**Entrepreneurship Essentials**
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**Module - 06**
**Lecture – 28**
**Design and Innovation – III**

Welcome. In this session we are going to discuss about the theory of inventive problem solving, its called TRIZ. Its an acronym from Russian language, but I do not have the Russian name, but its primarily theory of inventive problem solving called TRIZ, TRIZ.

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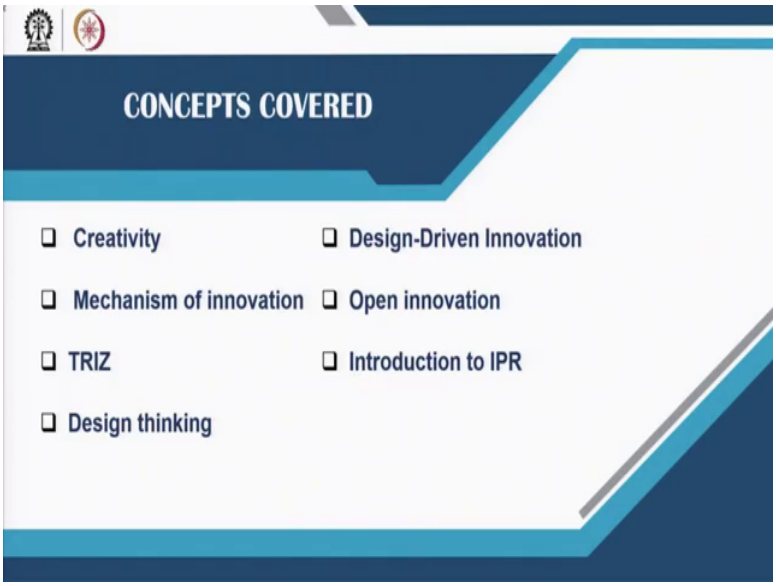

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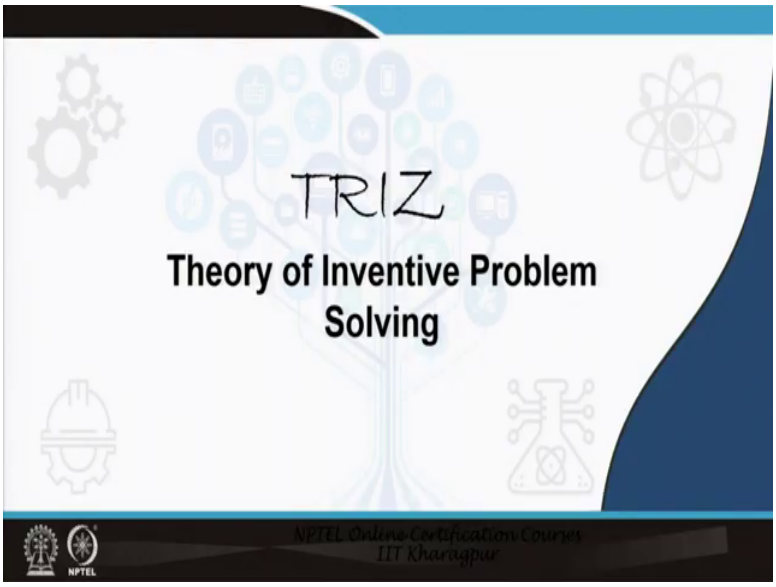

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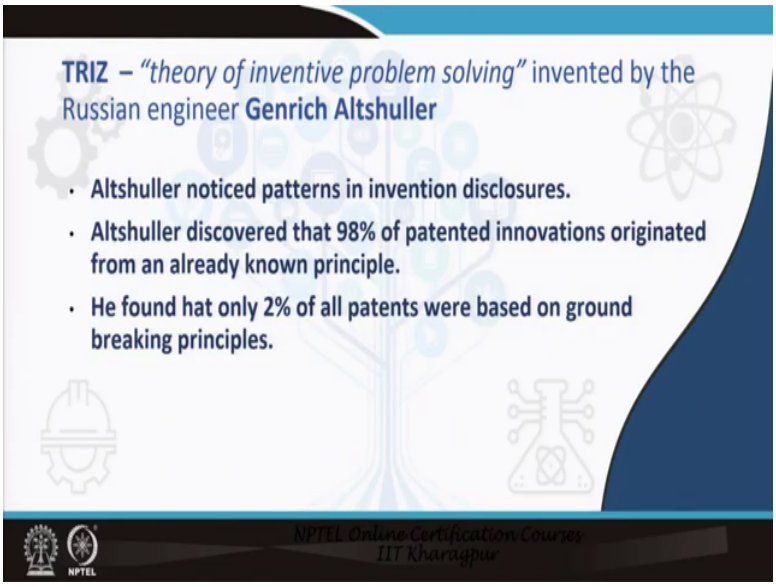


It is invented by Genrich Altshuller. He was a patent examiner or he was a clerk at patent office. So, used to shift through umpteen number of patent. So, he actually, he was introduce a tip and then he was trying to see what are the are the ground breaking principles that has gone in invention of all these patents, to his surprise he found that about 98 percent of the patented technologies follow a pattern. They are they can be categorized or they can be classified into certain sections or segments or they follow certain, certain principles.

So, how many principles that is that came later, but he found that many of the patents, followed particular pattern. So, they were not ground breaking, he found that about 2 percent of the patented technologies were ground breaking they came up with new principles. Whereas, rest were kind of its not a copy, but it was inspired by some knowledge and it can be explained with those or it can be classified into those.

So, he decided that let me see, what are these principles and then eventually he came up with 40 inventive principles, using which almost anything can be invented. So, eventually he propounded about 39 contradictions. Contradictions meaning, if you want to develop a solution you will find that there are problems, like suppose you want to increase the speed of a car, say the car is speed is say 200 kilometre an hour, you want to put it say 300, 400. You will find that the engine capacity or the fuel consumption will be more and many many other things will be more, so there is a contradiction.

Suppose, you need a big umbrella to cover you from rain, now the big umbrella carrying is difficult. So, when you are not using the umbrella it becomes difficult to carry. So, likewise there is always contradiction. So, you want to improve something, something crops up or something is associated with that which is an undesirable thing, desirable and undesirable make a contradiction.

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So, look at this cartoon, I am sorry that I could not really take permission from the original creator, I am using it from fair use perspective. But, I have attributed the place and the creator the Oxford creativity 2007 is regard is kind of has the copyright.

Now, look at the cartoon carefully and there is a wonderful there are two things that is coming out of the cartoon. Someone invented the wheel for the first time. One person is asking what good it is for whereas, some lady thinks that I can use it for a ground for grinding something, whether its spices or whatever, someone thinks that looks like a toy. Another lady thinks that I can make a kind of a cart or something, to carry something.

Another person think, that I can sit on it and do something nasty or whatever. But then, there are two messages I said from this. One is we think from our experience, we think from our education, from our background. So, if my background is something where I am trying to

carry many many heavy weight from one place to another, I will always think how to find a solution for this. So, looking at a wheel, I will immediately think that, I can use the wheel to make a car or something or a truck.

Whereas, somebody means depending on their background they will be thinking that way, number 1. Number 2, and that is even more important. Is that one technology can be used for many purposes, like your wheel really can be used for as a grinder and a small wheel really can be a toy or a something which can serve another purpose and definitely a wheel can be used as a wheel as well. So, that is precisely the message that TRIZ gives us. TRIZ tells us that, whatever you problem you have the solution already exist almost for everything.

You have to find in what form and where these solution is lying. And then almost like copy paste from there, you get inspiration you get knowledge and then replicate it in this new context and you have a solution. So, you have to actually look both inside as well as outside the domain of your knowledge. Even if you are in the automobile industry, its not necessary that all knowledge in the automobile industry will be useful in automobile. You may find elsewhere the knowledge that you need to be incorporated in next generation automobile.

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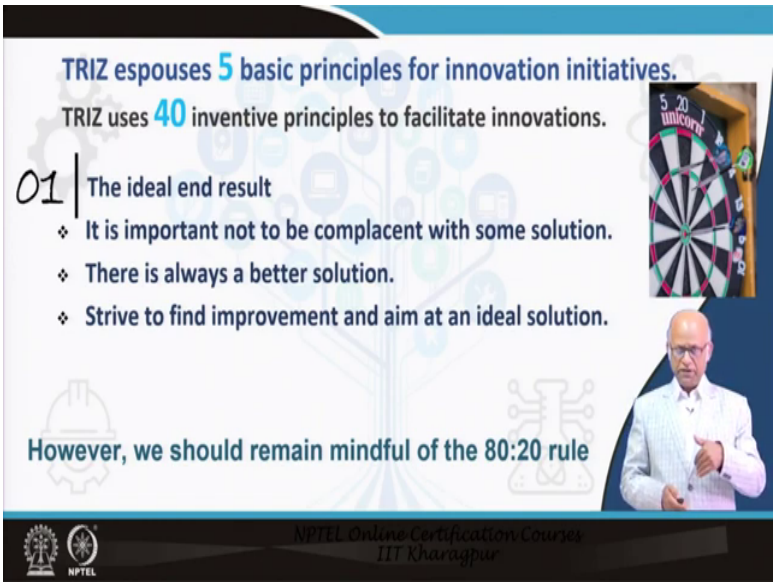


So, these two messages are very prominent this wonderful cartoon, I have the full reference given in another slide. So, you can see there is a wonderful slide share presentation also this is kind of wonderful I could not give lot many ideas that are contained there because of shortage of time, shortage of time means my presentation should be done in half an hour. TRIZ espouses 5 basic principles. And the first principle is that there is always a chance to improve do not settle just with the first solution, second solution or third solution, know for a fact that there is always a better solution.

So, a strived continuously to find a better solution of course, one should remind remember the 80-20 rule. Meaning that you should not spend years on to find the best solution. If you have almost like a 80 percent perfection, that should be with it you should go ahead and go to a market give it to the customer let them start using getting the benefit and then gradually you

add perfection, that is number 1. But then getting that 80 percent is a kind of a debatable issue like whatever you got at the first place you might think that this is 80 percent.

Whereas, perhaps you try some something more perhaps you get a far better form of the same technology.

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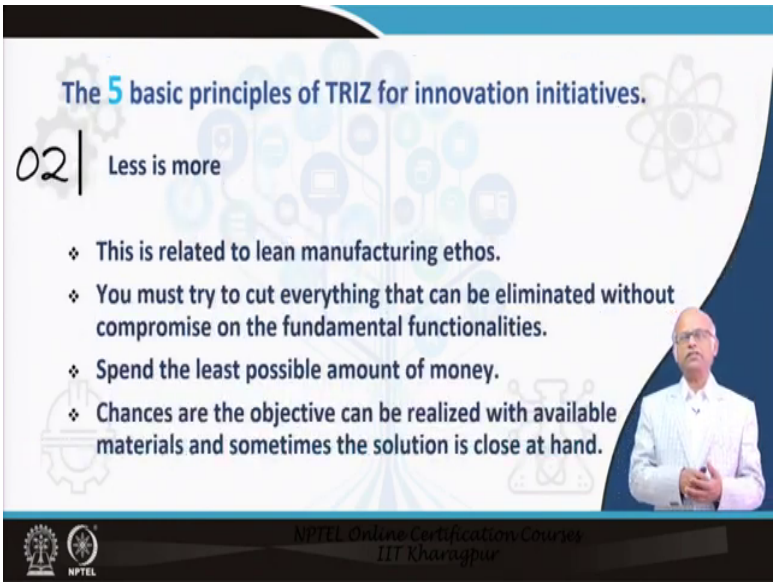


So, try for betterment of the existing framework, whatever you have. The second is less is more, this is a lean philosophy. Meaning that there is always a possibility that you can cut corners and then cut cost do it faster. So, cut time and then use less people, so cut resources as well.

So, you can do perhaps more with less try to do more with less, a spend the least possible amount of money the least possible amount of time and try to do as fast as possible. Then

your technology will not lose relevance and you will be able to exploit it for full market potential.

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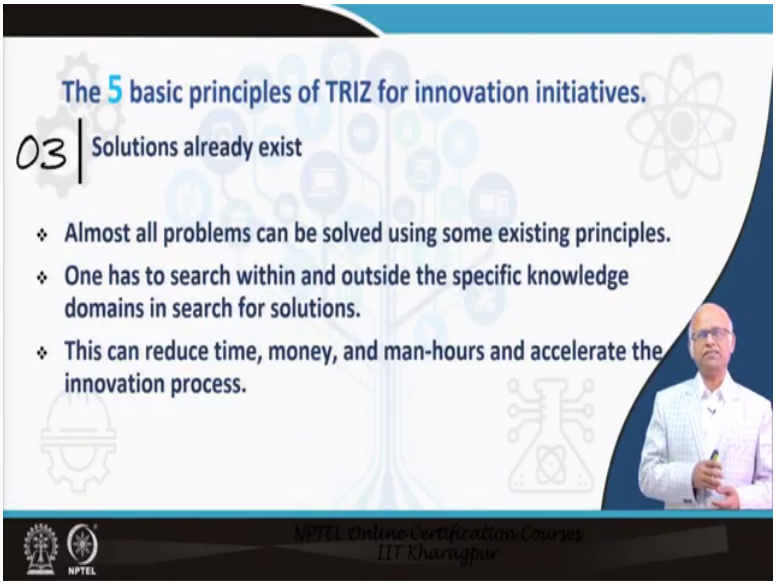


Third and the most important philosophy of TRIZ, is that solution already exists. Whatever problem you have 98 percent chance is that the solution already exists. You have to find it, you have to shift through all the 40 inventive principles that all should hallshawlder propounded and then see the 39 contradictions you will arrive at you will converse on the exact inventive principles that you need to find this solution. This can this can first of all eliminate just casual invention you just keep on inventing something and then to realize that this is not going to work, and then it may take years together to come up with an invention.

Whereas, here it just a matter of, matter of a few minutes of time. Use the software that is available and come up with the succinct inventive principle that is necessary. Then you keep on becoming creative and come up with inventive more inventive ideas.

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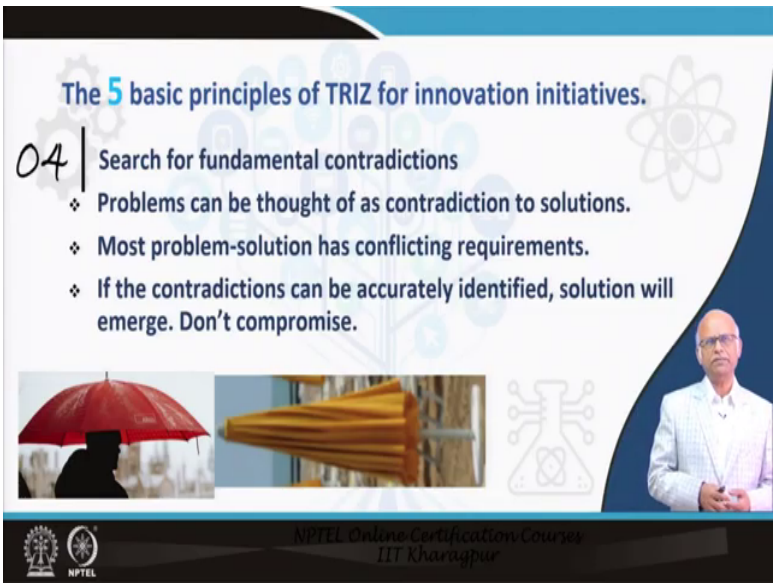


So, then only idea should germinate based on those domains, will come to that very quickly. And the 4 th is search for fundamental contradictions. Meaning that if you designing something you find a solution and you will start building on that rather than doing that you try to find if this is the solution then what is the contradiction. If I am trying to adopt this as a solution, then what is going to crop up as a disadvantage, disadvantage and advantage together gives a contradiction.

Using the contradiction, you are going to find the inventive principles, we are coming to that.

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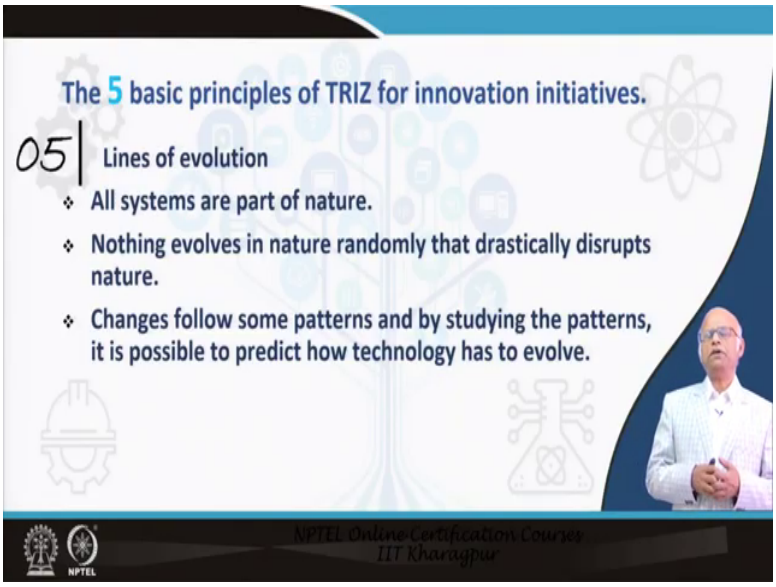


The last one is, line of evolution. Meaning that everything in nature or we are part of nature, nature is a system we are part of the system. Nothing in the nature come just like that, it evolves. Maybe its a part of the theory of evolution. So, anything that you see evolves through a natural a linear way, is not nothing happens drastically. So, you have to think or think linearly extrapolate from backward and forecast the future has to what is the future technology. You will be able to identify the future technology through this process.

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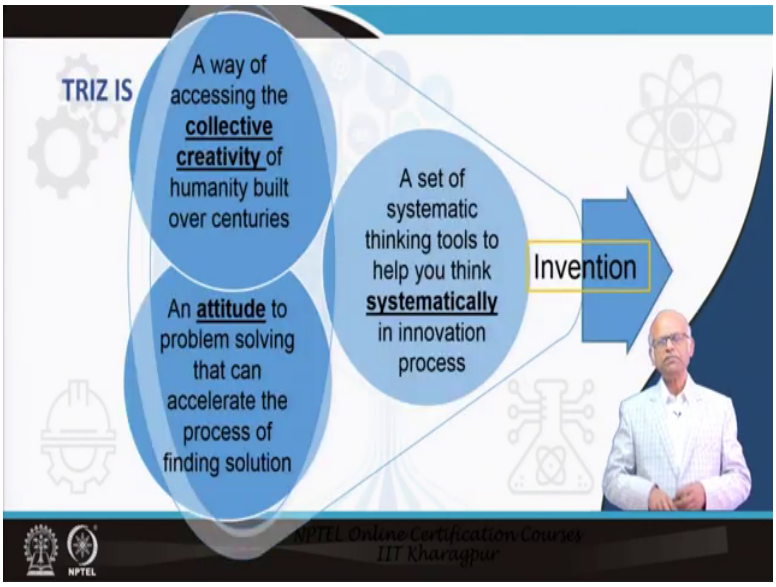


TRIZ therefore, is a collective wisdom. Collective, creative pursuits that human kind has made so, far starting from times time antiquity. So, for whatever they have done everything is documented. So, use that reservoir, reservoir of knowledge to make new invention have the attitude of solving problem like never be satisfied never become plus end that ok, I have got a solution this is the final.

Only then you can accelerate, and then think systematically you have a reservoir of knowledge, how to use or how to identify the nuggets of intelligence or knowledge that you need to solve a particular problem from an ocean of or a reservoir equivalent to an ocean of knowledge.

How to find that think systematically that what TRIZ actually provides and eventually you will be able to innovate that.

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This is the link for the cartoon and for a wonderful presentation, I am really fascinated about that presentation. And then there are other elements if somebody is interested to read more about learn, more about supplement knowledge about this can refer to that.

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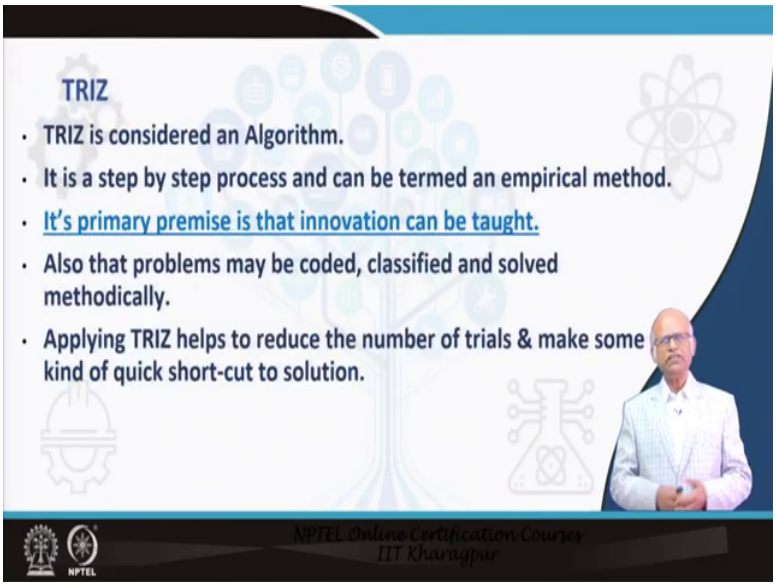


TRIZ is considered as an algorithm, we will see that TRIZ is a step by step process. That is why it is considered as an algorithm and empirical method. It is a step by step process and can be termed as an empirical method, its primary premises that this is most important, innovation can be taught.

TRIZ eliminates uncertainty, TRIZ restrict or limit the requirement of out of the box thinking for innovation, but it does not eliminate altogether. TRIZ leads us to a certain place where we need to invent, but it eliminates a long path and retains only a small part, where we should use our creativity and come up with ground breaking innovation.

So, because it reduces that long path, it eliminates or it reduces time, it reduces number of trial because walking that distance would lead to many trials, many mistakes, many change of strategy etcetera many surprises.

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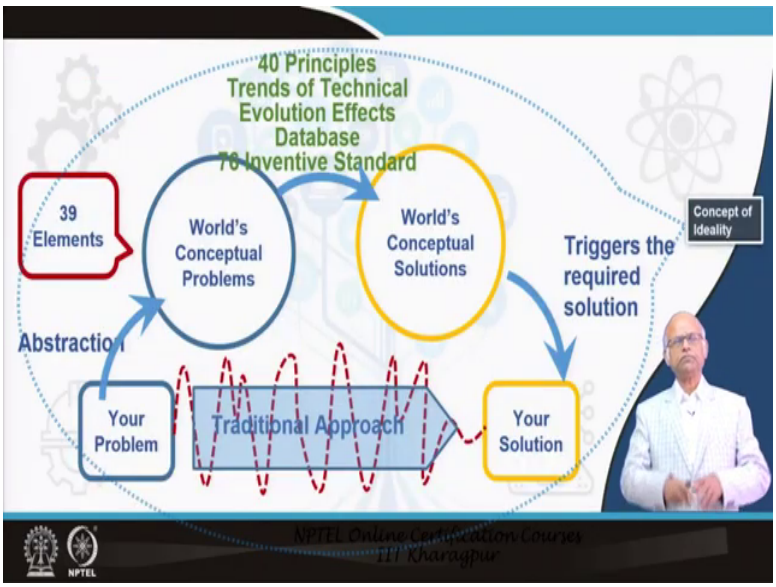


Another thing is that, another means another way of understanding TRIZ is like this, you have a problem. Now the world has a huge reservoir of knowledge, a generalized reservoir of knowledge. You have a very specific problem now this problem you identify out of that reservoir of generalized knowledge as to a what can be a specific solution for your problem.

So, you get a specific solution for your specific problem from a generalized reservoir and that is how your solution comes. If you do not apply TRIZ then the path will be tortuous you will

have ups and downs you will have many failures on the way and the time requirement is going to be far along we will show it with two examples.

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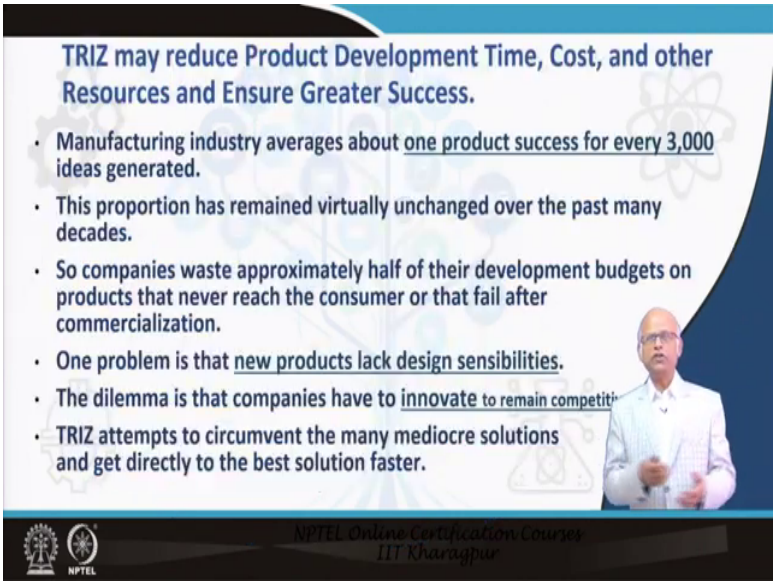


TRIZ may reduce product development time, cost and other resources, I will not tell much on that. Now the history tells or even data or empirical there are empirical evidences, that one out of 3000 product ideas only becomes successful and goes to market, goes to the customer.

Many actually leads lead to wastage of lot of resources and money, some products do not go after the market, some goals go after the market and fail. So, the huge colossal wastage of money resources time manpower and this is not just a new phenomenon, it has been there for decades. So, it is necessary to eliminate these number of failures. And then come directly to the point as to where the solution lies TRIZ actually takes us to that point that solution is here. Now we will start thinking and try to invent.

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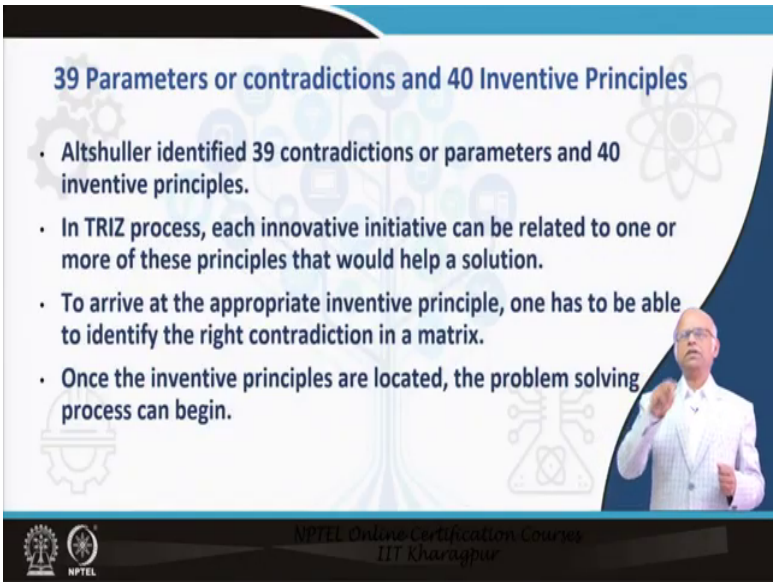


Now, the implementation part, TRIZ has or TRIZ recommends 39 parameters or contradictions. There is a matrix, on the horizontal side there are these 37 contradictions, on the vertical side there is this 39 contradiction is a matrix, same contradictions on the horizon on the horizontal side and same on the vertical side.

Now, you have to these parameters or contradiction contradictions meaning that there is one positive, another negative. One advantage, another disadvantage. So, identify an advantage of your solution or of your, right of your solution or proposed solution or desired solution. And then look for the disadvantage side of that.

Suppose, you want to build a furniture say a table or a chair, you need a strength, you need is to be you need this to be strong and you look around anywhere in this world, you will find that strength comes with wet, it becomes heavy. So, if you are looking for a strength is a

desired characteristic, heaviness is an undesired characteristics in some context. So, this is what is contradiction. Now, identify this desired characteristic and then that may be on the vertical side vertical, means horizontal side. Identify its disadvantage part on the vertical side.

Then you wherever they intersect you will find there is a formula hidden there. Using that formula you go to the 40 inventive principles and you will get to know how the solution is to be found out. So, once the inventive principles are located, the problem solving process actually starts.

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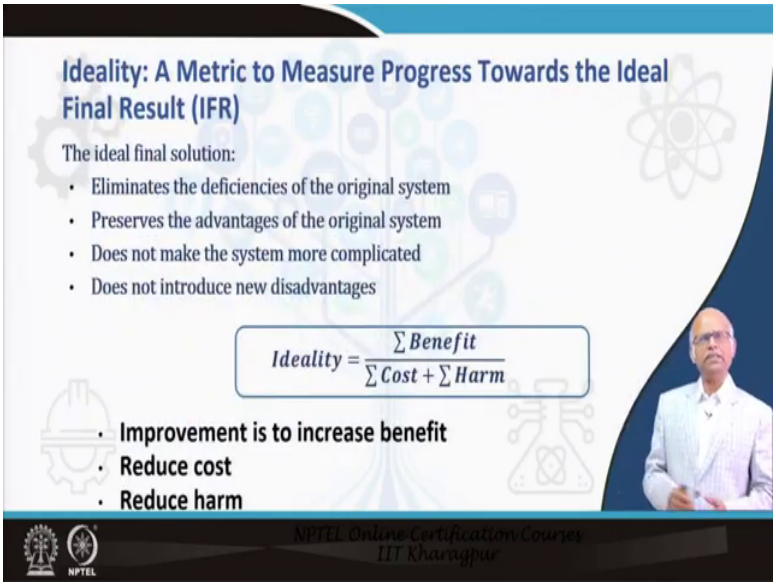


Before we go to the example, there is a wonderful philosophy or say a data or a metric that defines the goodness of a product or product market fit, that is called ideality or what you should necessarily target when you think of developing a new product.

You should target to improve ideality, the formula for ideality is like this the numerator is the sum total of the benefit benefits that you are trying to incorporate in the product or service, the numerator. The denominator is the sum total of the cost and the sum total of the harm that you are causing because you are trying to give this advantages in this product. As we know already that advantages comes advantages come with disadvantages.

So, there is a conflict or contradiction. So, numerator is the sum total of the benefits, denominator is a sum total of the additional cost and additional harm that we are going to incorporate by trying to find incorporate these benefits into this product. So, this is the conflict benefits and cost and harm.

Now our target should be to increase the benefit, then ideality goes up or reduced cost ideality goes up reduce harm ideality goes up. So, improvement is to increase the benefit reduce the cost reduce the harm. So, try not to increase any kind of disadvantage, try to improve on the original system the advantage the ease the efficacy etcetera.

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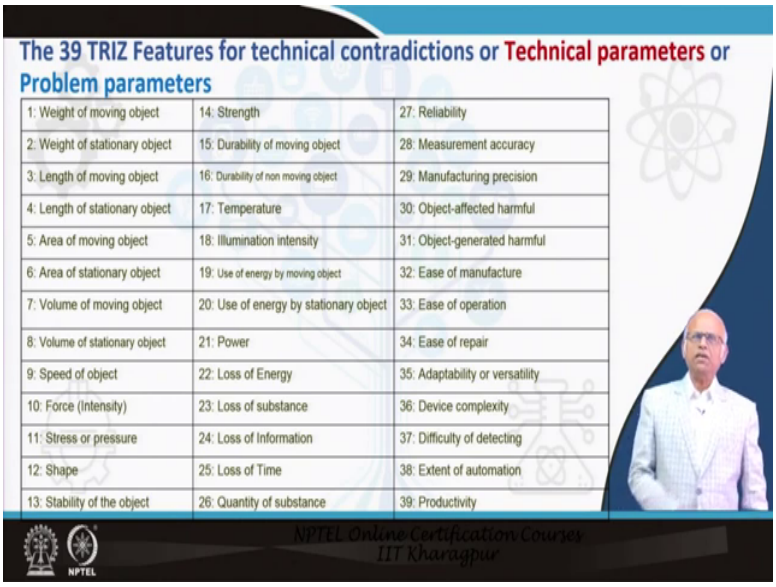


Now, this is a list of 39 contradiction. It is not represented like this, it is just to make the lists very difficult to put the list horizontally and vertically. So, these are sometimes referred to as contradictions, sometimes technical parameters, sometime problem parameters.

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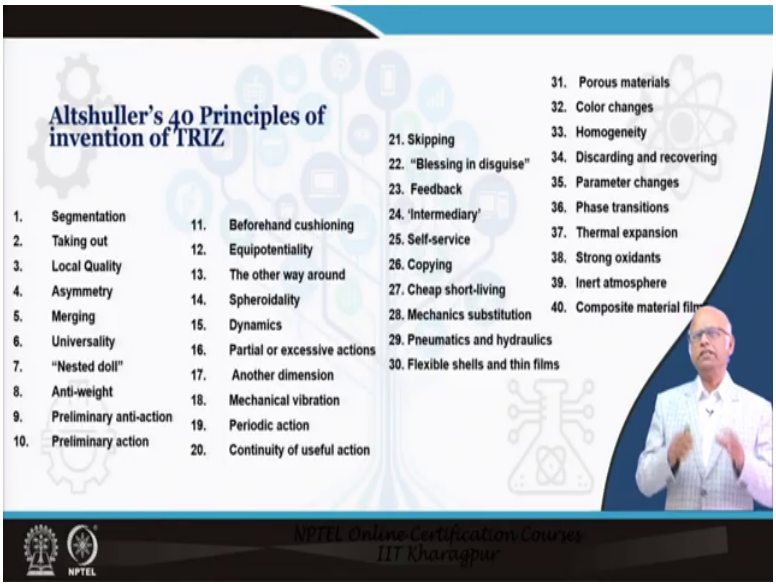


And these are the 40 inventive principles. So, we will come to that 40 inventive principles remain like a chart. So, we well come to that.

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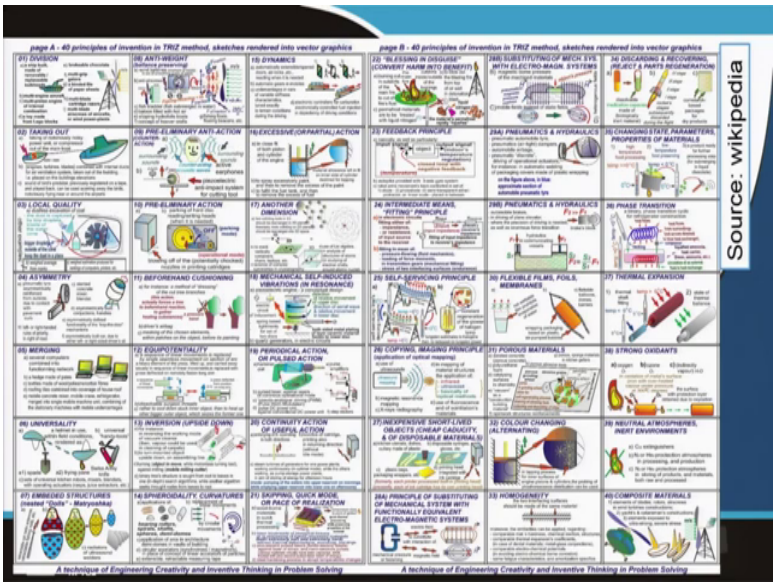


This is how the forty inventive principles are shown this has been taken from Wikipedia and its very difficult even to read, so, I have a small close up.

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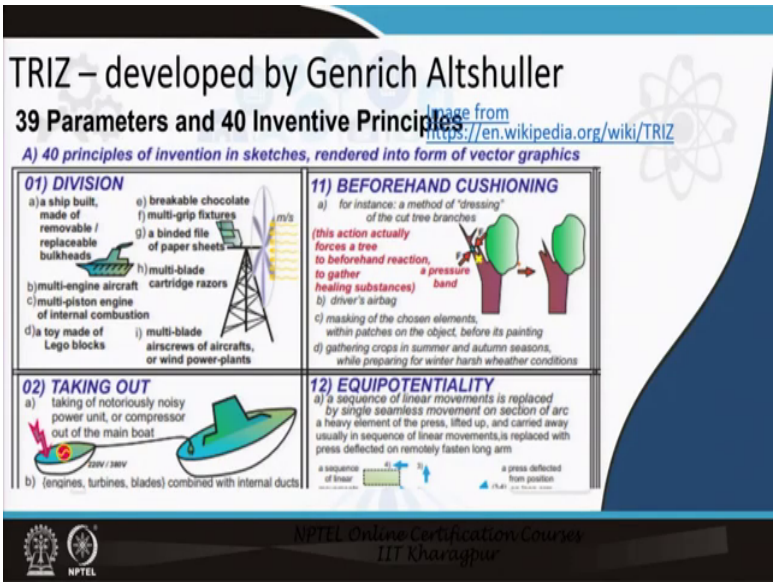


So, number 1 is division, number 2 is taking out. This these perspect is it not make lot of sense, but if you go inside the way researchers have incorporated several sub headings or several possible solutions, those are very important and those are going to give us clue as to how to innovate or how to take a clue from here to find a solution.

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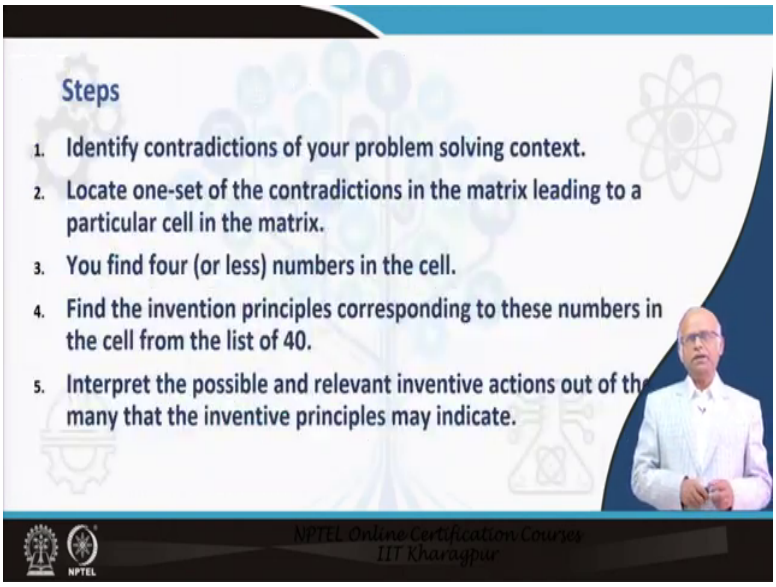


Let us see the a steps fast. There will be let me show the contradiction matrix this is the contradiction matrix.

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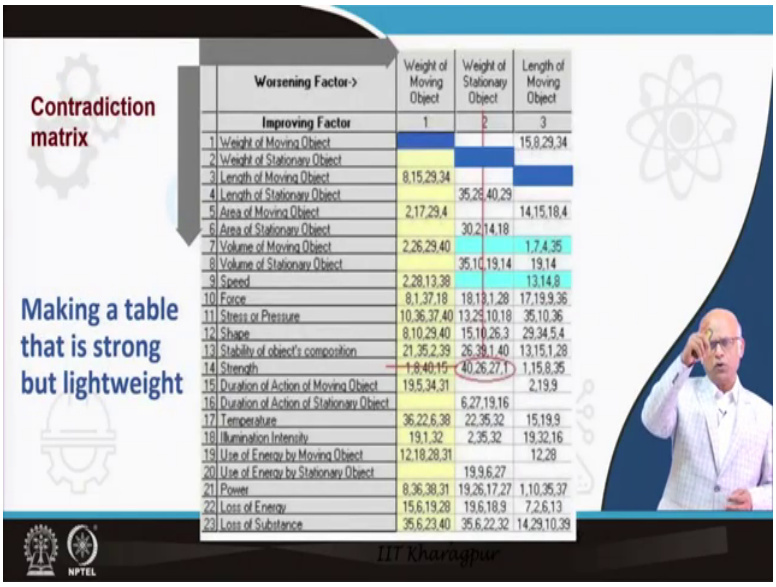


On the left this vertical one to 39 contradictions on the horizontal side of the top there are 39 contradictions, all 39 contradictions both horizontal and vertical. The steps are like this identify contradictions of your problem solving context. So, let us see here suppose you are thinking of building a table that is both strong at the same time it is light. So, what you do is, first of all you maybe you come to the horizontal side, say or vertical side whichever side. Say a strength and number fourteen you have the a strength you need a strength for the table.

So, you go to you travel horizontally, and then you go up at in at a column where you find weight of a stationary object this is in a stationary object and you see weight of a stationary object. Then you see that this two line intersect at a particular point its rounded here. So, there are three items in this, one is number 40, another is number 26, another is number 27 these

are the inventive principles. So, now, with these numbers you have to go to the 40 inventive principles to find a solution.

So, coming back locate one set of contradictions in the matrix like a strength and weight of a stationary object. Matrix leading to particular cell in the matrix find the invention principles corresponding to these numbers in the cell from the list of 40. Interpret the possible and relevant inventive actions out of the many that the inventive principles may indicate. So, if we are thinking of building a chair, building a table, now we have this 40, 26 and 27.

Now, if you if we go to go here you will find that number 40, has something like composite material; that means, composite material is something that is light and strong. So, we do not have to go much we have to see 26 and 27, but from here itself you get a clue that if we need a strength and if we need less weight, composite it is a material we can start with. Then you visit 26 and 27 you will find more features and you will find a solution.

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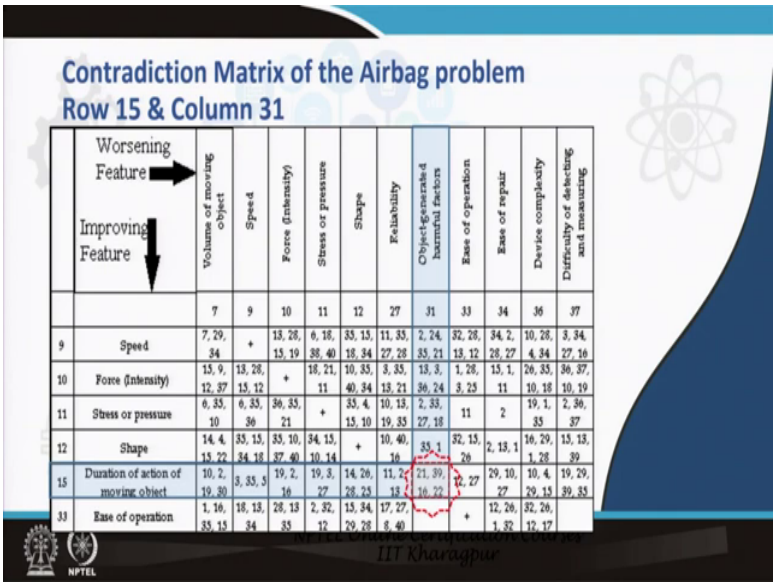


Here is a more complex context say you are thinking of designing a air bag, I have taken it because I personally met with an accident and air bag actually saved my life. So, take this air bag. Now, for air bag in a car when somebody hit the car with an object, then there is going to be a collision and a jerk, and the air bag will inflate that will prevent that person from hitting the dashboard or the steering wheel, and then it is going to save the life.

Now, there are contradiction. One is if the air bag comes very fast. Means is blows very fast and hit on your face, that itself may be that impact itself may be so big that perhaps some people may die of shock. At the same time if the impact is slow meaning that it comes slowly, in that case before the air bag will hit the person, the person will hit the steering wheel. So, there is no saving of life. So, either way you are kind of problem. So, there is a contradiction, if the speed is high then the impact is high. So, it is kind of its a bad thing.

Now, if the speed is low, it does not serve the purpose, so there is another contradiction. Now, look how TRIZ can help us to find this solution. So, on the vertical side, visit number 15. Here it says duration of action of moving object meaning that it should be fast, meaning duration should be less or more whatever it is our in our case duration should be less. So, duration is 15. Then you proceed and see what is the contradictory contradiction object generated, harmful factor meaning it is hitting the body and then you have the problem of meaning if it make cause harm to the body whereas, you want that it should not cause harm.

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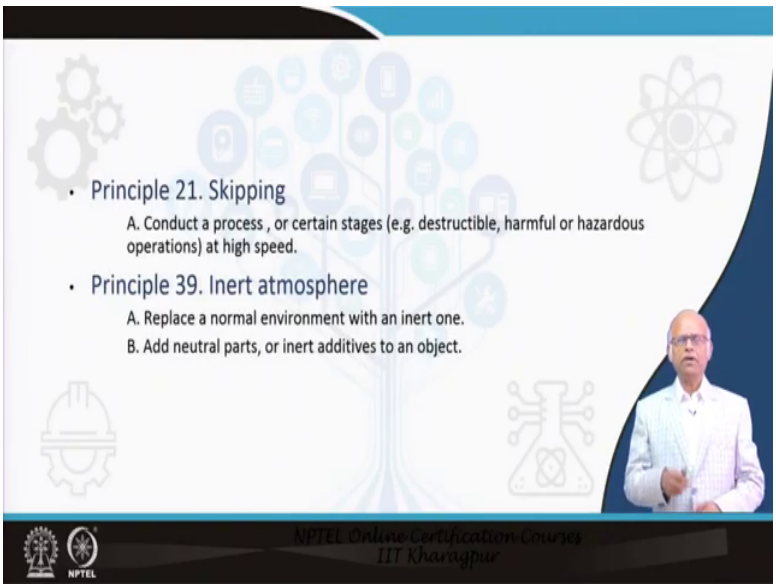


And look at the numbers, 21, 39, 16, 22. Let us see what is there, what are these inventive principles. Principle 21 is a skipping. Meaning the speed, meaning it is in it is suddenly a skip is suddenly coming at a fast-high speed. So, high speed is one thing that is one of the factors, but then we have other factors which together should give us a solution, inert atmosphere. Inert atmosphere is something like if something is causing harm you try to make the

atmosphere in a manner that its harmful effect is neutralized. Meaning add neutral parts or inert additive to an object. So, that harmful effect is neutralized.

Replace a normal environment with an inert meaning if something is causing some harm then try to add something. So, that this harm can be eliminated. What can we do that we what we can do is what or this actually is trying to hit hint on a like this. That this the cloth which makes the air bag can be so soft or can be corrugated or can be there can be multiple bags one coming at a slightly faster speed and where it coming slightly slower speed. So, that or maybe there are layers. So, one will hit and it will blast and body will have some impact, but then there is another

So, gradually your body impacts on layers and it get burst and gradually, gradually the impact is neutralized something like that.

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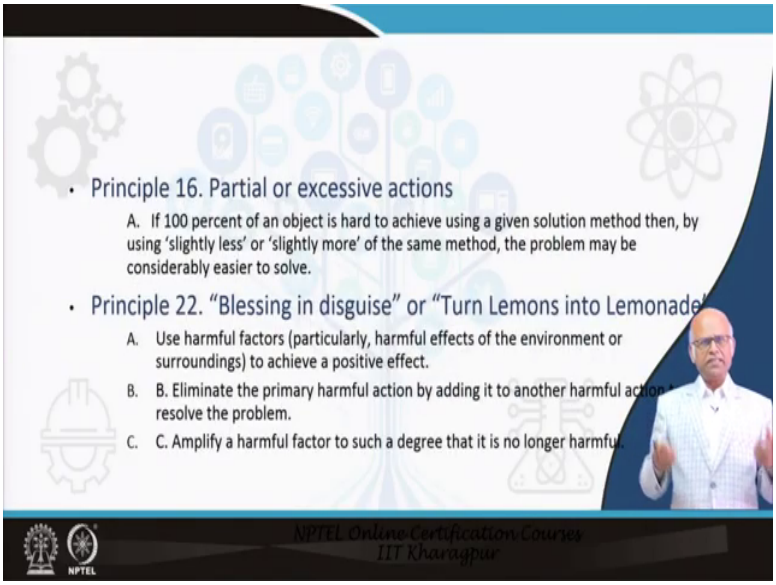

So, it gives. So, many clues this 39. Then 16 is partial or excessive action. Partial means can we think of air bag, that will blow. so, hard so, fast that the body before leaning forward will hit the airbag. So, there will be no impact at all because the moment car will impact there is some inertia. So, before the body actually tries to move forward the air bag comes in. So, the exact collision is less that is called excessive action or maybe partial..

Partial how maybe there may be some several layers, so part impact will be taken care of by layers, blessings in disguise. Sometimes, sometimes negative actions can be used to create some wealth. Like say there is a waste heat you can use it for generating power, here blessing in disguise maybe you can amplify harmful effect to some degree. So, either this impact meaning the impact with which the bill the air bag is coming.

Perhaps by increasing by speed perhaps you can neutralize the effect of the impact. So, we have to really go deeper inside as to what nowadays there are software's, where you just hit the button 22 you will get all possible solutions and you will get hint as to what should be utilized.

Eventually out of this four inventive principles its  easy to really come up with or to narrow down your domain of thought. Now you be creative and then find out the solution it becomes easy that is what expert says professionals says consultant says all are saying the same thing.

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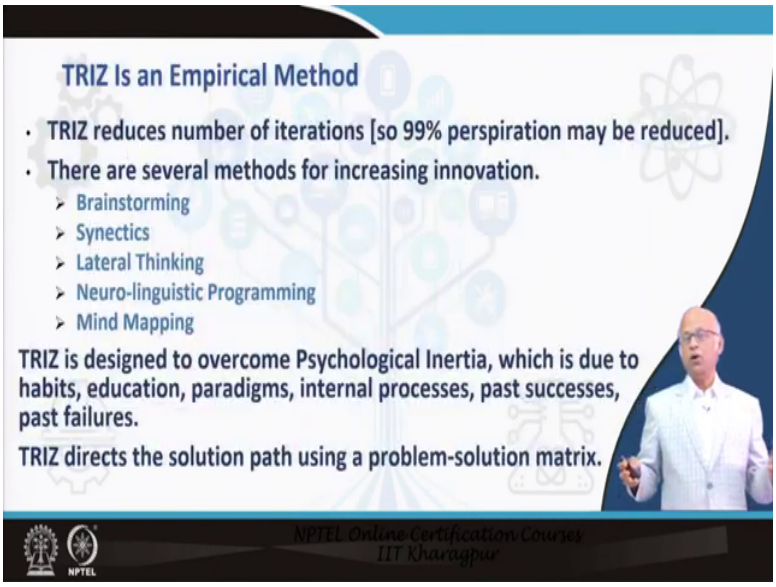


If TRIZ is not there then you have to go through the linear process normal process like brainstorming like synectic's that we have discussed lateral thinking that is a kind of a orthogonal thinking, not thinking in a straight line or not thinking in a straight line thinking vertically. Then Neuro Linguistic Programming NLP or mind mapping like a graphical representation of mind by of a team or members of the team.

There are other alternatives which are kind of proven to be complex and you come up with. So, many alternatives that it becomes tedious time consuming and costly.

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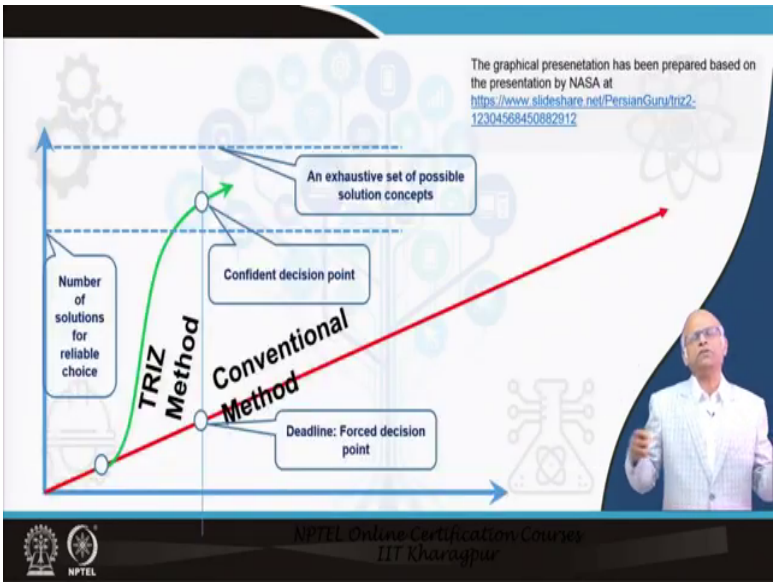


Therefore, the people suggest that TRIZ method gives you a huge leverage and within short period of time you are reaching at a point where using conventional method you may not reach anytime.

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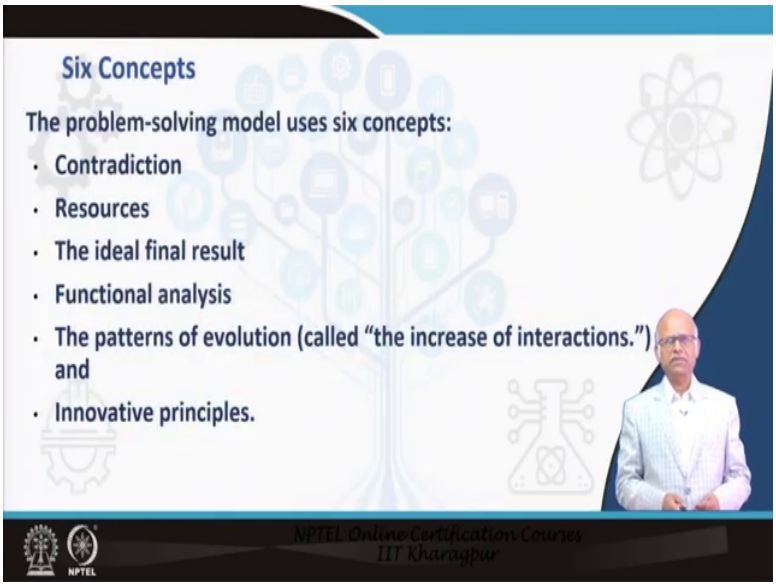

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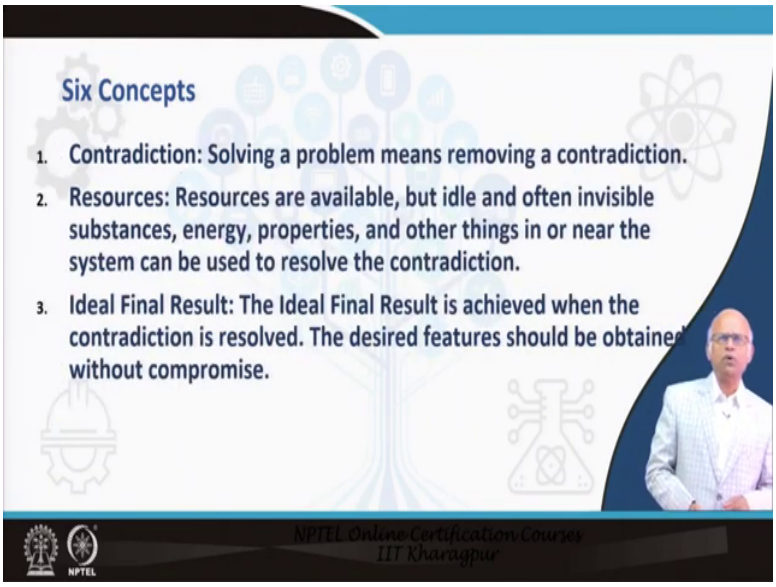


Now, there are six more concept its not means its almost like discussed. So, I will just not spend a lot of time on this. Contradiction we have discussed resources meaning that you should look around you resources are everywhere, so do not look far away. Ideal final result meaning that you should not compromise or come be plus complex (Refer Time: 32:36).

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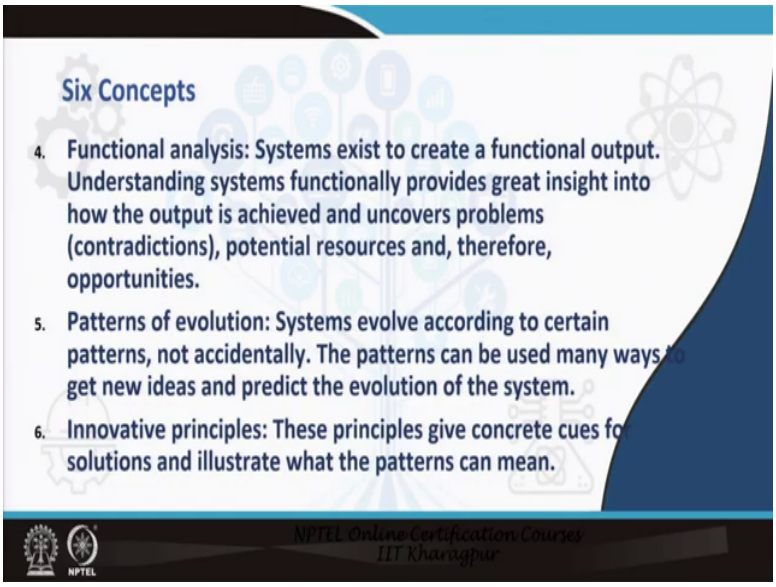


Then function functionality analysis. Systems exist to create functional output understanding system meaning understanding your environment is very important pattern of evolution like as I said technology has been evolving in a straight line almost like in a straight line its a natural process.

So, we can forecast what should be our next action then there are innovative principles.

Thank you very much.