Quality Design and Control
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Lecture – 05
History and Evolution of Quality Control and Management (Contd.)

Ok. So, under the first topic called history and evolution of quality control and management, I am going to discuss the last or the fifth subtopic.

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Which is titled as serial and concurrent engineering, quality related issues in design and manufacturing. Now before I start explaining this two concepts in product development and how this two concepts are related to the quality engineering or quality management ok, let me make some the remarks like say you know almost you will find the 90 percent of the cases even today as far as manufacturing of a product is concerned, that means for the product development for the end manufacturing sectors we find that the serial engineering approach is followed particularly Indian context you will find.

Now obviously, you know this concurrent engineering approach is the latest one and many companies they are trying to move from serial engineering to concurrent engineering. Now obviously there are certain advantages in concurrent engineering, but you never assume that the for the sake of concurrent engineering you need to move from serial to concurrent engineering. Now under certain conditions so serial engineering is

the best one under certain other conditions you have no other alternative but to go for concurrent engineering.

So, it is not that as the serial engineering has been developed initially and the later on you know in many cases many product manufacturer so they have moved to concurrent engineering by hook or by crook we have to go from serial to concurrent engineering ok. So, obviously you know in a serial engineering the you look at the quality issues from one perspective whereas, as soon as you to move to concurrent engineering the same quality issues you may have to look into from other perspectives alright.

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Now, so this serial engineering or the concurrent engineering, this is used for product development purpose. And as I have already told you that what do you what do you do under product development, what are the pressures involved like say product design, process design manufacturing in different forms. So, for product development either you will opt for serial engineering approach or you will opt for concurrent engineering approach ok.

Now, obviously the product development process is the most important process for any company. So, product development process in a company is one of the important activities that is primarily responsible for it is long term survival and sustainability in the market, in today's context you will find that the sustainability is a becomes a the main objective, means you have to create a production system but make sure that this is

sustainable and whenever you talk about the sustainability there are three aspects of sustainability we are referring to one is you know the economic sustainability, then we refer to environmental sustainability and we also refer to social sustainability. Now, in a broad framework when you talk about you know developing the quality systems now in many a time what you try to do, that means to what extent the your quality systems which you have developed it is promoting the causes of sustainability, that is you have to link it.

That means it gone are those days when you think of quality in isolation you just you cannot do, so and this framework you have to develop and one point I like to highlight like say you know we will always you try to study the systems what is the you know the relationship between quality systems with say the financial systems of a company or say you know the economic sustainability or say environmental sustainability and ultimately the social sustainability.

Now, if you want to you know the structure this model or this concept you have to refer to several case studies. In fact that means you have to create a database model that means from a company's perspectives from the manufacturers perspectives the system should be explained from all these three perspectives. Now so long term survival and sustainability is your goal and in this context what I try to highlight like say essentially for sustaining your activities for sustainability of your organization what you require two important things you must have, one is definitely the profitability.

You make sure that the profitability is guaranteed today as well as tomorrow all time this is the first objective the second objective is, obviously as a manufacturer you are producing products you are selling products in the market either it could if it is a new product, it is new market or you know the existing product in the existing markets so you have created your market and there is the market share for your product.

So, you have to have your market share and the market share should be such that you can maintain you know you get sufficient returns and so that the investment is possible for technology upgradation and the technology upgradation has a very close link with quality improvement is it ok so whenever you talk about the quality systems we are referring a quality systems with respect to a particular level of technology. Now, whatever say the earnings we have, whatever the revenues whatever the net profit you

have or say returned earnings you have now some part of it you must be able to reinvest for technological upgradation. So, there is a very close link between technology and the quality. So, you have to take a very holistic approach and in particularly in the concurrent engineering approach when you apply you take a very holistic approach towards the quality and related issues.

So, entire process of product development consist of several steps to be filled in sequence in traditional approach, that means for in a sequence that means you will find you know that is the old technique like say someone is a designing your product and he is not visible you as say manufacturer you have just collected the drawing and as per the drawing requirements you have two set of your production systems and you start manufacturing ok.

So and this design document is considered to be sacrosanct means you do not have any authority to change it, so that is the formal order you have to produce that is it is a means suppose you are the production in charge you are the manufacturing in charge, manufacturing engineer your heading that cell so it is your responsibility you never you will be able to question the design.

So, the design is over and design team you will never find a in the shop floor it is clear so that is the traditional approach when the design is over you try to produce a design, you try to manufacture the design as per the requirements the design specifications sometimes you are successful sometimes you are not so it reflects your performance and accordingly you know you try to produce and send those produced items to the customers.

So, one by one in a sequence you do and there is a such there is no feedback informations, that means the kinds of problems you are you are you are facing whether you may be it is a design for meeting the design requirements like say sometimes you know for you have designed the meeting parts and what you find that that tolerances are very tight tolerances and the kinds of the traditional manufacturing systems you have you know you just cannot produce or you cannot achieve that particular tight tolerance, so what you do obviously you know you try your best, but as in certain points in time you fail.

So, obviously this information you feel like giving to the design department, that means there must be a feedback information. So, in the traditional approach when you have no other options see you have to produce with respect to you know using the traditional manufacturing one the new technologies are not coming, so obviously you are bound to produce as per this as per the specifications and alternatives used to be very few.

Today what has happened like say you have many kinds of designs you may offer, many sorts of technology you can adapt and similarly at the manufacturing stage you know you have different alternatives you can go for the traditional manufacturing systems you can opt for N C based systems, you can go for high level automation or there could be a perfect balance between you use the computers at the production stage, there could be a perfect balance between the human labor then the use of computer and the automated systems is it a level of automaton.

So, there are lot of the new opportunities coming up and with respect to these opportunities why do not you use strengthen your design and while you design something as a designer you also must look into what kind of facilities the manufacturing system is having ok, so when you have these interactions obviously, you know this sequence is on that means it is always it is not an open loop it is a closed loop systems this becomes that means, you feel like working in concurrent engineering or simultaneous engineering mode.

So concurrent engineering is also referred to as the simultaneous engineering; that means, while you designed something you think about manufacturing in advance you think about post manufacturing conditions in advance and you try to have a common database where you know these interaction between design and manufacturing is always highlighted. And this is to be made formally and that is sort of thing you do in a in a formal you know the concurrent engineering approach.

So and as the time passes you will find that the data you know this files are getting updated and the you know the current problems are known and immediately, you know response time from say the designers for changing the product design response time gets reduced and ultimately what happens it helps in you know the developing the product with the minimum time now, another important factors is that the companies objectives are known the profitability and market share is it ok always try to increase this ok so

increasing. Now, there must be a backup that means, you have you have created a manufacturing system and the manufacturing system must promote this two objectives, so what are the objectives of a manufacturing the setup or say the production system there are three objectives, the first one is you try to produce the product with a maximum quality that is objective number one, second objective is very important you try to produce the product with a minimum cost, the cost is very important if the cost is less you know the sales price will be less and with the sales price is less, obviously you know the demand will be more and you will be producing more and your revenue will be more and ultimately you know your you know gross profit as well as the net profit will be more is it ok.

So that is key, so that is the second objective you produce with the minimum production cost. And the third objective is also very important that is the linked with the total production cost definitely that is, you know from start to finish you start designing the product and you end up with selling the product ok, even from the consumer product even for you know say the industrial product you have some other steps like you install the product if you if you produce if you design if you manufacture an industrial product. So, this is the specific requirements on a company and as per the specific company orders if the specifications you try to produce it.

Now so the total time you engage yourself for developing the product it should be as minimum as possible. So, the development time is closely linked with the development cost so you try to reduce it so that is the third objective. That means first objective is maximization of the quality, second objective is minimization of the cost and the third objective is reduction of say the product you know the manufacturing through put time, so this is basically the total through put time so the total through put time means essentially say, you suppose you produce in a manufacturing systems there are some say 8 or say the 9 stages one after another in a sequence.

Now, the starting time of the first unit at stage one and ending time of the last unit that means the nth unit from the last stage. So, this is the total through put time, now this through put you must have control on the through put time, now this through put time we will have four components one is the set up, second one is the actual processing time, the third one is the waiting time and the fourth one is basically the transport time. Now what we have observed if you deal with the companies data related to the throughput time you

will find the almost 65 to 80 percent of the time you spend on say the waiting or the giving as well as transferring you know the semi finished items from one stage to another.

So, these are essentially absolutely you know the non value adding activities. So, what you even the set of is essentially non value adding activity. So, what you try you to do that means you try to deduce it, now how to do that obviously many things you have to do simultaneously, that means when you produce something at a particular stage I know this semi finished item from your process it will go to the next process whether you are sending into the right conditions right quality or not, if you just send it you know some the scrap or say the defective item to the next stage obvious you know the next stage will be will not be able to do any work so it will be stalled it will act as a bottle neck ok.

So, these are things to be considered that means, many aspects you need to consider simultaneously and at any point in time you will be able to you know you know the relate your design with manufacturing, related to design there could be many design options similarly related to manufacturing there could be different manufacturing alternatives it could be traditional it could be nontraditional it could be you know different types of machineries. So all are you know the all combinations are feasible for which combination you get the maximum you know the quality minimum cost and minimum throughput.

So, these exercise you routinely religiously you carry out in a concurrent engineering approach, later on you know there are many you know mathematical modelling is possible so we will definitely refer to those mathematical models you know indicating the kinds of relationships you have between design and manufacturing. Now in a traditional the approach like say serial engineering approach, you know this is just a simple guess is it is some ones just opinion there will be lot of vagueness in establishing the relationship between say the design and engineering, that means to what extent design is instrumental in getting the quality to what extent the designing instrumental in the total production cost and to what extent design is responsible for reduction or non reduction of the manufacturing through put time is it ok.

So, this is the basis I could explain. Now, these process typically requires that the persons involved may be able to communicate freely and effectively this is very

important among themselves among themselves regarding such matters as data collection problem solving and suggestions for improvement in products, processes and manufacturing. So, this is very important in fact that means, the persons that means a team is to be formed and the team members must have adequate authority and responsibility in dealing with all this aspects.

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So; obviously you know there are knowledge base you must have, that means we were related to a particular design what sort of knowledge base you have, related to manufacturing what sort of knowledge base you have that is very important and you also must be aware of what are the new technology is coming, new materials you know you can use. So, and the as a designer you also must have you know the knowledge adequated knowledge in the product design as well as the process design. Similarly as the manufacturer yes you are primary concern is manufacturing related knowledge base you have definitely but simultaneously you have to have a knowledge based in design also is it ok.

So, it is a team and unless you have a team approach because you know the whole the product in most majority of the products they are becoming very complex in nature is it ok, you need the knowledge in mechanical engineering electrical engineering instrumentation computer all in one product. So obviously and there will be there is miniaturization in the design and the automation these are all there so that is why you

know a team formation is a must ok. So, the main objective in product while you suggest this these approaches for product development, the main objective is to improve communication between the manufacturing the top management group the designers it is very important gone are those days when the you know the designers they used to leave in their own world and they is to hardly you know inter mix with other persons in the organizations.

So, that at which you will not help, so the suppliers and the customers on a continuous basis this is very important. Because you know ultimately the product quality is very much depends on in the quality of the supplied items because if you look at the bill of materials or the product structure code of a particular of a particular product what you find that in majority of the cases like say 40 to 70 percent of the items listed in the bill of material these are to be procured from outside.

So, obviously you are the supply base it should be very strong and so the suppliers so ultimately the quality of the final product is very much dependent on the quality of the parts or the component or the raw materials which you get from different suppliers. And the obviously the customers view point is to be constantly you know you know is to be you create a system where the customers requirements are constantly you will come to know and you update these document. T

o become successful in product development in the long term the company is required to establish a collaborative and multi disciplinary approach for product development this is the key, means today that point I was highlighting that is essentially is a multi disciplinary approach and while you form the team for product development in concurrent engineering approach you go for you know a you need to consider several sorts of disciplines the requirements of several or the demand from several disciplines simultaneously.

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So, this is the key and in today's business environment, a number of tools techniques and methodologies may be quite usefully in design and development of the products. So, a few important methodologies and tools that are being widely used by many companies are, one is the product developmenting sometimes these are referred to as there could be you know the nominal group technique you know you can use N G T sessions also the product development team you have to form.

Sometimes you know why it is referred to as the projective team also that the first time you know you want to develop a product or the process concurrent or simultaneous engineering you have to apply there is no other alternative in many cases, but make sure that you have create the environment and so that in such a way that the concurrent on a simultaneously engineering this is a feasible technique, it is not that you know the suddenly you take a decision and you go for simultaneous sorts sort concurrent engineering approach this is not possible so you have to create environment certain necessary conditions you have to fulfill.

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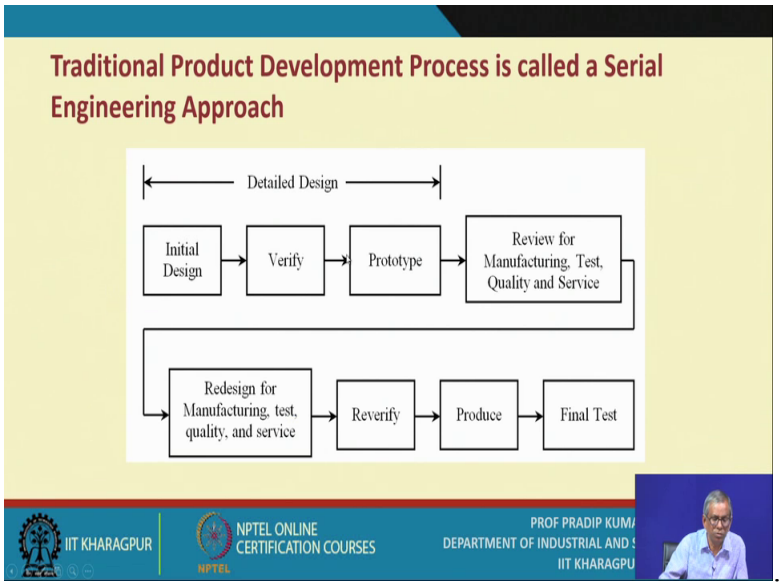

Computer aided design or the CAD you use computer aided engineering also you use and computer aided manufacturing you are all aware of and the virtual reality this is at the prototype stage these design the perfection from when the several conditions you want to test it. So obviously, virtual reality kinds of systems or the software you may use the traditional product development is called a serial engineering approach this is initial design then you go for verification and then you go for prototyping and ok.

So, prototyping and then once detailed design is over after you make the prototype you go for review for manufacturing test, quality and service. That means essentially on the prototype you do lot of experimentations and you check whether it is manufacturable whether it is testable whether the quality is you can maintain and whether it is serviceable, once you do this then obviously you know there will be lot of the changes means when you go for review always in the first time when you get the design it may not be the perfect.

So, always an improvement is required. So, that is why improvement in the design that is why you go for redesign for manufacturing, testing, quality and service. So, these are the four issues in the traditional you know the serial engineering approach you focus on that means, the manufacturability, testability, quality and serviceability again you go for reverify this is the process then you produce and then you go for the final testing, so this the approach one after another you do.

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The important objectives of an organization one is I have already mentioned the profitability and market share of the products, and I have already discussed this point while you develop a product these are the key points you should always keep in mind, that the product development process must ensure maximum quality, minimum cost and minimum product development time that means what I have mentioned that is manufacturing throughput time.

So, in this context the alternative concurrent or simultaneous engineering approach for product development is recommended in many instances, while this is an acceptable practice for many world renowned organizations or the product manufacturers. This ensures achievement of maximum quality, minimum cost and minimum product development time, if you go through many case studies you will find that unless and until you adapt simultaneous engineering approach this three objectives simultaneously you may not be able to fulfill. There are menu such cases, so the main advantage is knowing the relationship between design and manufacturing this point already I have highlighted.

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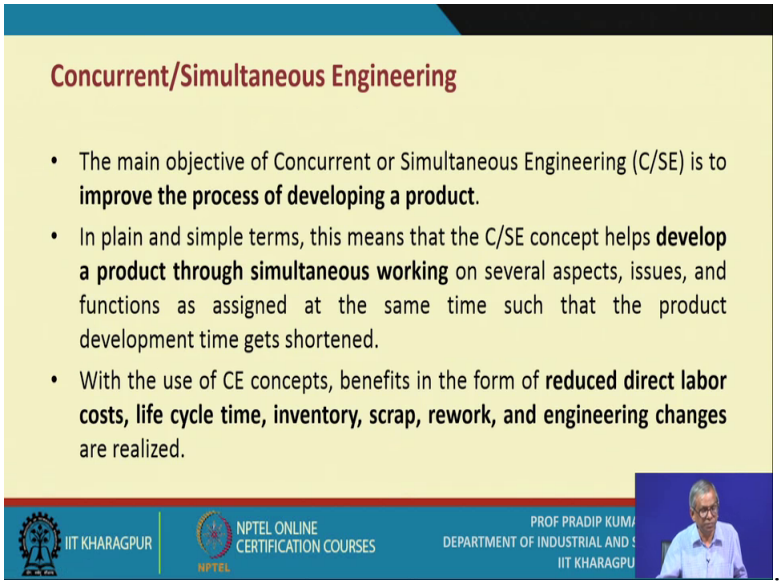

Now, you know concurrent or simultaneous engineering what we try to achieve we try to improve the process of developing a product that is the most important point to be noted in plain and simple terms this means that concurrent engineering concept helps develop a product through simultaneous working on several aspects issues and functions as assigned at the same time such that the product development time gets shortened.

So, this is your key unless the product development time gets shortened, you cannot offer the product to your you know the customer base quickly if you take long time then the other your competitors will beat you and they will take you of the market. So, with the use of concurrent engineering concepts benefits in the form of reduced direct labor costs direct labor cost, life cycle time, inventory, scrap rework and engineering changes I

realize; that means, I have already refer to you know the prevention based quality control versus detection based quality control.

Obviously when you believe in the concept of concurrent engineering approach that concept in the concept of concurrent engineering approach; obviously we will be working on the prevention based quality control amount.

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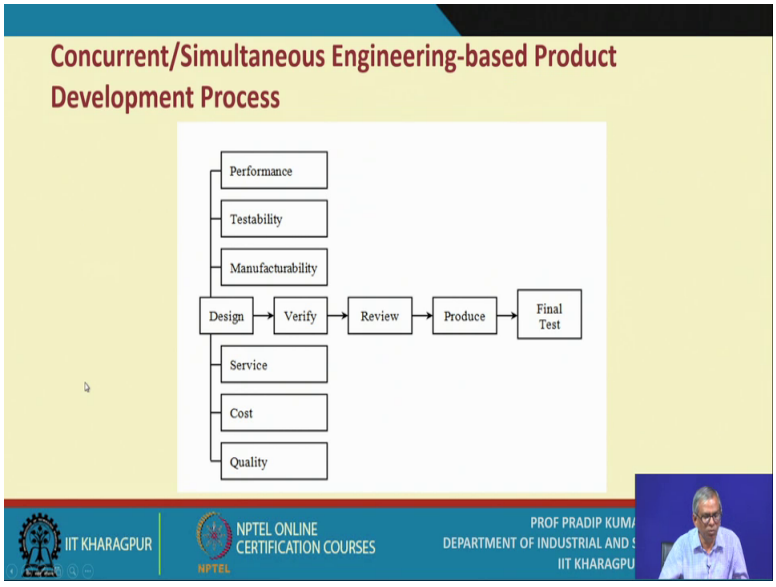

So, this is the concurrence or concurrent or simultaneous engineering based product development process like, during the design and verify these two stages design and verify that what try to do you look into 6 aspects, first is the performance of the product testability, manufacturability service or serviceability cost aspect and quality and this is a closed loop you know constantly developed, but the manufacturing team as well as you know the design team they must work together they form a team.

So, constantly you know both the parties they form a team and this team is experimented with this and ultimately you get a best possible design which is manufacturable with minimum cost with minimum development time with an ensuring maximum quality and this you review and then you give clear cut instructions for production and after you produce you know obviously there will be final testing is it as per you know the requirements from a particular product ok.

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So, this is so this is essentially this the diagram or this figure it will explains all the you know the way a concurrent engineering approach is being followed ok so this is one. So, over the years concurrent simultaneous engineering approach has proved to be a valuable tool for designing competitive products in a changing and expanding world market. So, these days what we say that I have already mentioned that in the value of a product which is closely linked with the quality you have most important value component that is called exchange value.

So, if you want to have the best possible exchange value for your product, obviously you have no other alternative but to go for exporting your product, so that it becomes an internationally renowned product is it ok, so say expanding world market so you will give lot of opportunities so obviously you have to you know produce something with the minimum time maximum quality minimum cost is it and you have to offer this product as quickly as possible. It is reported that the Japanese companies take almost half of the time that a typically us company takes to launch new products in the market.

So, these days we talk about the new product development N P D. So, whenever we take up a project on new product development as far as possible we should adapt the philosophy of concurrent engineering, this success is due to the fact that the concurrent engineering has contributed to a significant reduction in the product development time.

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So, what are the quality related issues to be considered in the product development process, first one is while you go for concurrent engineering approach or while you go for offline quality control approach along with the online quality control approach the dimensions like, reliability these are the dimensions of quality reliability, maintainability etcetera are considered dimensions like manufacturability process settings are considered all these issues are considered simultaneously ok that means you must have you can have the best possible balance or the tradeoff.

Performance of the product highlighted always, because you will come to know and that is the main dimension servicing and warranty of the products can more scientifically determine this is the point to be noted that the warranty of the product, let us say warranty of pace maker or say warranty of say the bathroom geyser there are many items for which you provide warranty other items you go for consumer items you may go for the guarantee so the warranty you need to determine ok.

So, and warranty actually represents the level of quality as well as the reliability, so design level versus I will conclude by referring to one concept that is for a particular product you may offer different design levels and against each particular design level you may have a corresponding value and the cost simultaneously.

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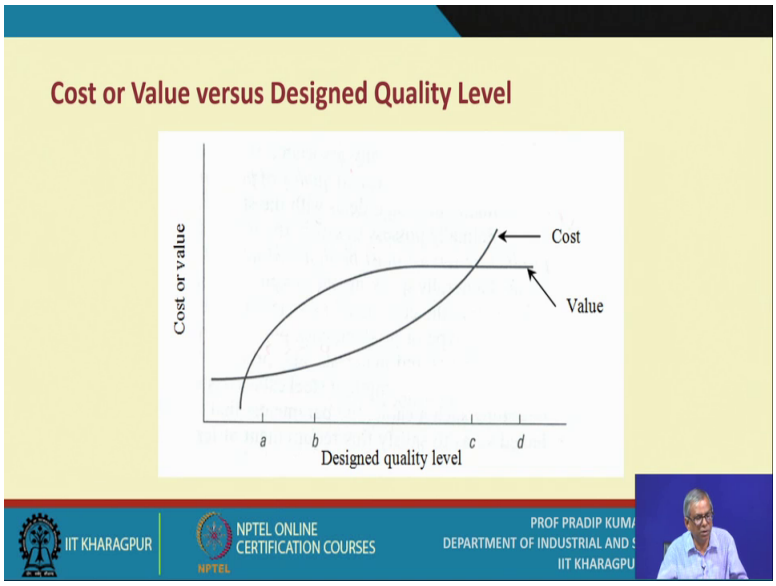

So, how do you select design level, so this is usually if you get the data and through case studies this sort of you know the relationships you will get like on the y axis you have cost of the value and on the x axis you have to design quality level. Now, in this case there are four design levels offered four types of designs four alternatives A B C and D.

Now the question is considering this characteristics one is the cost characteristic and the second one is the value characteristics which design will opt for whether it is A B C or D is it ok, so the value it at certain point in time it saturates or against a particular design level because A is the original design, B is a improved design, this is third improved design second improved design and D is the latest design.

Now, even in the latest design there is hardly any change in the value in the value of C and in the value of D with respect to value of C ok, whereas the value of B is significantly less so also the value of A, so but the cost increases at an exponential rate as the design level increases. So, my question is that how do you select the design level and as per the design level now you go for manufacturing you apply you know the concurrent engineering approach.

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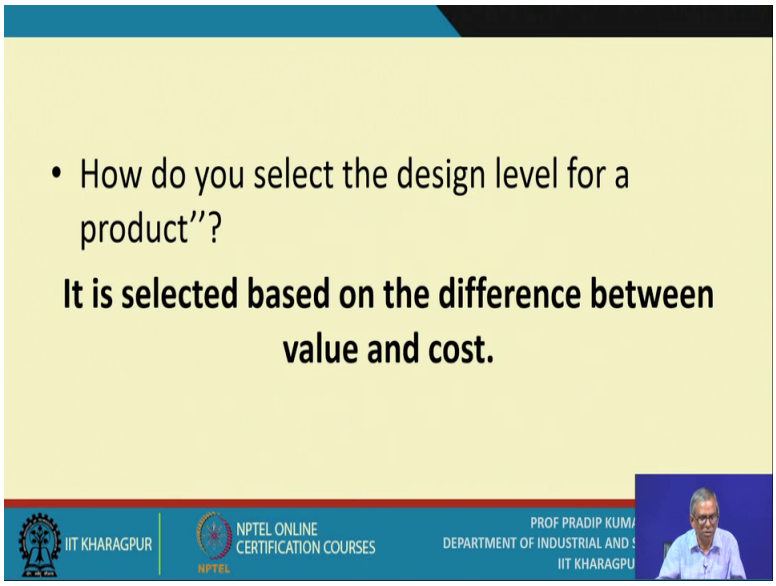

So, how do you select the design level for the product it is the very crucial you know very important question in fact there are many alternatives available and for which design level you will go for concurrent engineering approach.

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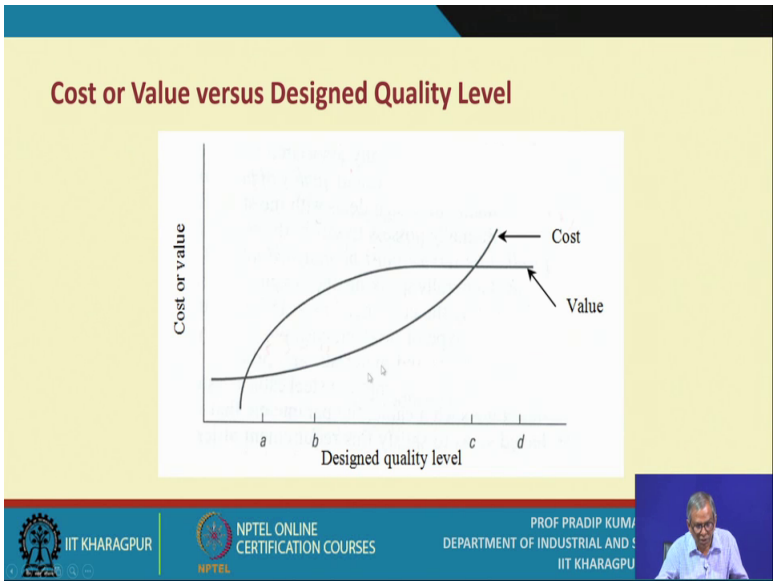

So, it is selected based on the difference between value and cost, that means here may be for the A the difference is less, whereas for the design B the difference is maximum, getting my point it is the value minus cost it should be positive it is do not go for say the cost minus value like if you have say the cost is very high the value is less so it should be

positive value minus cost, so obviously you may opt for design B. So, I close this session.

Thank you.