Automation in Production Systems and Management
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Lecture - 07
Manufacturing System Components- II

Continuing our discussion on Manufacturing System Components, there are number of issues you need to consider and there are large number of components. If you deal with just one product; and if suppose that product is a matured one, you might say that your system is already developed, it becomes easier for you to develop a stable system very quickly.

But, if you deal with multiple products; against each product there could be many models, many kinds of designs, and, maybe the same manufacturing systems you are using to produce different types of products and their models.

It may happen that one particular machine tool is being used not only to produce one particular product but also other products with variety uses. You must have enough flexibility in the system and one of the important conditions for creating an automated system is that whether an automated manufacturing system can work efficiently and effectively under different conditions.

These different conditions you come across due to many kinds of changes taking place, within the internal environment as well as in the external environment.

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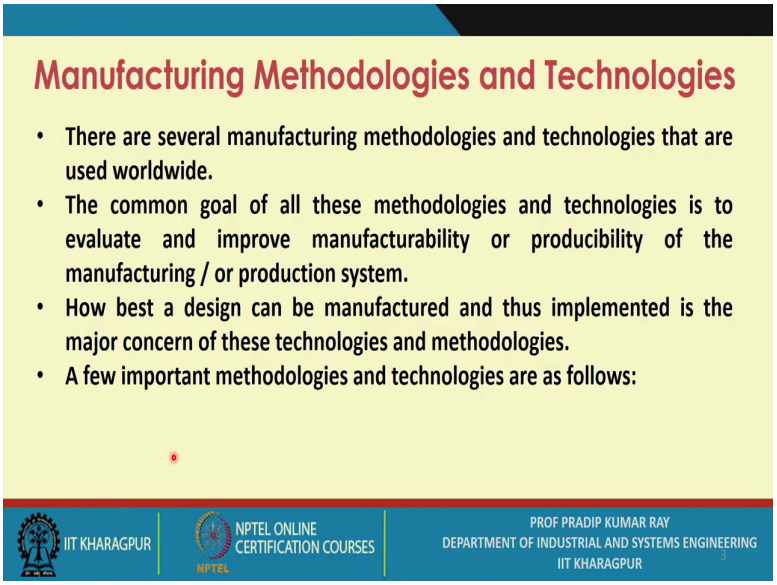

There are several manufacturing methodologies that are used worldwide. The common goal of all these methodologies and technologies is to evaluate and improve manufacturability or producibility. Now, the question is how best design can be manufactured and implemented and it all depends on what kind of the quality of design you want to have and corresponding quality of conformance.

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We have listed a number of manufacturing methodologies. The first important manufacturing methodology and technology is referred to as the electronic commerce or the e-commerce, and web purchasing, the computer to computer purchase sometimes we refer to, computer-aided design and manufacturing, Computer Aided Engineering and computer integrated manufacturing framework.

First you have CAD and then you develop the computer aided process planning or process plan, then ergonomics and human factors and human machine interface. You have to check whether the design is suitable for human use.

Essentially, we are focusing on interface design. Even if the system is highly automated, but then you have to check that the people who are working with the system.

What are the kinds of interfaces they have to work with and whether the design of such interface is acceptable to you not, or needing improvement? Material requirements and enterprise resource planning MRP systems, online real time control, this is for inventory control or material control and it is also related to the production control integrated system, Inventory control and just–in-time based manufacturing.

Also to be considered group technology and cellular manufacturing system in the context of developing an automated system and the flexible manufacturing system.

, all these details come to know and there is a pre-condition for developing or implementing an FMS. What is the pre-condition? That means, your manufacturing system must be converted into cellular manufacturing system. And, in order to say the develop, as a cellular manufacturing system you have to apply the group technology principles.

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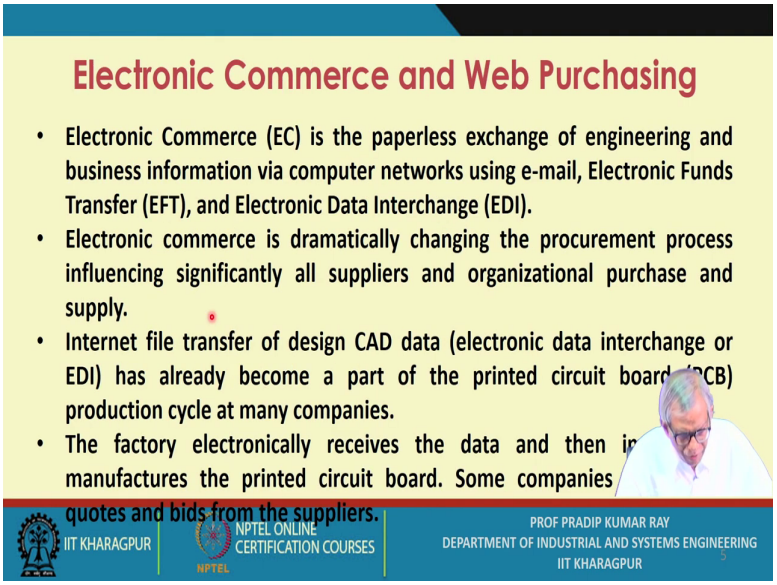

let us first now discuss electronic commerce and web purchasing. Electronic commerce is the paperless exchange of engineering and business information via computer networks using e-mail, Electronic Funds Transfer, and Electronic Data Interchange. Electronic commerce is dramatically changing the procurement process influencing significantly all suppliers and organizational purchase and supply. The internet file transfer or design CAD data is also possible. Electronic data interchange or EDI system you can adopt. This has already become a part of the printed circuit board or the PCB. In many companies the factory electronically receives the data and then immediately manufactures the printed circuit board.

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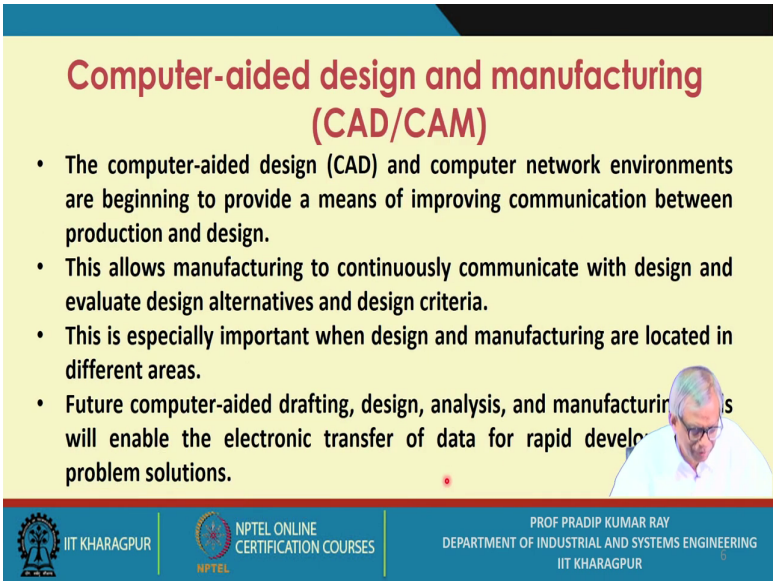

Let us the talk about CAD (Computer Aided Design) and from computer-aided design you can move to computer-aided engineering and computer network environments are beginning to provide a mean of improving communication between production and design.

This allows manufacturing to continuously communicate with design and evaluate design alternatives and design criteria. That is always done and the design activities you carry out in one location whereas, the manufacturing activities you carry out in another location.

Future computer-aided, drafting, design, analysis, and manufacturing tools will enable electronic transfer of data for rapid developments of problem solutions.

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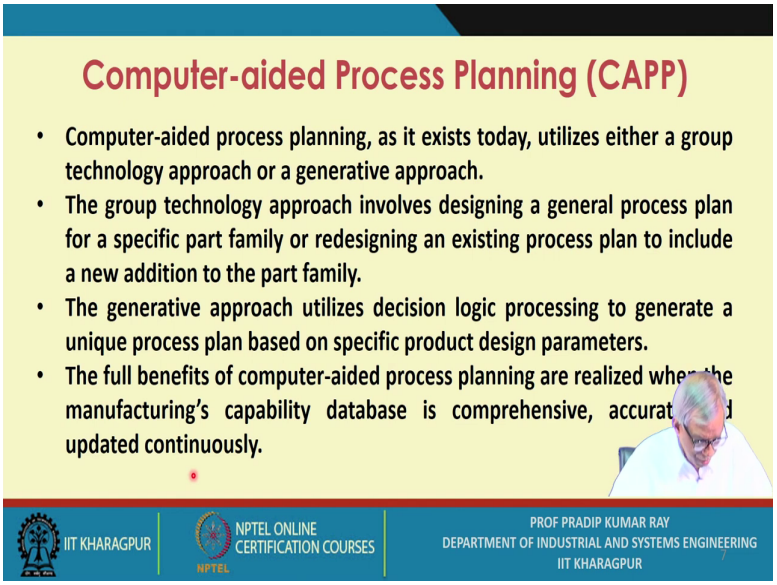

Once you establish your computer-aided design, the next important activity that you carry out is referred as the computer-aided process planning.

Computer-aided process planning utilizes either a group technology approach or a generative approach. Under the computer-aided process planning approach, there are a number of varieties. It could be just two types in fact, one is not 100% automated with manual intervention, called as the variant type.

Alternatively, you have to explore, you have to verify, whether 100% automated process planning approach you can develop. Once you feel that this is necessary, you have to use the generative approach.

The group technology approach involves designing a general process plan for a specific part family. By defining the similarity between parts, entire population of part is grouped under several part families. Against each part family you need to consider those items which are similar in nature.

The full benefits of computer aided process planning are realized when the manufacturing's capability or manufacturing systems capability database is comprehensive. The database must

be a comprehensive one, accurate one and you have a system of continually updating the database.

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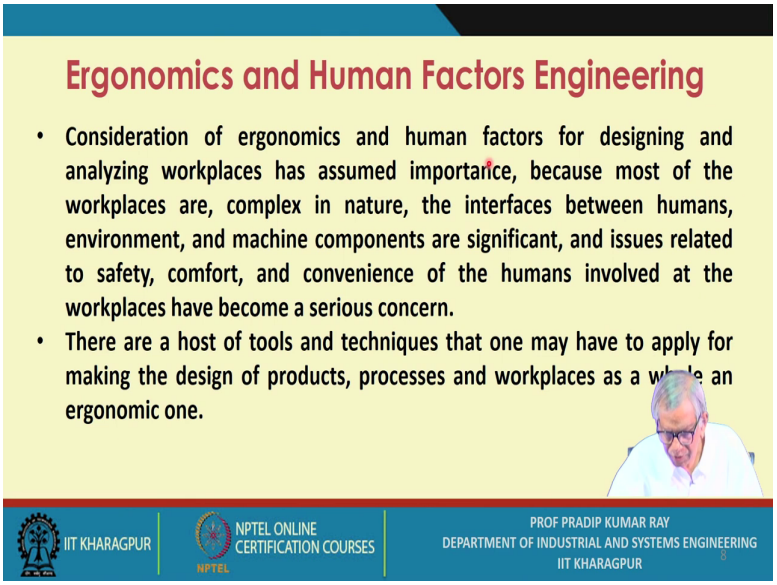

Let us first highlight certain important issues related to ergonomics and human factors. In many cases, you have to verify whether your design is ergonomically designed or not. Consideration of ergonomics and human factors for designing and analyzing workplaces, we refer to is work system.

That means, there will be the process, there will be human beings, there will be interaction between human and machines or the processes, and, this interaction system is embedded in an environment. There are three elements in the work system, the first one is human, the second one is processes, and the third one is environment.

You have to consider the ergonomics and human factors for designing and analyzing workplaces. Most of the workplaces are complex in nature these days. The interfaces between humans, environment and machine components are significant.

Under ergonomics human factors engineering, we will be referring to the interface design and you have to certify, you have to assess the quality of interface the design.

This is very important because it is directly related to safety aspects, comfort aspect and convenience aspect of the humans involved at the workplaces. There are host of tools and techniques that one may have to apply for making the design of products, processes and workplaces as a whole an ergonomic one.

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Now, the next important aspect I just want to briefly discuss, that is material requirements planning. that is the first stage MRP. Then you move to manufacturing resource planning, which is also referred to as MRP-II. And, then you include the distribution requirement planning and ultimately, you create enterprise the resource planning or the ERP.

Many companies promote online real time control. Planning, scheduling, producing, purchasing and controlling all the used in manufacturing including supplied parts components is an extremely complex process.

Due to large number of parts and materials used by most companies, particularly discrete part manufacturing systems; formal planning and control systems are utilized. That is why MRP is proposed or the ERP is implemented. It focuses on eliminating all types of wastes in production and manufacturing activities in terms of lead time, material, storage space, money, unnecessary processes, and inventories.

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These goals we have set are minimum lead time, minimum WIP etc. The same goals, you have to consider, you must be able to achieve when we install an automated system. Otherwise, despite the automated system may run perfectly alright, it may not be cost effective.

And, if it is not cost effective you just cannot use an automated system within a production system. It just cannot be a part of production system because it will directly affect adversely the financial performance of the company. In MRP, the programmed logic evaluates the schedule and decides when parts will be needed.

The bill of material could be one input or the product structure code, then you have the master production schedule which could be another input, you have to create corresponding databases and what are the purchased parts. The program utilizes available inventory and offsets the release of order by their necessary lead time.

The quantity you have to specify and you must know what is the expected lead time and you have to monitor the performance of in-house production, as well as the outside supply constantly; it is an online real time control system.

The enterprise resource planning or the ERP expands information to include all aspects of the entire enterprise. It has financial module, human resource management module, as well as a project management module.

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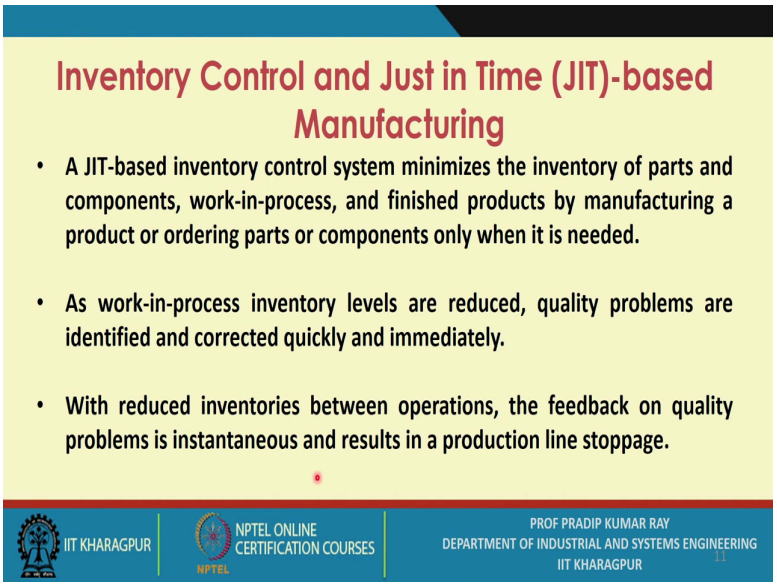

In just-in-time based manufacturing system, there are many goals, like zero inventory, zero setup, zero handling, and lot size of one.

Out of all these the goals, we first emphasize on zero inventory. Zero inventory in the sense that your goal is 0, but can you minimize the amount of inventory that you use in a particular production system.?

The JIT based inventory control system is also well-adopted by many companies. Advantage is that the JIT based inventory control system minimizes the inventory of parts and components, work in process, finished goods inventory by manufacturing a product or ordering parts or components only when it is needed.

That is the rule we should follow as work-in-process inventory levels are reduced, quality problems are identified and corrected quickly and immediately, Otherwise, for many kinds of manufacturing related problems, you may not be aware of with the reduced inventories

between operations, the feedback on quality problems is instantaneous and results in a production line stoppage.

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You have to check whether your manufacturing system should be converted into JIT-based manufacturing system before you think of designing and implementing an automated system. Now, the next one is the group technology and the cellular manufacturing system. Cellular manufacturing system is a kind of manufacturing system where the advantages of flow shop as well as the batch manufacturing you will get.

By creating a number of the work cells or machine cells, the entire manufacturing system is converted into a number of work cells, and each work cell produces one part family or more than one part family. There are many advantages of establishing a cellular manufacturing system One advantage is, if you develop cellular manufacturing system, it will be easier for you to implement automated manufacturing system. The parts are already known and the similarity of the among the parts you need to define. There are three general methods of grouping products into families.

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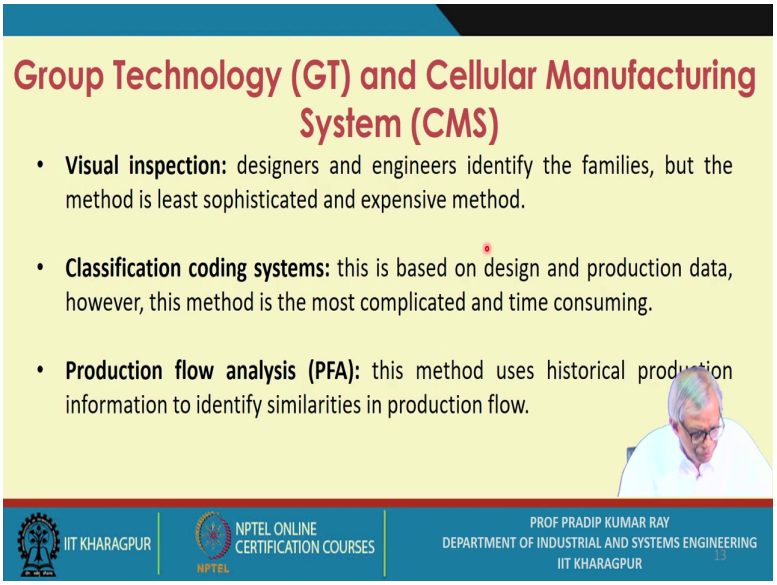

Visual inspection, Classification and coding system, and the Production Flow Analysis.

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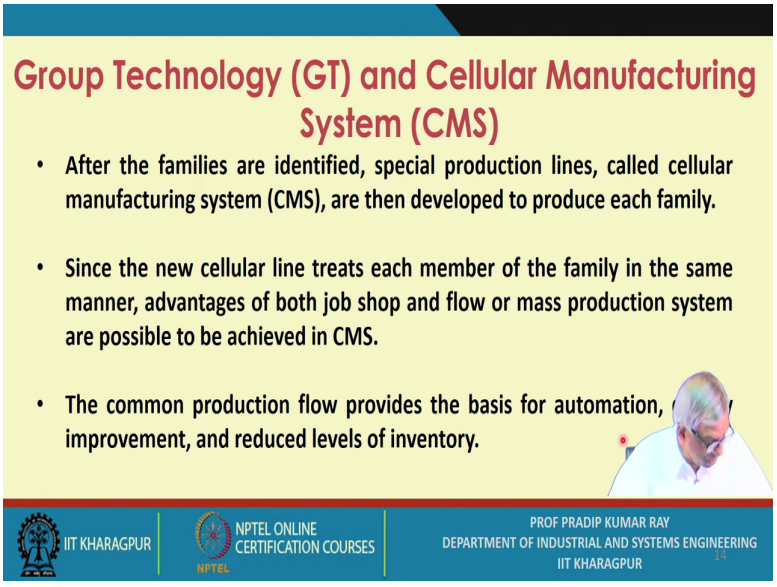

After the part families are identified, the special production lines, called cellular manufacturing system, are then developed to produce each family. Since, the new cellular line creates each member of the family in the same manner, advantages of both job shop as

well as the flow or mass production systems are possible to be achieved in a Cellular Manufacturing System.

The common production flow provides the basis for automation, quality improvement is possible with the reduced levels of inventory.

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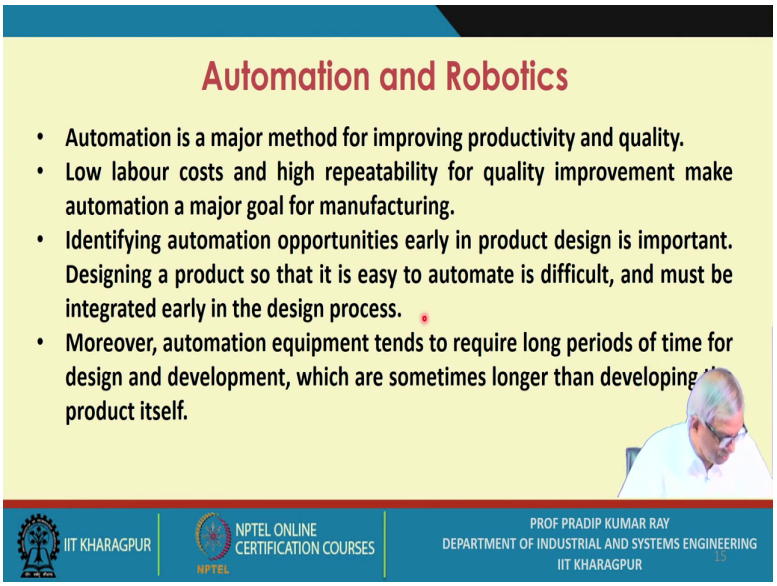

Now, we will be referring to automation and robotics. Automation is a major method for improving productivity and quality. Low labour costs and high repeatability for quality improvement make automation a major goal for manufacturing. Identifying automation opportunities early in product design is important. Designing a product so that it is easy to automate is difficult, and must be integrated early in the design process. You need to use one particular approach called concurrent engineering or simultaneous engineering.

Moreover, automation equipment tends to require long periods of time for design and development, which are sometimes longer than developing the product itself. That is why the earlier design stage, you must think of design for automation, you must think of design for assembly, design for manufacturability, design for maintainability, similarly you must start thinking of the principles in designing the product, principles related to design for automation principles you have to use.

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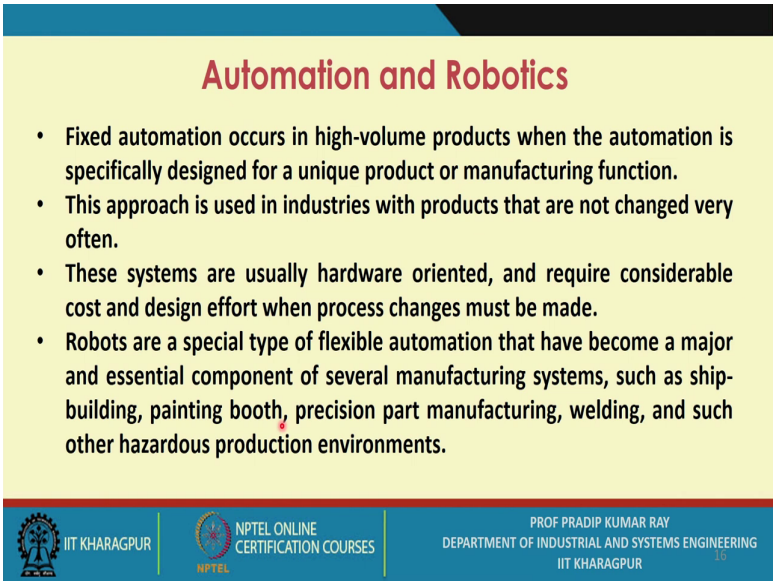

Fixed automation occurs in high-volume products when the automation is specifically designed for a unique product or manufacturing function. This approach is used in industries with products that are not changed very often. These systems are usually hardware oriented, and require considerable cost and design effort when process changes must be made.

Robots are a special type of flexible automation that have become a major and essential component of several manufacturing systems, such as ship-building, painting booth, precision part manufacturing, welding, and such other hazardous production environments.

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Suppliers can be recognized as an extension of in-house capability, and as such be treated as partners. Effective and shared communication is essential for an effective partnership relationship with a supplier, regardless of the location of the supplier. Suppliers should be committed to being the "best-in-class", willing to work in partnership, and have a working knowledge of statistical quality control. The company's goal is to keep the number of suppliers to a minimum, though additional suppliers be established for an item to assure sufficient production capacity, quality conformance, and pricing competition. You must know to what extent your system is linked with the other supply system, that also must be periodically reviewed. And, whether it is promoting the quick supply, whether it is promoting

the just-in-time, the supply of materials or not as and when required that can reduce the waiting time.

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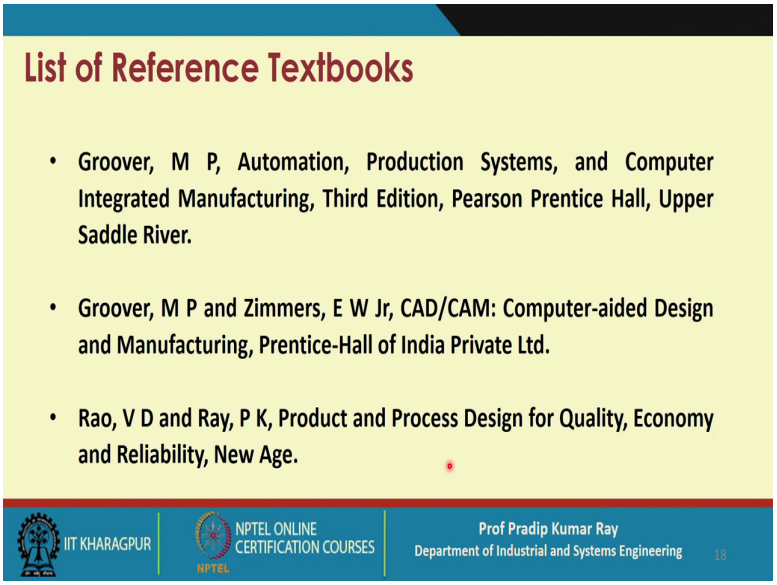

Knowledge of is important these activities and their interrelationships is important to to develop a fully integrated system. And, once you reach certain level of integration, then you start thinking of making the system an automated one.