Innovation, Business Models and Enterpreneurship
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Lecture - 22
Technology Innovation Process

Welcome friends. So, now, we are going to discuss about the role of technology in the innovation process. And for next 2-3 sessions we will be focusing on different aspects of technological innovation process. I expect that we all have some kind of confusion about science, engineering and technology.

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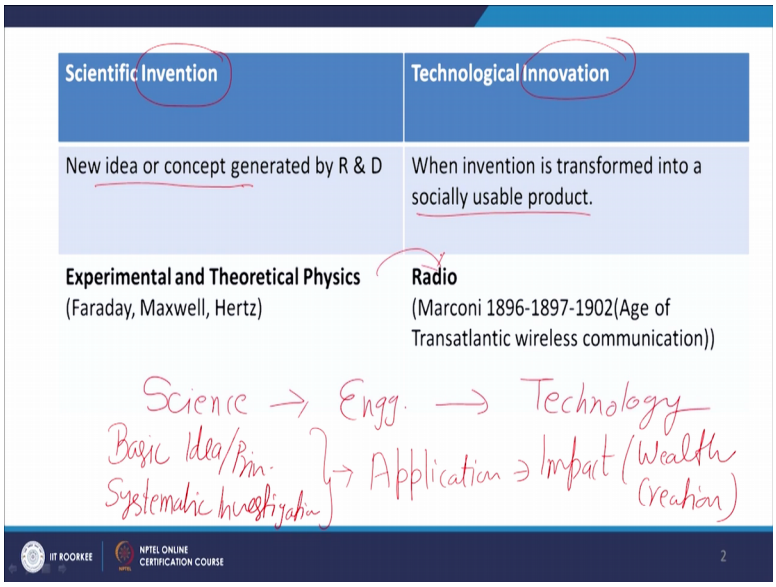

So, before I start this discussion of technological innovation process let me clarify that what is science, what is technology and what is engineering. Now, for that purpose it is important to understand that in innovation process there are two terms, if you remember in our very first discussion, we discussed one is invention and another is innovation. So, here we are using invention word with science and innovation word with technology.

So, what I am trying to do first let us see we move from science to engineering and from engineering to technology. Now, science is some fundamental principle, basic principles, basic idea, principle. These things are known as science which is based on some kind of systematic investigation. Because that systematic investigation otherwise every time you go to a physics lab and you do some experiments you will not get similar results.

Because you are following a systematic process therefore, you get same value of g every time. If you are using a register you use same value of resistance in that register for a particular combination of v and i. So, it is systematic investigation and on the basis of that systematic investigation you develop certain principles, you develop certain concepts that is size.

Now, the application of those scientific principles is the engineering. So, when you start applying scientific principles this becomes engineering part and then when you create impact and particularly this is wealth creation the impact of wealth creation that is technology. So, we move from science to engineering to technology.

And now there are large number of scientific inventions which are converted into technologies, which are impacting human life in different ways. And at the same time there may be equally large number of scientific inventions which are not the part of technological innovation. We know only those scientific inventions which have impacting, which are impacting the human life. But as I mentioned there may be a list of some of the inventions which are yet to impact, yet to be the part of technological innovation.

So, what we say that the new idea or concept generated by research and development; that new idea or concept is actually the scientific invention. But when this invention is transformed in a product, when you make some kind of impact you start getting money out of this invention then it becomes technological invention, innovation. Beg me pardon.

So, the idea converting into a product is actually the invention going into the innovation. Just to force, just to give you the example of how invention becomes innovation, we know a very popular branch of physics that is experimental and theoretical physics. And some of the landmark contributors who are pioneered the field of experimental physics; the names are like Faraday, Maxwell, Hertz. These are the scientists who actually contributed in the development of this experimental and theoretical physics.

But these scientific inventions done by these great scientists actually we all see that in the form of radio, which Marconi developed the concept of wireless communication that you can transmit using wireless systems. So, using this concepts research of

experimental physics Marconi developed a usable product out of it and initially the idea of Marconi was to help navy.

Because ships cannot communicate with the port because of no wires are possible. So, Marconi found the use of radio or the use of wireless communication for navies to communicate from their ships to port. And slowly this idea started in his mind somewhere around 90 1896, 1897 he did some successful experiments. And finally, in 1902 the first successful transatlantic wave communication; wireless communication was possible. So, the age of transatlantic wireless communication we all know is started in year 1902.

So, all these scientists they were working for decades in the area of experimental and theoretical physics, but Marconi converted that into a technological innovation. And since then since 1902 to 2017 we see that how much progress this wireless communication has made; tremendous communication. And this has become the most powerful tool in our hands nowadays, our mobile phones.

So, you see unless until the scientific inventions are converted into technological innovation you will not have the impact component of innovation. So, that is how you differentiate between science and technology, you differentiate between innovation and innovation.

Going further it is worth mentioning that technological innovations these are complex socioeconomic and technological processes.

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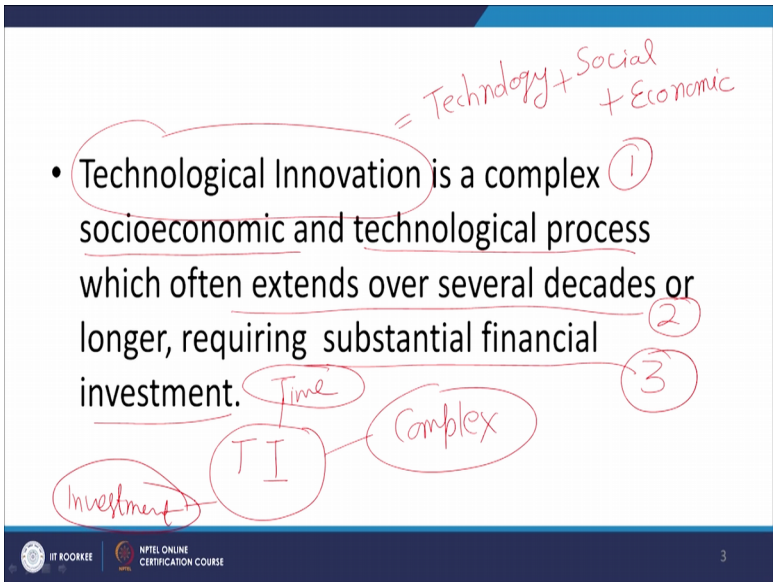

So, it is not only the word is technological innovation, but it is not only limited to technology. It includes the technological innovation actually this word includes a combination of technology, social factors and economic factors. And therefore, you see you see around you wherever social factors are involved things become highly complex, complicated.

So, therefore technological innovation is also a complex phenomena because of the involvement of social factors into it. The society must appreciate, the society must adopt those innovations then only some kind of impact is possible. If society is not adopting those innovations then there will not be any impact. So, to make the product usable by the society is not a easy task and therefore, I say that it is a complex process.

And this have a very long-time horizon, it may take several decades or even longer period and it also require substantial financial investments. So, you see there are three important characteristics. Three important aspects we understood, one is it is a complex process, it takes sufficiently long time and it is taking lot of investment also. So, here if I want to summarize technological innovation this is characterized by three aspects, one is it is complex phenomena. The second is time phenomena; it takes huge amount of time and third is investment. It require heavy investment for getting a successful technological innovation.

So, normally you will not find many organizations going for the offensive way of technological innovation. What is offensive way of technological innovation that we will discuss in our coming sessions? But you will not find many examples of such type of technological innovation.

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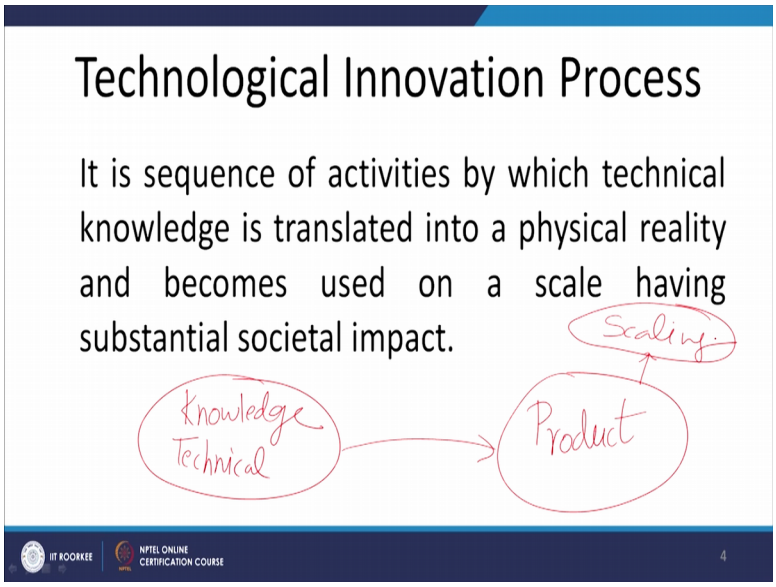

Now, moving further let us see what is the technological innovation process and if I see the technological innovation process. It is a sequence of activities by which technical knowledge is translated into a physical reality means you have knowledge of a technology and you are converting this knowledge, the technical knowledge let me be clear the technical knowledge you are converting into a physical reality and that physical reality is normally a product.

The simple thing is whatever technical knowledge you have you know about materials, you know about engine, you know about combustion process, you know about refrigeration cycles. So, whatever technical knowledge you have you are converting that technical knowledge into a product. You know how to code in the android environment and using this knowledge of android coding you are developing mobile app that is the process of translation of technical knowledge into a physical reality.

And over a period of time this product goes into a scaling activity. A scaling activity means where you start making things in large numbers, you start producing in masses, high volumes then only some societal impact is possible. If you are not able to reach to

this scale level, if you are not fulfilling the aspirations expectations of masses then societal impact is not possible.

If by offering a new type of car which is eco-friendly, we all are talking of sustainability; we all talk of environmental friendly vehicles. And now I develop a new car which is 100 percent environmental friendly. Even if I do the lifecycle assessment from manufacturing of car to using the car, to disposing the car all the processes involved in the lifecycle of that car are 100 percent environmental friendly.

But because of some issues, because of some issues, if I am not able to scale up the use of this car, this car will not be making any kind of societal impact. If this car is available only with the head of that state, it is only available with president and prime minister of a country and no other can use this car because of some reason. Then it is very difficult to call this as technological innovation because it is not scaled up and then there is not sufficient societal impact.

So, it is the technological innovation process does not stop at the development of the product stage. Rather it goes beyond that it talks of scaling up and in the scaling up the idea is to create large scale or a miserable or a sufficient level of societal impact. So, that is the three important stages in the technological innovation process. First is you should have you should have the technical know-how then you convert the technical know-how into the product and then that product is scaled up to create the substantial societal impact.

So, you can see many such examples in our lives there a company particularly a pharma company develops research and development and through that it gets patent. Then some kind of initial products which are very costly because the company needs to recover the cost of patent research and development those products are developed and over a period of time company goes for the large-scale manufacturing of those products so, that it can create the wider societal impact, it can help in eradicating in removing some of the deadly diseases.

So, that is how the technological innovation process. So, you can summarize the entire process in these three steps to give you the idea of the what we just discussed. So, this is the first step where you have the technology know-how and after this technology know-

how which we say is the invention process; this is the product development and then diffusion is actually the scaling up.

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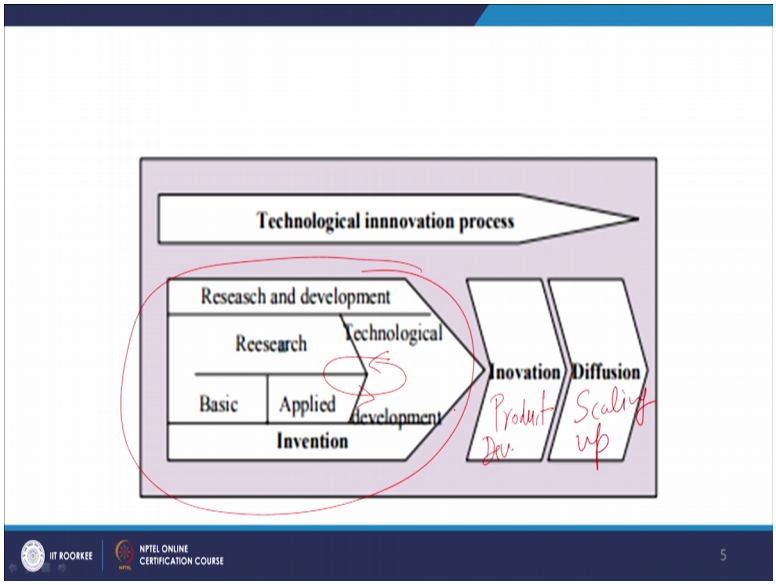

So, these are the three important steps in the technological innovation process. First is the invention, the development of technical knowledge know-how with the help of basic and applied research. And then you go for the development of technology for the application of that basic research. And with the help of this technical know how you develop the product and then you go for the scaling activities.

To explain this whole process of technological innovation process, there are different types of ways in which you can understand. One of the popular approach is the BRIGHT's 8 stage process. So, let us quickly discuss that what are the stages involved in this 8 stage process.

So, the stage 1 says that the innovation begins in one or both of two ways. One is by a suggestions or by discovery and another way is by the perception of an environmental market need or opportunity.

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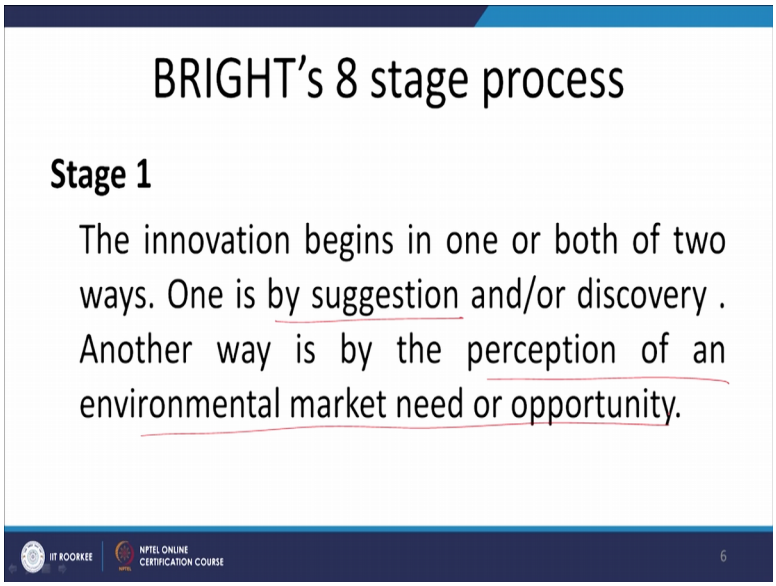

It is important to understand that innovation can begin in both these ways. One is by suggestion and another by the perception often environmental market need.

But most of the innovations which are happening nowadays or happening because of second approach. And here the concept of co-creation is also applicable because you are coming closer to your customer. And because you are coming closer to your customer you understand their requirements, their needs and accordingly you try to develop new products. Some of the innovations take place because of new discoveries also but these are not regular innovations, these are slightly rare innovations.

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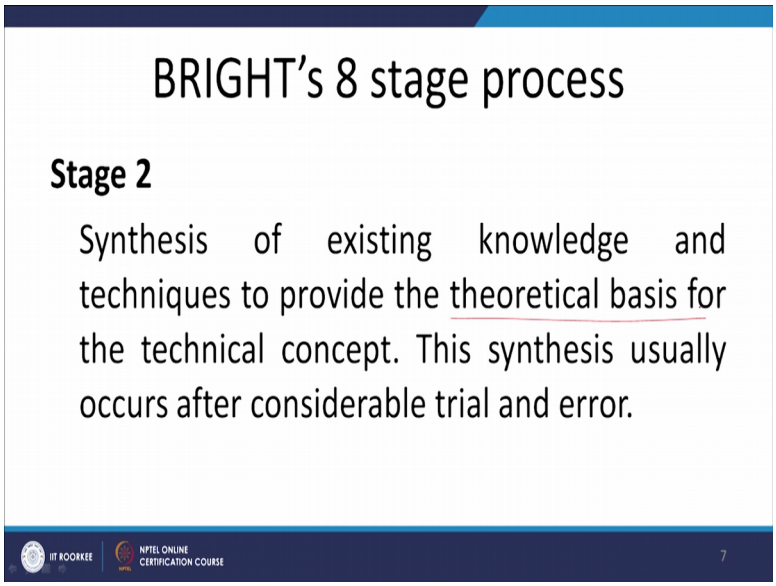

The second stage of this process is synthesis of existing knowledge and techniques to provide the theoretical basis for the technical concept. So, you get theoretical knowledge; this synthesis usually occurs after considerable trial and error.

So, when we are trying to develop this model we have just discussed that in this research and development framework we do research and technological development. And this is a iterative type of process where you are moving towards technological development and then again you do the applied and basic research. So, that you keep refining your technical know-how and by this you develop a good synthesis of your existing knowledge and techniques to provide the theoretical basis for the technical concept.

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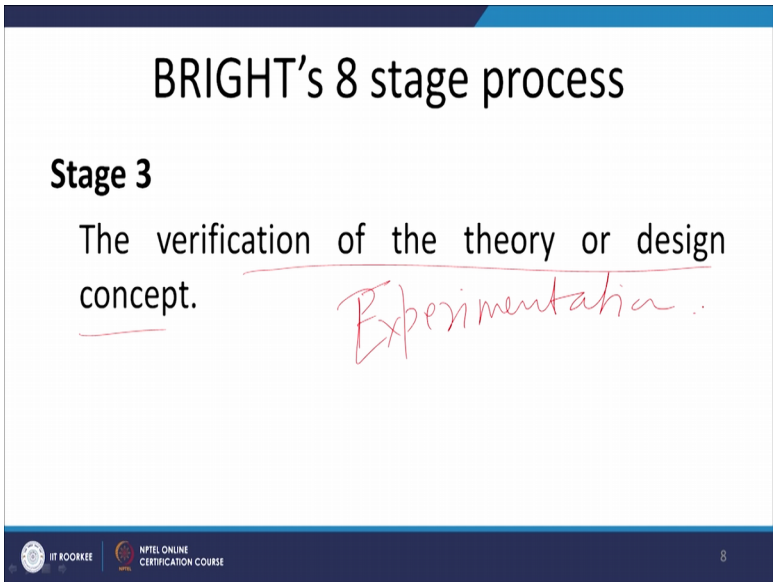

The stage 3 is the verification of theory or design concept. And if you recall you can go for experimentation stage for this verification of theory or design concept. We discussed that we have different types of assumptions to validate and that is what this stage 3. This is the assumptions related to technical aspects; in our one of the session we discussed about the experimentation and this is that stage which is requiring your knowledge of experimentation. Then the stage 4 is about the laboratory demonstration of the applicability of the concept such as the development of the breadboard model in the electronics.

Now, you develop with the help of this experimentation we develop a kind of prototype; the lab model the model which can be put in your lab.

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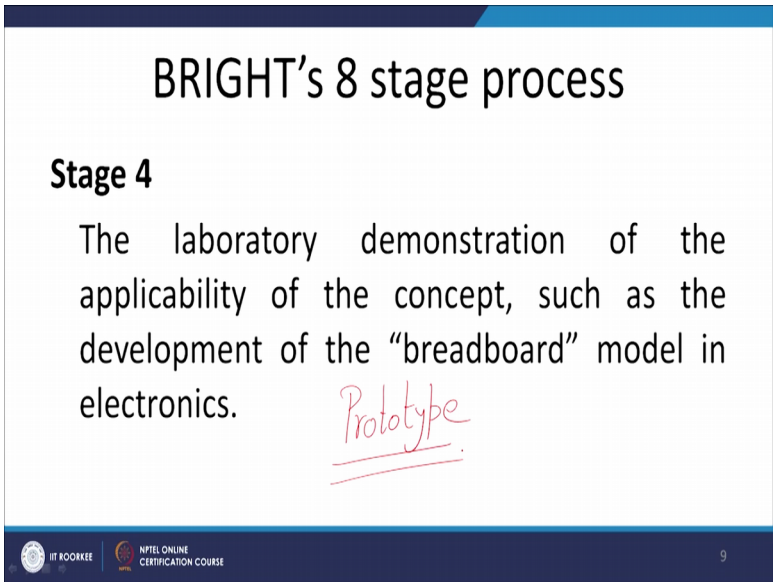

So, that you can demonstrate the applicability of the concept may not be used for the commercial purpose this model, but this at least can show you how your basic idea, how your scientific principles are going to be applied in this particular product.

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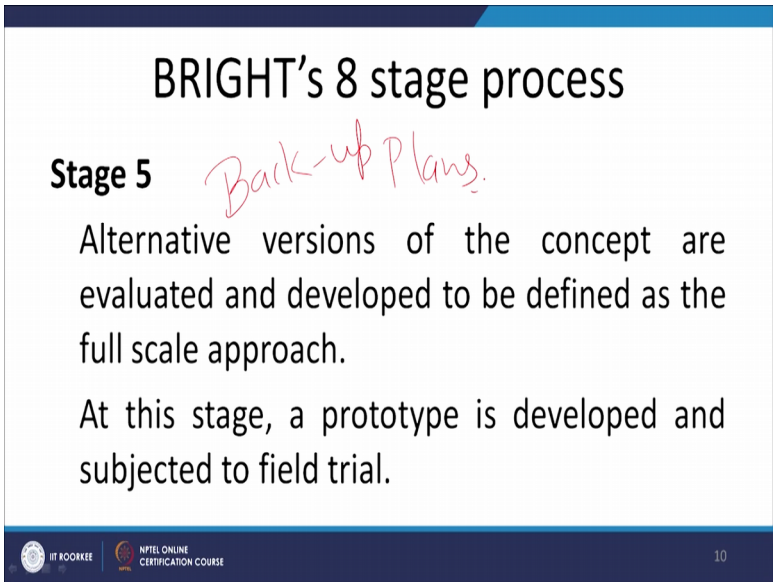

Then stage 5 is about alternative versions of the concept, these are evaluated and developed to be defined as the full-scale approach. If you remember in one of the session we discussed the example of Kishore Biyani where he mentioned about backup plans. So, this stage is actually the application of that backup plan. You should have the backup

plans and you also should have the evaluation of those backup plans that how much are you going to get with the help of these backup plans.

And which backup plan or which plan if you have alternative plans. So, the plan whichever is most suitable you develop your prototype and go for the field trial with the help of this prototype.

Now, once you are done with the field trials then you go for commercial introduction of your product. Now, you are going to launch the product you are bringing your product to the market. So, prototype after prototype going for the field trials and from the inputs which you receive in the field trial, now you are going for the commercial introduction of the product.

It looks that we are talking in a linear fashion, but please always remember please always remember that these things are iterative. It is not that after 5, 6 is coming after 6, 7 is coming after 4, 5 is coming there are many times forward and backward movements. We go from 4 to 5 and then again may come from 5 to 4. We may go from 5 to 6, but if results are not as per our liking we need to come back from 6 to 5. So, there are large number of forward and backward movements.

So, now the sixth stage as we discussed is about the commercial introduction of the product. At stage number 7, at stage number 7 now we are looking for the scaling activity.

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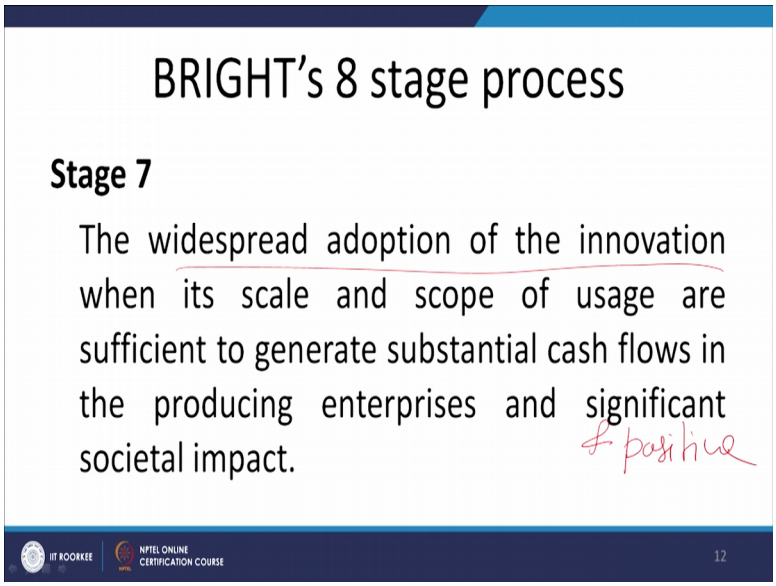

The widespread adoption of the innovation and this widespread adoption of innovation is only possible when you are going for a scaling of your innovations and where we create sufficient scope of wide uses of the product so, that you can generate sufficient cash flows in the producing enterprises and significant societal impact.

You see one important thing in our whole discussion of this course; we are not only talking of profits. We are not talking of simply the cash flows, but we are continuously talking of societal impact. And I think as a new as entrepreneurs you should also think in the similar direction that whether our innovation is leading to positive societal impact or not.

If your new innovation, we recently had a very challenging game blue whale and now the impact of that that young child is leading to death creating suicide. So, that is also an impact, but that is the negative impact. So, dear friends it is very important to understand that our innovation is leading to significant and positive. It is not only simply significant, but significant and positive societal impact that is very much required that your innovation took to the positive impact to the society.

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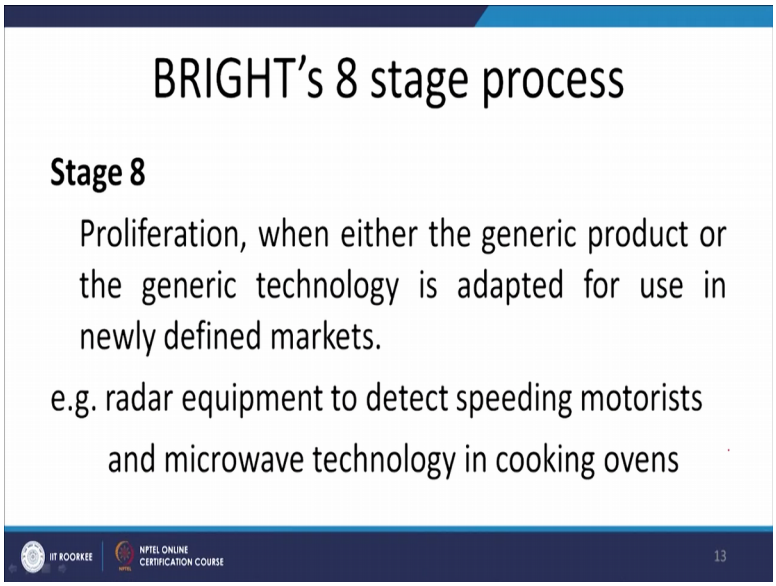

And finally, the point number the last stage of this technological innovation process is the proliferation when either the generic product or the generic technology is adapted for it for use in newly defined markets.

So, you started from a particular scientific invention; you developed a product out of it that product has moved to a scaling activities. It is creating a positive societal impact, but now we are talking of using that technology for some newly defined markets and for that purpose we have two examples. One is very popular nowadays everywhere in your household activities you find this that is the microwave heating.

So, now this microwave technology is used in our kitchens to heating activities. So, that is the technology is of the electronics and you are using that electronic technology, microwave technology for cooking ovens. So, that is a newly defined market for microwave technology.

Similarly, the radar equipments which are used for tracking the movement of aircrafts, now, you have a new market for that technology to detect speeding motorcycles. Now, these types of examples are actually the examples which tell you that how you are now going to use that technology into a new market. So, my microwave technology for this cooking ovens are a new market for radar equipments detecting the over speeding vehicles that is a new market.

So, these are the 8 steps of technological innovation process. We will discuss some more aspects of ecological innovation in our coming session and with this 8 stage discussion, we are coming to end of this session.

Thank you very much.