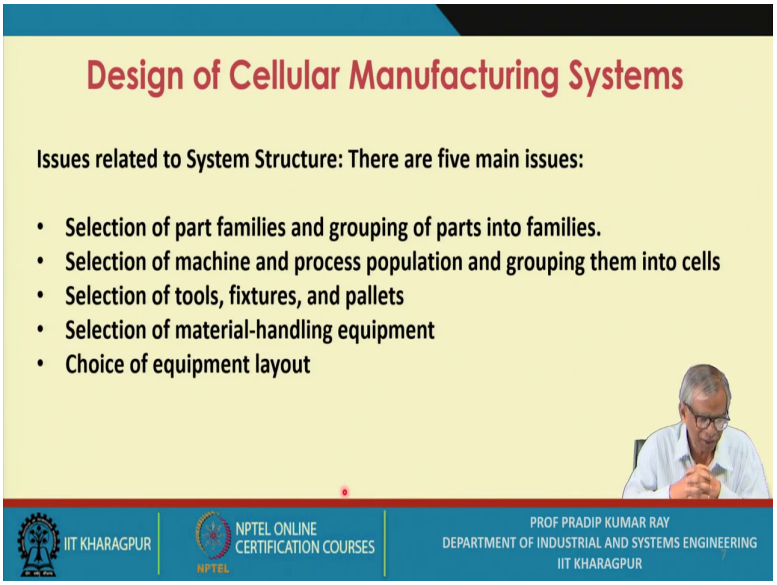

Let us talk about the issues related to system structure. You have to create a system called the cell. The cell is working, there are inputs, there are outputs and there is a transformation place and there is actually the production control for the cell definitely.

Some issues are:

Selection of part families and grouping of parts into families.
Selection of machine and process populations and grouping of these into cells
Selection of tools, fixtures, and pallets
Selection of material-handling equipment
Choice of equipment layout

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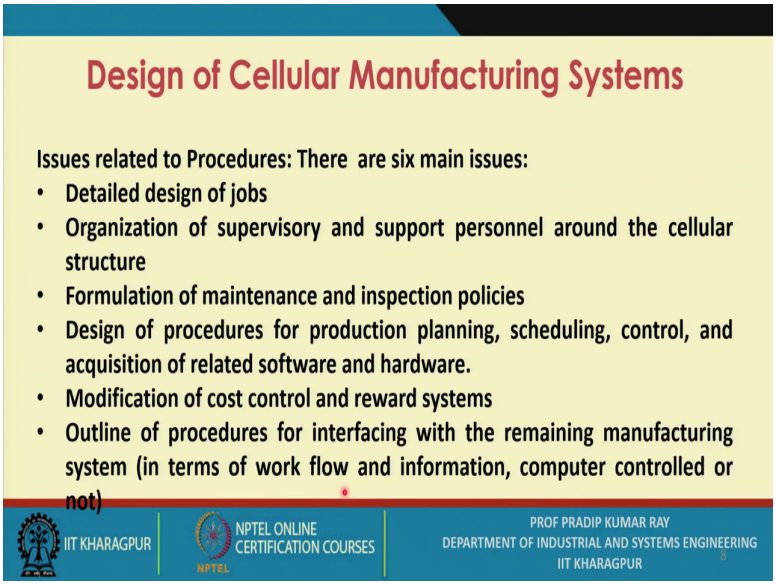

Next one is issues related to the procedures. There are six main issues, first one is the detailed design of the jobs. Second, Organization of supervisory and support personnel around the cellular structure. Third, Formulation of maintenance and inspection policies. Fourth, Design of procedures for production planning, scheduling, control, and acquisition of related software and hardware. Fifth, Modification of cost control and reward systems. Sixth, Outline of procedures for interfacing with the remaining manufacturing system (in terms of work flow and information, computer controlled or not)

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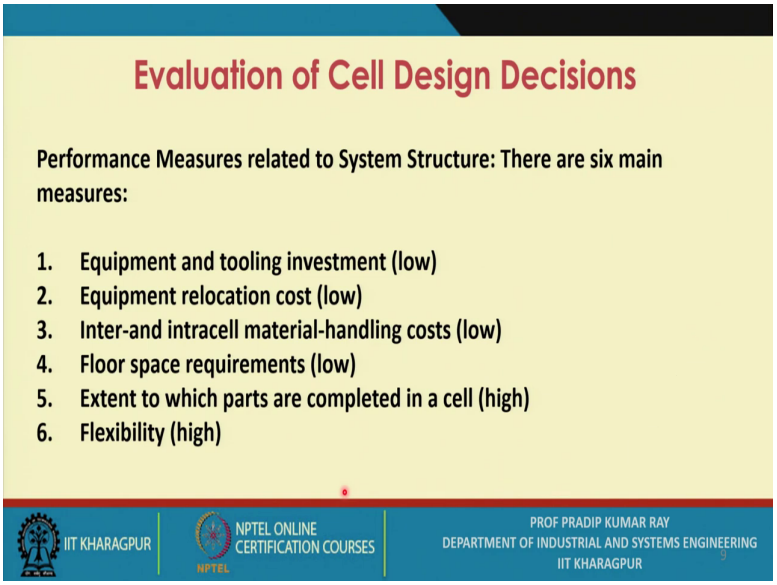

Now, we will be referring to performance measures to evaluate the cell design,

We are referring to the system structure. So, there are six performance measures.

First one is equipment and tooling investment. It should be as low as possible, that means, the selection of equipment is very important. Equipment relocation cost because you are converting your existing system to cellular manufacturing system.

At the initial stage you need to consider the relocation cost. It should be as low as possible inter and intracell material handling costs, you need to consider if the movement will be more, the cost will be more.

The number of the times you are required to move or the parts are required to move. So, if this number is high, obviously the cost is material handling cost also will be more. So, it should be low floor space requirements should be low extend to which parts are completed in a cell.

You can complete all the operations in a single cell, but for the complex parts and requiring a large number operations in most unlikely that all these operations you can do in a single machine cell you have to use, maybe you have to use another machine cell and the flexibility should be very high, the flexibility in the machine flexibility.

Or sometimes we say that mix flexibility operations flexibility.

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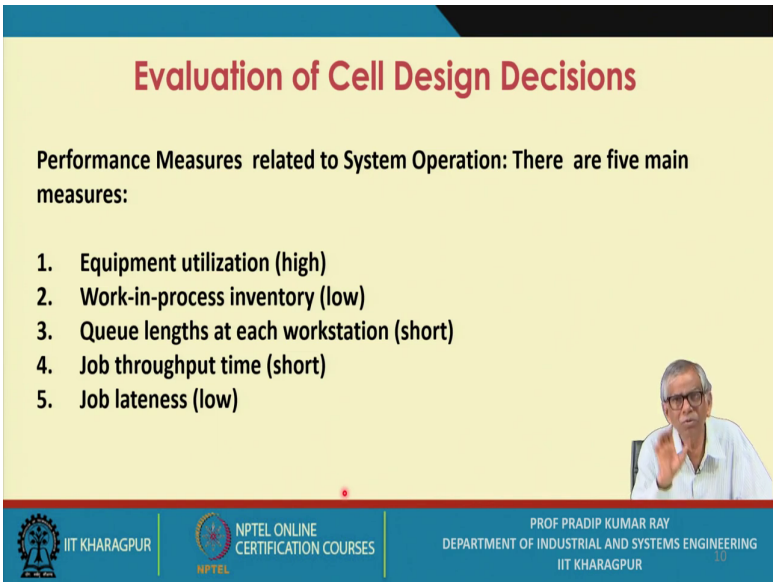

A few typical performance variables related to system operation are:

Equipment utilization (high), Work-in-process inventory (low), Queue lengths at each workstation (short), Job throughput time (short),Job lateness (low)

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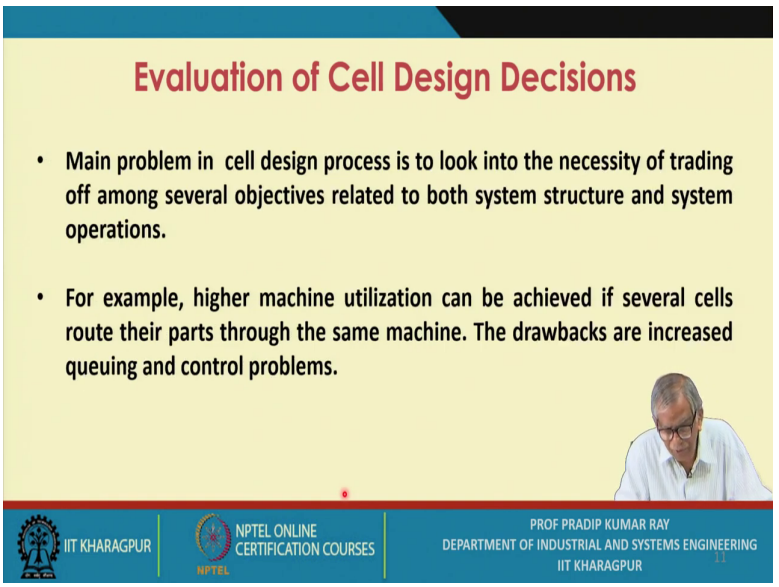

A major problem throughout the cell design process is the necessity of trading off against each other objectives related to structural parameters and performance variables.

For example, higher machine utilization can be achieved if several cells route their parts through the same machine. The drawbacks are increased queuing and control problems.

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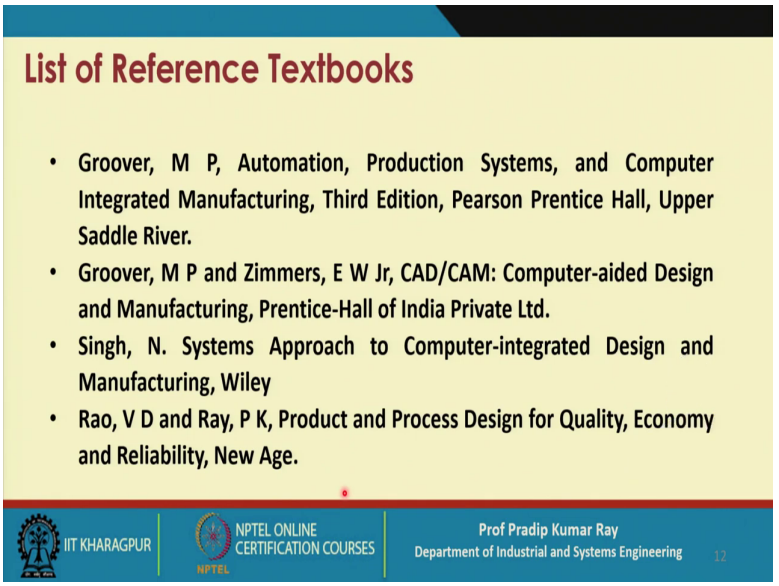

GT principles and the cell design aspect should be known and similarly, the cell operation type, system structure and system operations related to the system structure, the performance related factors should be considered.