Product Engineering and Design Thinking
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Module - 01
Introduction and Prelims
Lecture - 05
Product Planning and Innovation Engineering

Welcome to this session the lecture on Design Planning and Innovation Engineering. What we will do in this session is we would establish the importance of these two precepts and then we would understand their interlinkages or dependencies and then we would understand how both can contribute to the new product creation.

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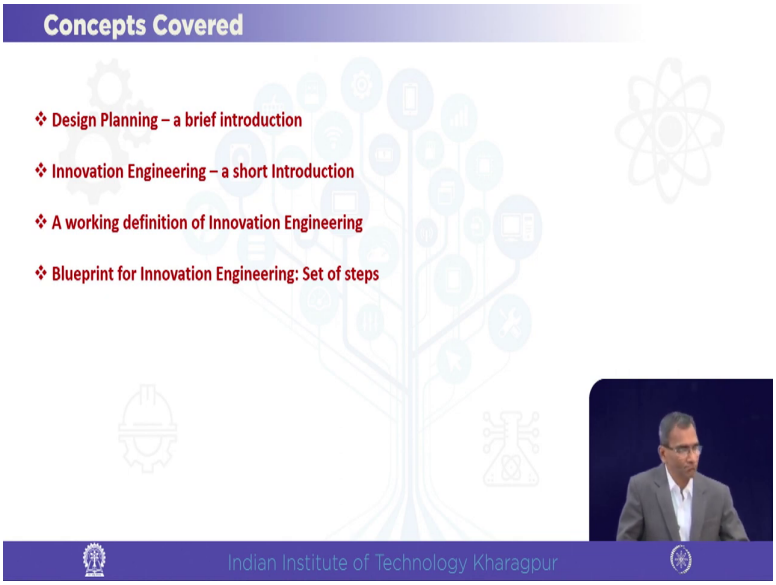

First, I would like to go to the concepts covered slide where we would be discussing design planning which will be overview or brief introduction followed by innovation engineering. Again, an introduction to innovation engineering and then we will discuss on the second and the working definition of innovation engineering will be presented.

Finally, to actually execute or implement the objectives or the guidelines of design planning, we would take up the program of the steps or which we would call a blueprint of innovation engineering.

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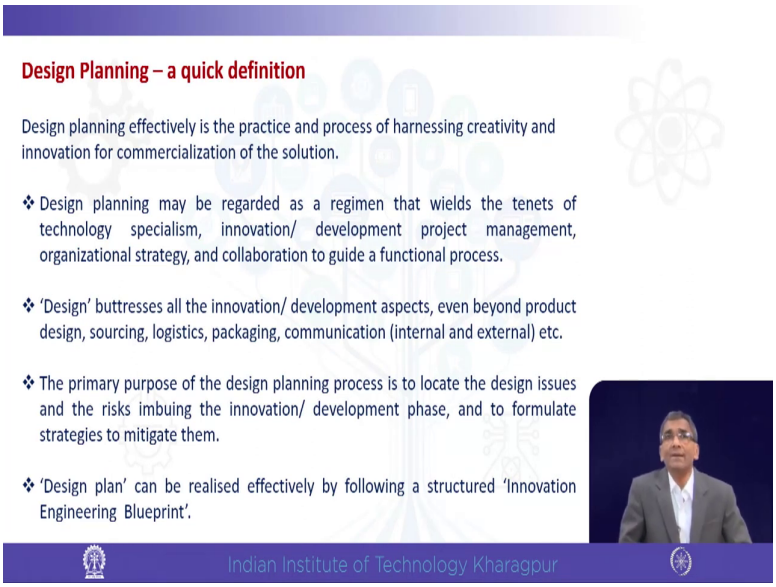

First as we start with design planning with a quick definition, let us see what it is. Design planning effectively is a practice and process of harnessing creativity and innovation for commercialization of the solution. Because see after all they design, discovery of the need the

technology etcetera when it is creating the opportunity perceived and then from that the design is to be prepared and from that we come to the notion of design planning.

Other parts we have discussed in the earlier slides. Now, those designs ultimately are to be translated into physical products which is a translation. So, that translation when it becomes syllable or which can or revenue, we call it commercialization. So, in order to do that design planning may be regarded as a regimen that wields the tenets of technology specialisms.

Because when we are talking about technology specialism; we are talking about multiple domain interdisciplinarity, transdisciplinarity, multidisciplinarity and all that. So, here different departments and different specializations or disciplines comes in branches of engineering comes in.

Where mechanical engineering will play an important role where it will have interface with other or units or other disciplines like say for a mechatronic product it has to interface with electronic engineering for software for firmware that is to be embedded in the hardware then at times it has to be thing called control systems, also it may be for material science in some cases. So, that is the specialisms we are talking about.

Innovation and development project management, organizational strategy and collaboration to guide a functional process. So, design buttresses all the innovation development aspects it goes beyond the design sourcing; sourcing that is vendors who would be supplying the components and subassembly is if needed to develop the product, logistics, packaging and also the communication.

Communication one is the internal communication, but also there are external communications like say what will be the marketing communication through the product brochure and all. The primary purpose of design planning process is to locate the design issues.

In the whole creation process, there are design issues at various points, we have to identify and locate where these problems are the issues are and the risks imbuing the innovation

development phase and to formulate strategies to mitigate them, to reduce them, to eliminate them. Design plan can be realized effectively by following a structured innovation engineering blueprint or the road map we may call it, but here we are calling it a blueprint.

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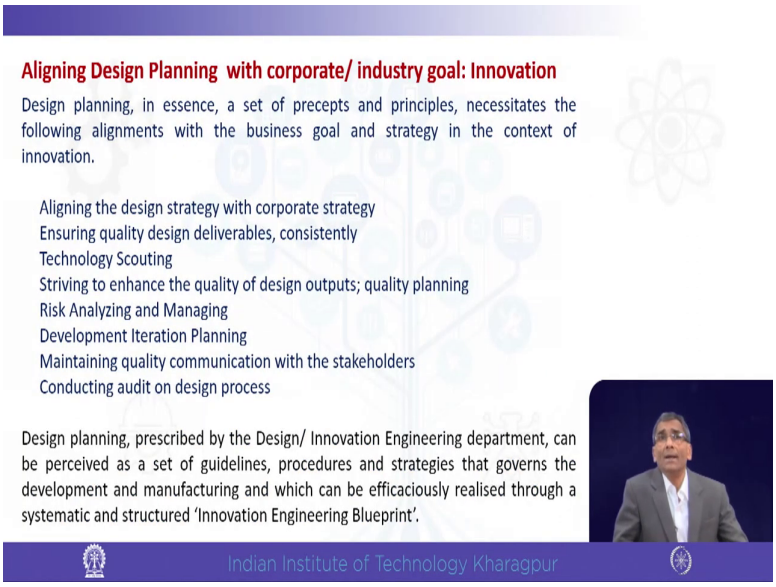

Now, the need is to understand that there is a alignment required between design planning and the industry goal or objectives industry of corporate goals where the drivers are revenue, the profit the brand image being built etcetera. Design planning in a sense a set of perception principles necessitates the following alignments with the business goal that we were just talking about in the context of innovation. So, what are the where the alignments are necessary? It is those self explanatory, but I would just go with this once.

Aligning the design strategy with corporate strategy; at the strategy level. So, what is the long term goal of the corporate where it is going to how it is going to realize its mission, its vision

etcetera. Ensuring quality design deliverables consistently. Technology scouting that is where that is what is a very important area; that the technologies are being developed, technologies are being commercialized, being licensed out and also technologies are being developed in the open platforms.

So, all these kinds of technologies are required. It may be required for a particular product development from all sources or may not be from all sources may be from several sources, but that for that technology scouting is necessary. Striving to enhance the quality of design outputs which is called quality planning. Risk analyzing and managing. Because risk at every stage say it may be that the component that was supposed to come from a particular country if it is an imported component.

They somehow the relationship with that country is not well now then there would be a issue. Similarly, if a vendor who could do otherwise good in technically, but if its financial health is not good and if it does not if it if it cannot continue its business then the component from that unit or from that organization is not assured.

So, risks are there. Cost fluctuation happens. So, those are the risk elements. Customer may not like a particular version that is also risk. Something which arrives in the market before time that also is a problem. Development iteration planning, because multiple iterations would be required.

So, that also is a design planning activity. Maintaining quality communications with the stakeholders about which we just have say few words and finally, conducting audit on design process. This is necessary because after the design process is over one needs to find out where it went wrong or how it was solved and how in future it can be prevented that is the main objective to not to let the defect or the mistake wrecker.

So, what it is necessary. Design planning prescribed by the design or innovation engineering department can be perceived as a set of guidelines, procedures and strategies that governs the development of manufacturing and which can be efficaciously realized through a systematic

and structured innovation engineering blueprint. Exactly that is where we are coming back once again to.

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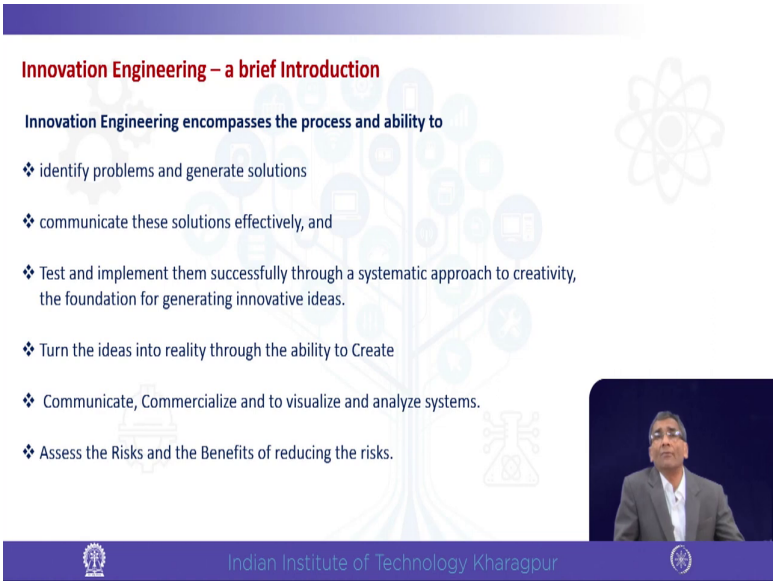

Now, from here therefore, our journey begins in the territory of innovation engineering. Innovation engineering a brief introduction. Innovation engineering encompasses the process and ability to; I will draw your attention to those points identify problems and generate solutions.

Communicate the solutions effectively and test and implement them successfully through a systematic approach to creativity, the foundation for generating innovative ideas. Turn the ideas into reality through the ability to create, communicate, commercialize and to visualize and analyze the systems. Assess the risk risks and the benefits of reducing the risks.

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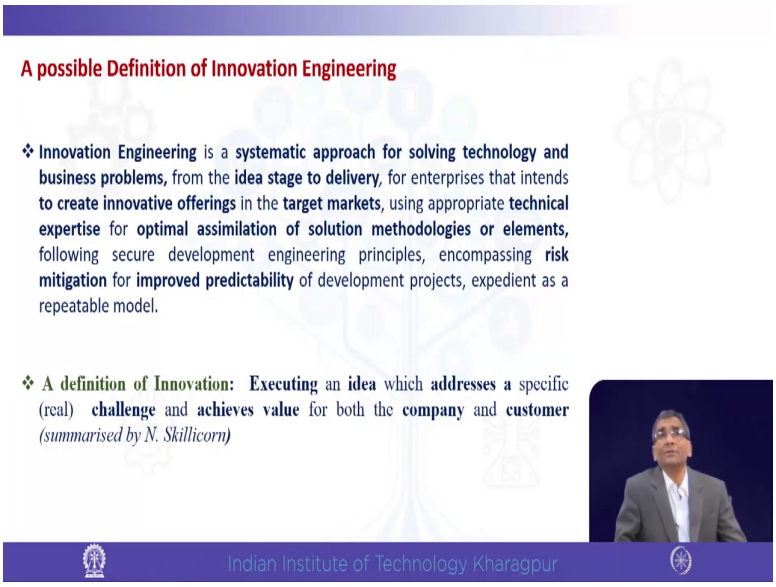

So, it is a brief introduction and then with this brief introduction we would like to explore and see what is the possible definition of innovation engineering? Well, before that I would like to draw a quick attention to what is innovation which is in the bottom part of the slide that it talks about a definition of innovation that is executing an idea which addresses a specific which is a real challenge and real challenge or problem.

Challenge is a problem and achieves value for both the company and the customer which is a summarized definition. Because there are plenty of definitions many definitions. But this one definition which is summarised by skillicorn. It shows that the four very important points are covered in this definition. That is for innovation there has to be an idea and the idea alone is not enough a good idea will not be a fruit.

Unless it is implemented or it is done properly with execution. So, execute the idea and then that idea execution actually should be meaningful, should be productive, should be valuable. So, which means it would add value to both the customer for whom the company actually survives by serving it too and the company itself. Because that is the producer or creator.

So, these are the four elements idea, execution and value for the customer and value for the company. Having understood the innovation we can go to the top part of the slide where the innovation engineering is defined a functional definition that is; it is a systematic approach for solving technology and business problems from the idea stage to delivery.

For enterprises that intends to create innovative offerings in the target markets, using appropriate technical expertise for optimal assimilation of solution methodologies of elements, following secure development engineering principles. Encompassing risk mitigation for improved predictability of development projects, expedient as a repeatable model.

That is all the points actually if you carefully see have been said, but the one thing that I would like to emphasize upon is that the consistency of a structured model is necessary that is what is that it model should be repeatable and through that model it should be predictable. So, improving the predictability of a model is the important thing and therefore, when we would present the innovation engineering blueprint you try and take care of this particular aspect.

Though all these earlier points have somehow been somehow been discussed in our discussion. In this discussion the first part as well as earlier, but this particular aspect is to be carefully noted.

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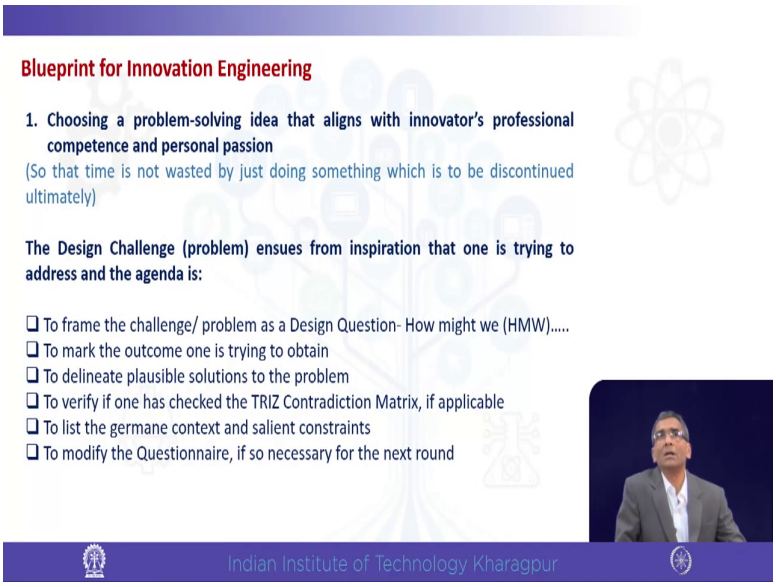

So, now I would go into the blueprint for innovation engineering. It is basically a 11 point plan or 11 point blueprint. The 1st one is choosing a problem solving idea, any idea that we are talking about it is to solve a particular problem or solution idea that is that aligns with the investors, professional competence and personal passion.

Because these two things are important in the sense that a product is successful when the execution is successful. And for execution it needs attachment with the activities. Product creation and development and innovation activities. It is quite obvious that one can be attached to something for a pretty long time.

If it is head and heart both are with it. So, head means here is the professional competence and heart means where the passion is. So, these two are necessary through which the

problems are to be chosen. And it is necessary. So, that time is not wasted to chase a wrong problem or a problem that one would not stick to and therefore, it would not add any value.

So, that is the first thing that one has to take care of. The design challenge of the problem as I was mentioning ensues from the inspiration that one is trying to address and the agenda is. To frame the challenge of problem as a design question. How might we how might we solve a thing when we are defining then we are talking about how might we or it is very commonly known as HMW.

To mark the outcome, one is trying to obtain, to delineate possible solutions to the problem. So, to delineate possible problems to the solution is; that means, there are several multiple ideas being generated and from that we would be taking some ideas forward through the conceptualization filters. We will talk about that very soon.

To verify, if one has checked the TRIZ contradiction matrix. Now, this is a become new term I understand as far as you are concerned because TRIZ we will discuss that TRIZ in detail later. For now, let us understand that it is technique by which the innovator or the product developer would not try to reinvent the wheel would try to figure out if a particular problem is there.

If already a solution exists somewhere and there is a methodology to find that out and if that solution is available for some other problem how that can be brought to a broad for the use of this current problem. That is the fundamental issue about TRIZ which is a Russian term its English equivalent would be tips that is theory of inventive problem solving.

We will talk about that later in detail. To list the German context and salient constants. To modify the questionnaire if so necessary for the next round. These are the first this this is the in the first point.

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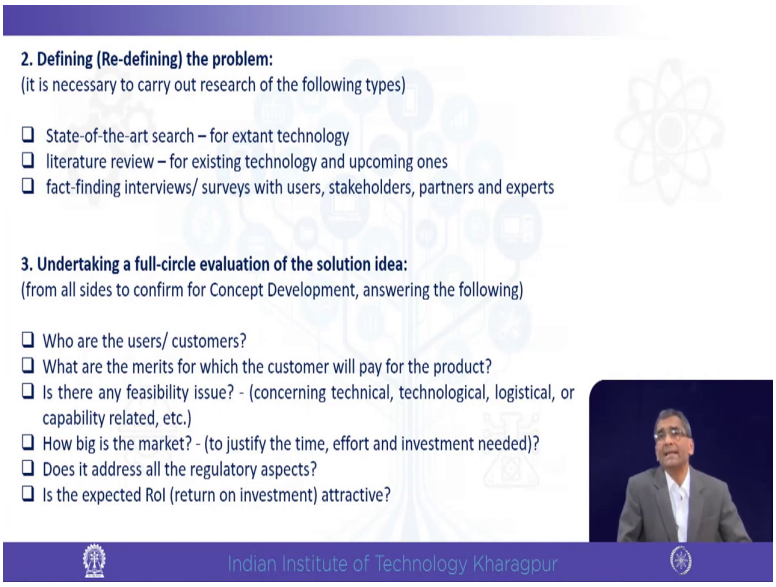

The second point is therefore, as I said the definition of defining a problem correctly would be solving a half-way in solving the problem. So, 50% work is done. So, it should be emphasized that defining the problem is important. So, it is necessary carry out research of the following types. One is the state of the arts research that is what is going on now? What is the prior art? It is called prior art. What is the existing technology? That is how it is being addressed?

How it is being solved? Literature review of all kinds. Literature, it may be trade magazines, it may be white papers, it may be journals, conference papers and also the company brochures. So, that is the literature which would tell us what is the current technology available? Or on what research is going on? And there is a possibility that something will be coming up quickly in your future etcetera. So, we can use it for our product creation.

Then fact finding interview or surveys the which is sometimes called primary survey or something that uses users, stakeholders, partners and experts. The face to face or one to one it may be; it may not be face to face always it may be online, but then that is one to one rather and not from the secondary source of data. First an understanding of what is that. Next is the undertaking a full circle evaluation of the solution idea; that means, completely examining how what how valid is that. From all sides the examination is to be conducted to confirm for concept development answering the following.

What should it answer? Who are the user or customers that would be identified? Who are the target customers? So, targeting the customers by segmenting the population into different groups say for example, it may be a demographic segmentation, it may be a psychographic segmentation, behavioral segmentation.

So, different segmentations will give a target group we will talk about those later, but then who are the user customer in that particular whether we are targeting for the aged people, we are targeting for the disabled people, we are targeting it for the young people or we are targeting it for the office goers; I mean depending on the situation the segmentation is done or we are we targeting for a market which is in the emerging economy where the affordability is a big issue; that means, where the cost is to be contained?

So, there we can supply the product at a cost economic rate and when we are talking about that we also need to talk about the when we are doing that what is the feasibility? Whether it is possible to do that whether it is a technically possible, technologically possible, logistically possible or is there capability to do that. So, these are certain (Refer Time: 22:37) through which the ideas are to be measured, checked, screened. How big is the market? So, that will justify the effort whether we should go into that at all.

If the market is too small then there is no great attractiveness or what? Does it address all the regulatory aspects, legal, environmental and all. Is they expected ROI or return on investment attractive? So, if a business is investing money to do something, develop something, sell something thereafter and if they return or the revenue or the profit that is being earned, profit

that is being earned, if that is not adequate then there is no point. If it is adequate one should go for it.

So, product should take care of this considerations, product development should take care of this considerations and therefore, it comes under the innovation engineering paradigm.

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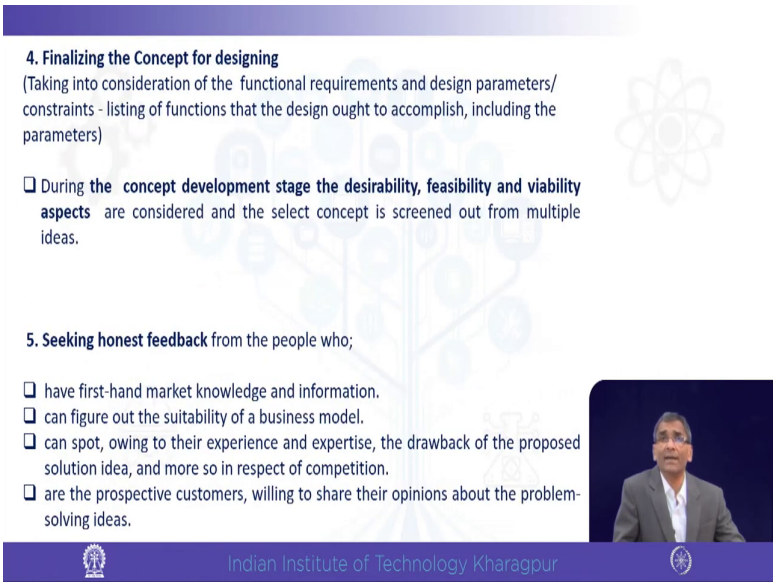

So, as already I have pointed out to you that finalizing the concept of design, it is required to be filtered under the three very important considerations which is the actually the considerations of IDEO the design thinking organization, design organization practicing design thinking.

And according to them these three are very vital and therefore, all ideas will not pass through this filters those who will pass through this filters well. Those are actually be out of them the

best would be translated would be considered as a concept which would be ultimately translated in the product.

Then seeking honest feedback, the candid feedback, the genuine feedback, the feedback which is with constructive criticism maybe. Have the first hand market from who from anybody cannot give that. This will be provided by those who have the first hand market knowledge and information, who can figure out the suitability of the business model.

Whether it would be a product is be sold or it would be the best model would be to lease out or to supply a product where against certain monthly rent and the revenue for the work done like Xerox photocopier was doing in its initial stages to popularize the product.

Possibly you have heard that story or you can find out from internet or some place that what is the business model of Xerox photocopiers. So, for process that is important can spot who can spot going to their experience and expertise the drawback of the proposed solution idea and more so in respect of competition.

So, how the solution may fail may not succeed that is very important and that is a very I would say crucial and vital information. If one can get that early on then that is best. Because after proceeding a lot on a particular program which ultimately is not going to be successful a huge energy money is wasted, time is wasted and frustration sets in.

So, for energy and motivation also that is important. Are the prospective customers willing to share their opinions about the problem solving ideas? If they that is one of the finest thing to do.

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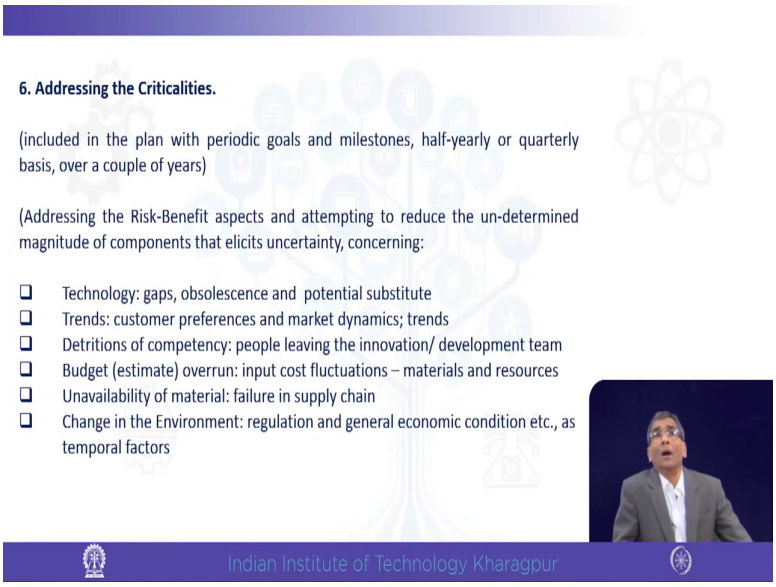

Now, in the journey what is to be very careful about is the criticalities. Everywhere something may become critical and if we do not anticipate those criticalities and do something about it early on then that there will be a problem later.

So, addressing the criticalities which is the included in the plan and goal which talks about the review, periodic review say half year earlier quarterly reviews for say few years initial years of product development; I mean during the product development period. Addressing the risk benefit aspects and attempting to reduce the undetermined magnitude of component that is uncertainty should be removed that elicits uncertainty concerning.

Concerning what? Concerning the following; technology gaps where some where the product is being conceived. Assuming that some function will be addressed through this, but whether

that gap that is currently not available is available or can be made available that is the gap current in current design obsolescence.

Similarly, whether because a particular version of electronic component they may become obsolete a new version has coming or is coming in. So, that is to be considered. Potential substitute is the is a good substitute is about to come. Trends, customer preferences and market dynamics which changes so often.

Detritions of competency of people; that means, people leave the development team which is a risky or disobeying issue that the when people leave, they leave with their knowledge in their head and if it is not documented well or if I mean if the substitute skill or the skill is not adequately substituted then it hampers.

So, the detrition due to attrition is important. There may be risk due to unavailability of material which is failure of the supply chain. As I have already indicated how the material failure supply chain failure can happen say if it is import, there may be chance if the company from where it was coming, it was on viable there is these are the things.

So, those are to be taken care of. Then change in the environment, regulation changes, economic condition changes, COVID happens. So, these are the temporal factors and so the criticalities are to be dealt with.

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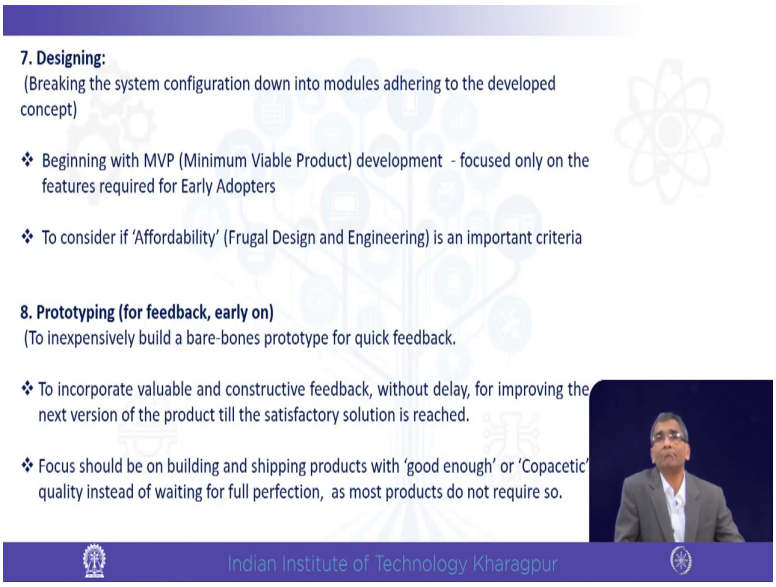

Then comes the actual central work called designing which is breaking down of the original concept into sub components, sub parts and it may begin with a thing called a product version called it is not really a product version it is rather a functionality being tested or feature being tested which is called MVP or minimum viable product which is not a full product.

But there are customers who would like to examine that particular aspect of a product and that is if created through MVP if that is tested and if that is satisfactory or the customer likes it then it would be embedded and then full scale product would be developed. So, in designing the two important things are to be considered one is that MVP; that means, the feature or the functionalities are there and then whether it is affordable.

It is also very important factor because the one of the major concept is that anything can be done, but when it comes to the budgeted manufacturing or design then there is a challenge.

So, within a given target cost it is to be developed. So, the affordability or frugal engineering and design becomes important whether that criteria that is the designing part.

I have already said that after design comes prototyping so immediately after designing the prototyping is to be developed. Inexpensively it is to be developed. So, the quick feedback comes from the customer which may be a bare bones prototype. Not every aspect not all it is not fleshed out enough only a bare bone sometimes is called ugly prototype that also is good enough that is working, but not finally, a car is set up it moves and with a particular engine and it goes at a speed, but then the exterior is not prepared yet, but that is good enough for testing.

So, that kind of prototype is to be rated quickly. Focus should be on building quickly build something and ship out. So, that you can one can get the feedback and it is not necessary to wait for the final perfection, ultimate perfection when everything will be absolutely fine then it will be sent then there will be a big problem. Because that for perfection as you know the more you become perfect a huge time is required.

So, but the market will not wait. So, and also getting the feedback from the market is important and also for survival getting some revenue is important. For startups it is bootstrapping which is required.

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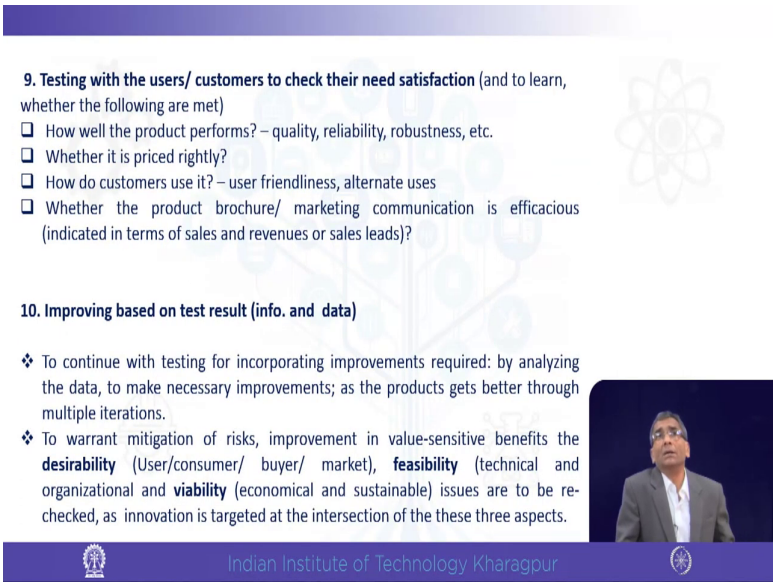

So, we move on to the next which is the testing finally, once it is developed then the it is to be tested with the customer in the market.

How well the product performs in terms of quality, reliability, robustness etcetera we will talk about these aspects separately what is reliability? How it can be addressed? Robustness what is it robust is that it can work under fluctuating external conditions whether the price is correct how do the customer use it? I mean whether it is user friendly or do they make any alternate use of this? Whether the product of brochure or marketing communication is efficacious.

That means whether it actually helps to get sales and revenues or also can also get also helps in getting the sales leads that people are sending enquiries which will be converted into sales or revenues subsequently. Point number 10 is improving based on the result.

That means, it is basically again kind of a repetition I would say of those three yardsticks that is a desirability, feasibility, viability which I have already discussed in my earlier lecture; that based on that if it is found that there is something for the to be done to improve to satisfy the customer to delight the customer those are to be done subsequently that is improving.

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And finally, is the auditing because I audited, I have already explained only to say that to track the process so that the same mistake, defects or errors are not repeated in the future they

are they can be prevented. So, the documented audit report will help in that. I would like to put a an end note here which is interesting.

Innovation primarily is about assimilating the knowledge, experience, information and data from many different sources and then it is actually the ability to inter blend them; that is one very important characteristics of innovation. And therefore the it combines the inter blend knowledge of the technology, marketing alongside the acumen of scanning of innovation from a strategy business viewpoint.

Innovation engineering process, flow process flow aims to subsume the same as I just have spoken in a systematic form, in a blueprint; the blueprint that we have just now discussed.

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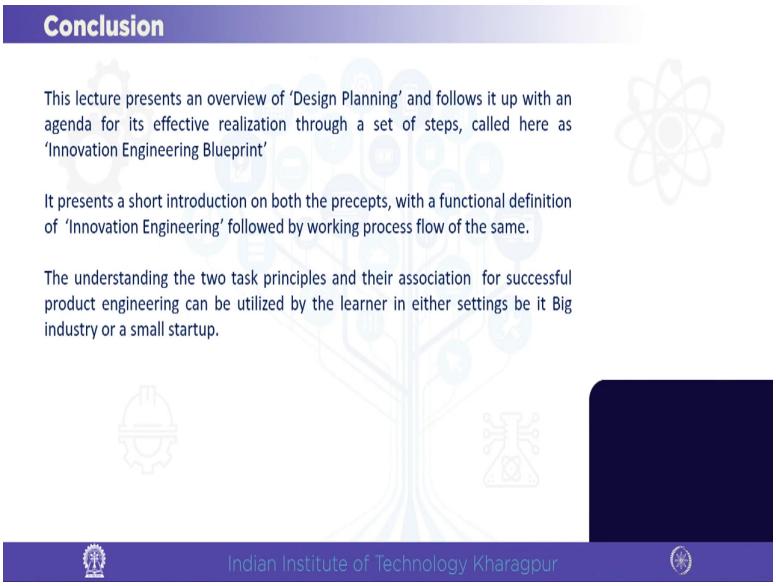

So, to conclude the session we may see that this lecture presents an overview of design planning and allows it and follows it up with an agenda for its effective realization through a set of steps. The steps we have seen one through 11 just now called here as the innovation engineering blueprints.

It presents a short introduction of both the precepts that design planning and innovation engineering and followed by the process flow which we have just completed the understanding of the two task principles and their association for successful product engineering can be utilized by the learner in either setting up a big industry or a small startup or one may actually go and serve in a big industry or in a small startup.

So, either way that is helpful; very very helpful professionally. It will provide a good rewarding career.

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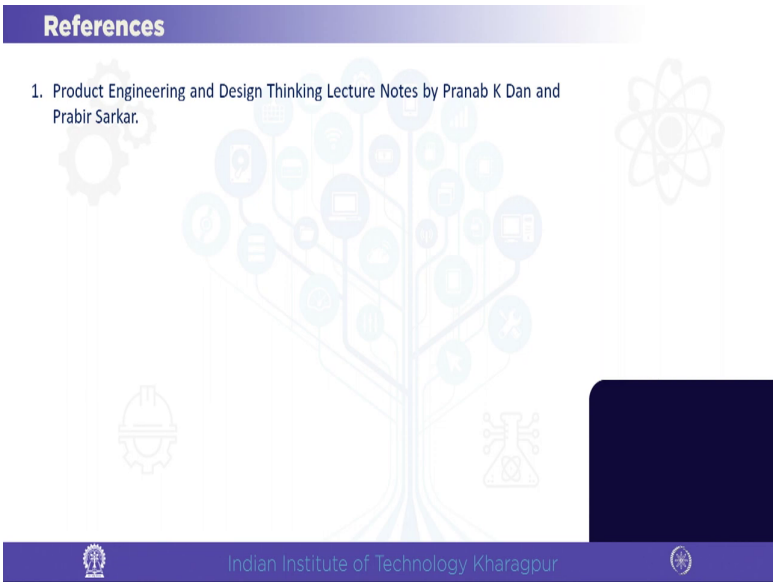

The reference is I would say is this that our lecture notes particularly for this and because this is an upcoming topic and not too many texts are yet available, but that is why we have presented the 11 points in detail that you can see from this lecture. Thank you very much for your attention and be with this session.

Thank you very much once again.