Automation in Production Systems and Management
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Lecture - 14
Characterization of Concurrent Engineering Framework

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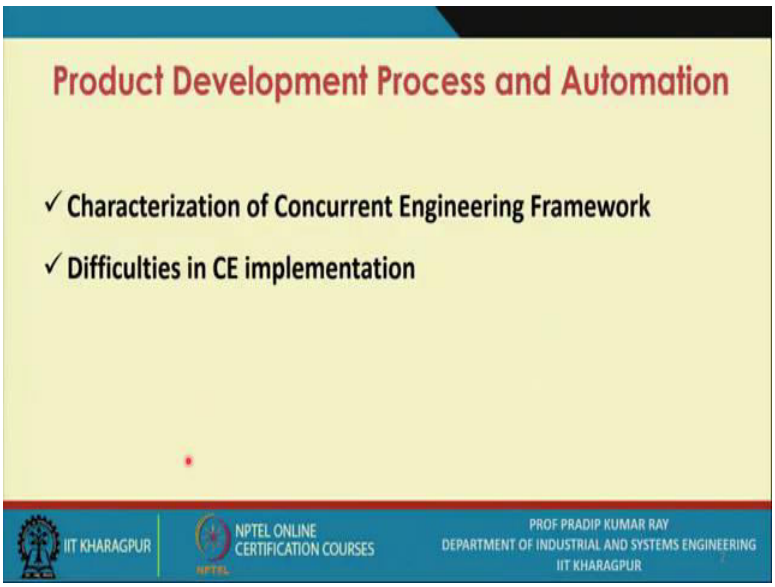

So, during this lecture session, I will be referring to two important issues. The first issue is the characterization of the concurrent engineering framework. And the second one is implementing the concurrent engineering approach.

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Concurrent engineering considers all the issues involved in product development from conceptual to disposal, in a concurrent and integrated manner.

Techniques and systems that support CE by advising designers on aspects that reduce life-cycle problems include the use of:

1. Design teams
2. Handbooks
3. Checklists and procedures
4. Process planning and manufacturing simulation
5. Rule based expert systems.

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Now, let us talk about how to design a concurrent engineering program, a framework for concurrent engineering approach or concurrent engineering program. So, this framework has been very well defined in the textbooks written by Shing.

According to the writer, there are three phases in this framework. First phase identification of influencing dimensions and their levels.

Identification of influencing dimensions or the dimensions which influence the dimensions which basically, identify the dimensions of the products and the programs that influence the concurrent engineering approach, such as product complexity, product technology, competition, and resource tightness. So, these are the four factors that need to be consider.

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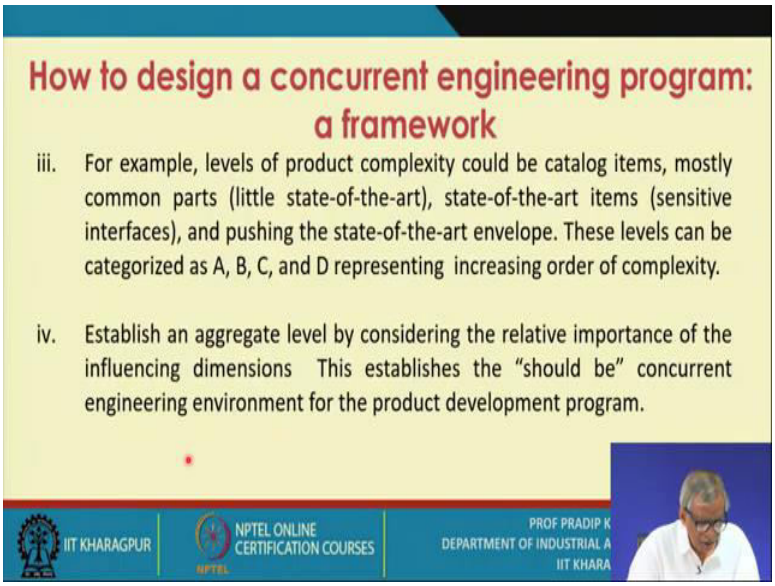

For examples, their levels of product complexity. So, what is the standard norm? first you try to check, try to verify with respect to your product, the level of complexity.

So, how do you define it? It could be a catalogue items right, like any company, the interacting with the suppliers and these suppliers, they regularly supply these catalogue items, new kinds of products, new kinds of parts, they try to send a particular function or product design, best quality items or the parts made available related to the raw materials, mostly common parts little state-of-the-art , the state-of-the-art items; sensitive interfaces . So, these levels can be categorized as A, B, C and D representing increasing order of complexity.

Next, establish an aggregate level by considering the relative importance of the influencing dimensions. This establishes the "should be" concurrent engineering environment for the product development program.

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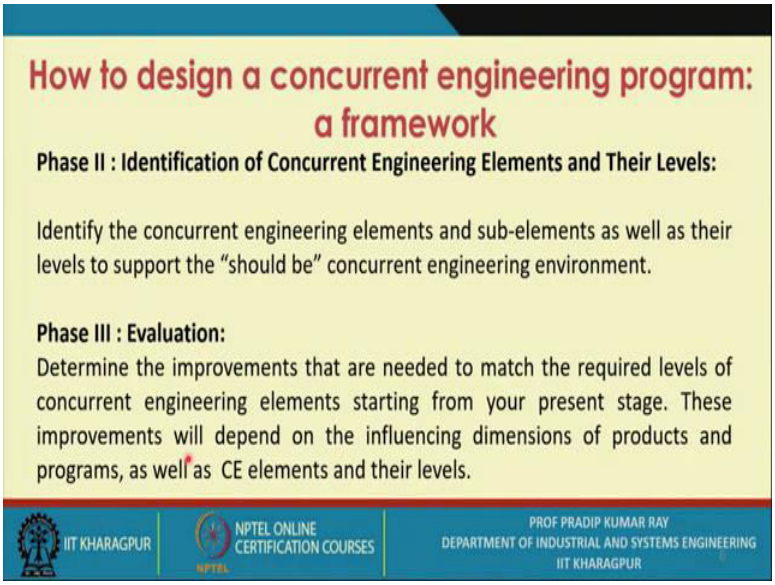

So, that is the first phase. Now, you reach the second phase. In the second phase, You need to identify the concurrent engineering elements and their levels.

Identify the concurrent engineering elements and sub-elements as well as their levels to support the concurrent engineering environment .

Then, you reach the phase III and that is called the evaluation phase.

You determine the improvements that are needed to match the required levels of concurrent engineering elements starting from your present stage. So, your current stage must be known. These improvements will depend on the influencing dimensions of products and programs, as well as CE elements and their levels.

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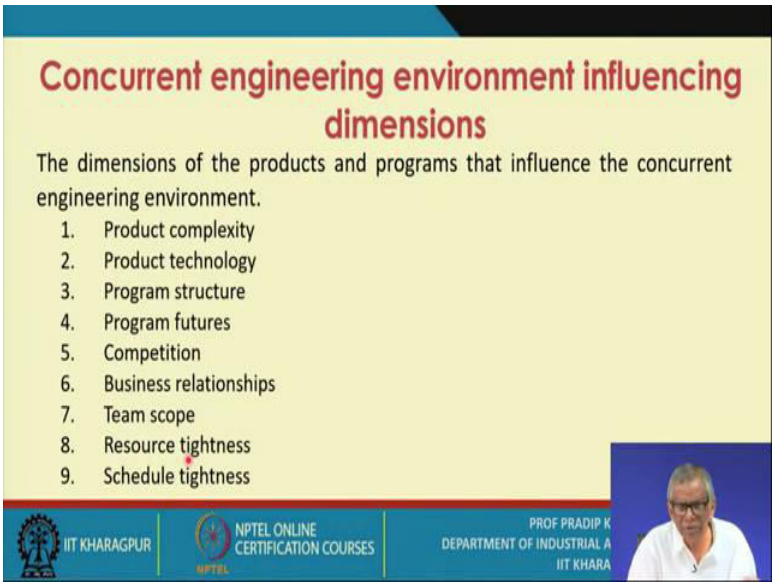

The dimensions of the products and the programs that influence the concurrent engineering environment has nine factors, they are product complexity, product technology, program structure, product technology, the program structure, program futures, competition, business relationships, team scope, resource tightness, schedule tightness, .

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What are the four major elements? First one is your organization, second one is your requirements, third one is what kind of the communication systems you have and what sort of product development methodology.

There are a number of methodologies possible for product development.These elements and their sub elements provide a basis for assessing specific capabilities within individual programs to address the concurrent engineering approach to product and process development, the manufacturing system could be multi-product manufacturing firm, not a single product manufacturing firm.

Initially, for all the products the serial engineering approach or the traditional approach is followed. Now, you want to adopt concurrent engineering approach. You just identify just one product and try to implement them, implement a concurrent engineering, with respect to that product. What will happen that the first time, for the first product, for which concurrent engineering you are going to implement, you may have to create the entire system for implementation, once you are successful in implementing concurrent engineering for that product, for other products also, implementation becomes easier, that is why a total systems approach is a must.

So, individual programs, one individual program or say one pilot project or say pilot program may help you in establish this concurrent engineering system for other products easily.

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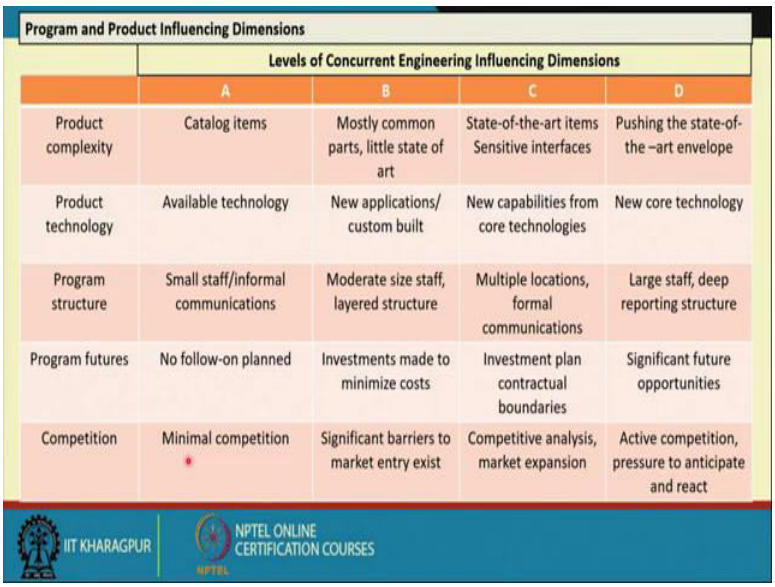

This framework shows four level, it could be catalogue items mostly, common parts little state of art, state-of-the-art items sensitive interfaces and pushing the state-of-the-art envelope. The factors like the product complexity, product technology, program structure, program features, competition are also there. So, product complexity is defined in four ways; product technology is available technology, newer application custom built, new capabilities from core technologies, new core technologies.

So, this is just one approach. Now, you have to design the entire system for implementing concurrent engineering approach.

Like program futures; no follow on planned. Catalogue item, investments made to minimize cost investment plan, contractual boundaries then, significant future opportunities. And then, as far as competition is concerned, minimal competition, catalogue items can be opt for significant barriers to market entry exists.

Competitive analysis market expansion, because it is a state-of-the-art items, that you are going to produce through concurrent engineering approach. And here, pushing the state-of-the-art envelope as far as competition is concerned, you have to face active competition and pressure to anticipate and react.

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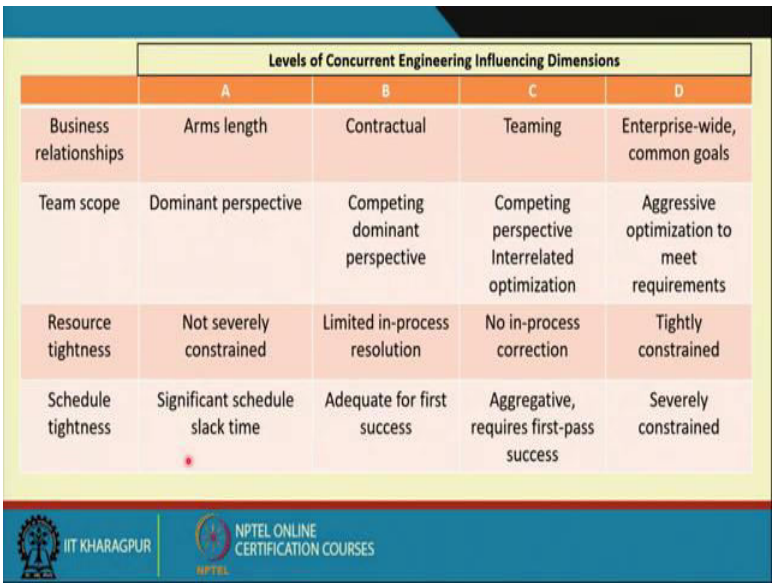

So, many times it becomes problem under uncertainty. Business relationships, arms length, contractual teaming and enterprise-wide, common goals. Such other factors are

also given in this particular table, also the team scope; dominant perspective, competitive dominance perspective, competing perspective interrelated competitions all these details are given.

And for resource tightness and the schedule tightness; these are the two important issues. Many companies face these problems, majority of the companies resource tightness it could be not severely constant; that means, it becomes easier for you to adopt concurrent engineering .

As far as these factor is concerned, resource tightness, When you try to propose a new technology or the new technology you are proposing concurrent engineering approach.

Limited in process resolution, no in process correction. Schedule tightness means, significant scheduled slack time. Adequate for first success for the pilot project aggregative would and requires first pass success. Means, these are the terms they use, the severely constrained. In both the cases this is tightly constrained severely constrained.

So, that is why if it is a pushing state-of-the-art envelope, normally, it takes longer time than the initial stage. And for other cases maybe, you take 1 year of time, but for the pushing state-of-the-art envelope, you take at least 2 to 3 years of time, .

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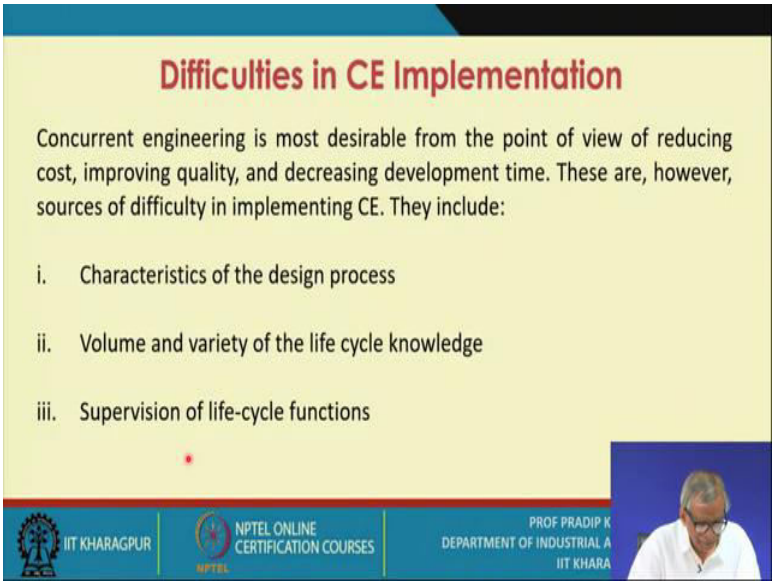

Concurrent engineering is most desirable from the point of view of reducing cost improving quality decreasing development type. These are however, sources of difficulty in implementing concurrent engineering,

They include:

1. And Characteristics of the design process
2. Volume and variety of the life cycle knowledge
3. Supervision of life-cycle functions

So, the first difficulties is related to the characteristics of the design process, the design process is sometimes, cumbersome one, complex one and that is not avoidable, depending on the type of product you design.

Second, the volume and variety of the life cycle knowledge and the supervision of the life-cycle functions, means, the initial design, this is the detailed design then, prototyping, testing, review, verification, reverification and then you go for the commercial production and then the final testing. So, these are the activities.

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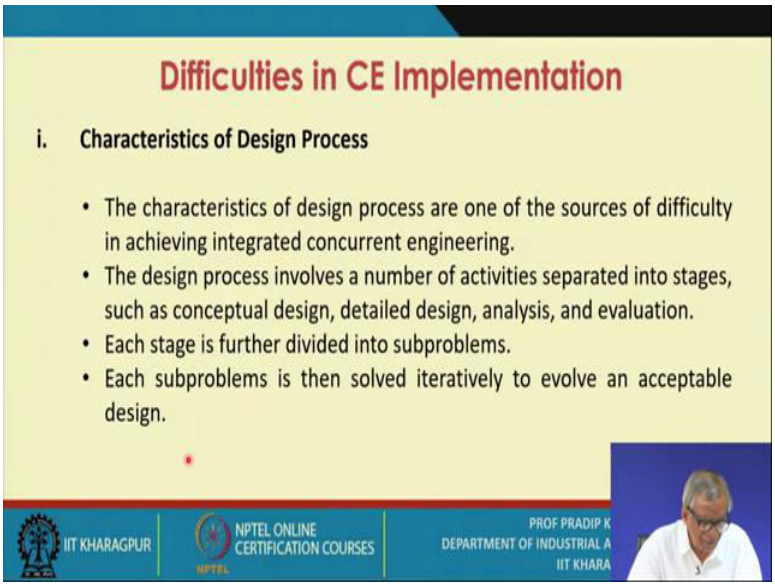

As far as the characteristics of the design process is concerned, there are certain points you should keep in mind. They are:

1. The characteristics of design process are one of the sources of difficulty in achieving integrated concurrent engineering.

2. The design process involves a number of activities separated into stages, such as conceptual design, detailed design, analysis, and evaluation.

3. Each stage is further divided into subproblems.

4. Each subproblems is then solved iteratively to evolve an acceptable design.

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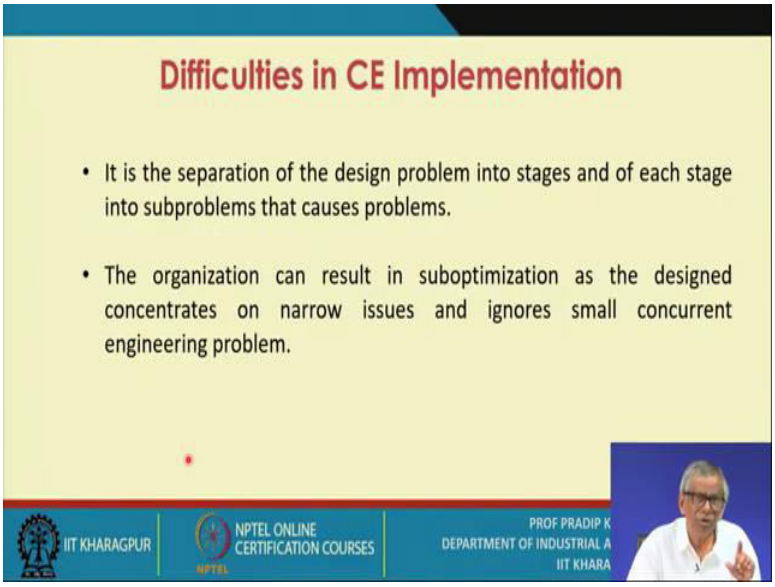

Against each stage what are the kinds of problems you need to deal with while implementation, It is the separation of the design problem into stages and of each stage into subproblems that causes problems.

The organization can result in suboptimization as the designed concentrates on narrow issues and ignores small concurrent engineering problem.

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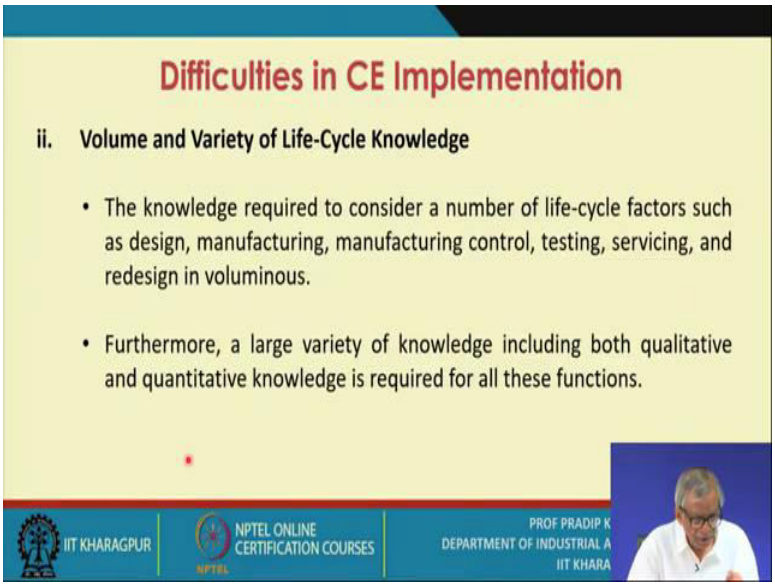

Next important aspect is the volume and variety of life-cycle knowledge. The knowledge required to consider a number of life-cycle factors such as design, manufacturing, manufacturing control, testing, servicing, redesign in volumes redesign .

Avariety of knowledge including, both qualitative and quantitative knowledge is required for all functions and that is why one individual knowledge base is not sufficient. So, there must be product development team.c

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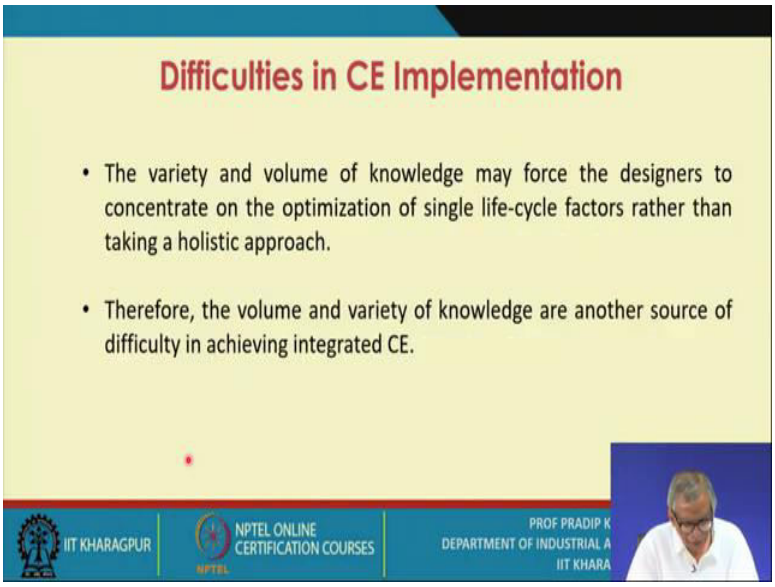

The variety and volume of knowledge may force the designers to concentrate on the optimization of single life-cycle factors rather than taking a holistic approach.

Therefore, the volume and variety of knowledge are another source of difficulty in achieving integrated CE.

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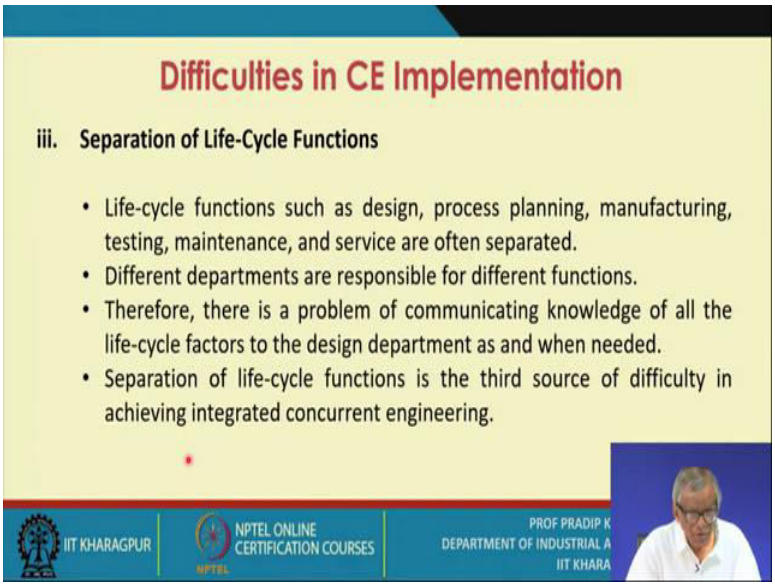

Now, as I have already pointed out that related to the bill of material, 40 to 70 percent of the items, are to be purchased from outside.

And, that is basically make over by decision against each item you do, but then again, you definitely we will be making in-house or your will be making the other components which basically, determine the functional value of the product.

And core competence is there, but there are the peripheral items those are the core components you produce. So, for peripheral items, you make sure that the quality of these peripheral items which are usually purchase from outside there is a supplier's items is well maintained.

While you can have interaction with the suppliers based in such a way that if required, the supplier is ready to improve the quality of those parts.

life-cycle functions such as design, process planning, manufacturing, testing, maintenance service are often separated. So, the functions like process planning and control then, the production, then the final testing examination, then the packaging and the storing, sales and distributions, then the installations and operations, then the service and maintenance. all these activities are to be considered simultaneously, these are basically, referred to as the life-cycle functions. Therefore, there is a problem of communicating knowledge of all the life cycle factors to the design department as and when needed, if the communication system is poor and there are many deficiencies in your communication system or information system exchange which means difficult to implement the concurrent engineering approach. And later on you will find that there is a positive impact, but still you may not be gaining much. So, that is why we always emphasize on a very powerful and strong, and the robust communication system.

Separation of life-cycle functions is the third source of difficulty, in the organization structure, there are many functions and each function has its own knowledge base and in certain functions you may not have enough knowledge. So, the integration may be difficult.

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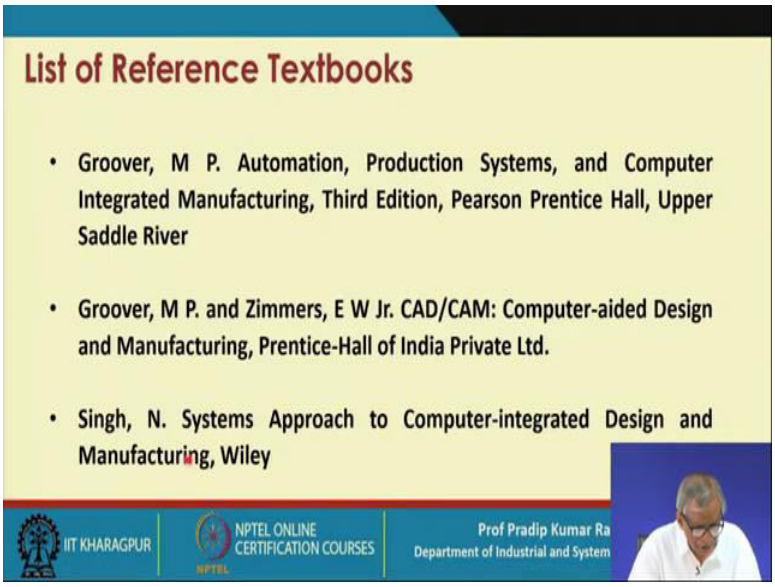

So, in the design process, you identify all the stages and against each stage, you need to identify activities to be carried out. And you link all kinds of the activities you carry out

at the manufacturing stage or the production stage and the kinds of activities you carry out at the post production stage or the post manufacturing stage.