Advanced Green Manufacturing Systems
**Prof. Deepu Philip**
Dr. Amandeep Singh Oberoi
Department of Industrial & Management Engineering
Department of Mechanical Engineering
Indian Institute of Technology, Kanpur

Lecture - 15
Creativity Techniques

Good morning. Welcome back to the course on Advanced Green Manufacturing Systems. We had seen what is value engineering green plan in the last 2 weeks. So, in this week I let you talk on creativity techniques which I said I have a lecture on this and will also see the concept of Fugal Innovation which is a kind of creative inventions or creative or innovative ideas those have ledge to the green products and one session will have on QFD Quality Function Deployment. We will see how is QFD conducted and how various phases of QFD progress is and how can we bring QFD in green manufacturing systems

So, this session I will focus on creativity techniques.

(Refer Slide Time: 01:07)
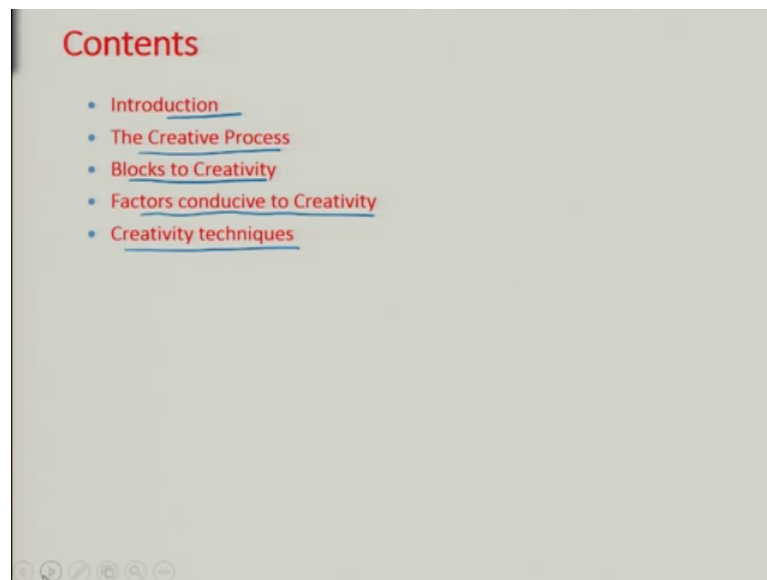
Contents will go like this. I will just introduce what is creativity, the process of creativity, then will see the blocks to creativity, why people are not creative or people do not practice creative exercises, then factors conducive to creativity are important to discuss, then will discuss some creativity techniques.

Now, why is creativity important? Because we are talking about Green Manufacturing Systems as we have seen in value engineering that creativity helps us to develop the ideas which are not even in the mind of the production manager because they are all work on the proved facts. What an engineer think of there is a process, they are materials a b c, their process is 1 2 3, their products x y z.

So, let me combine materials a and b with using and using processes 2 and 3 and get a material y, get a product y, ok. This is the mindset generally, ok. This is I have to produce something. After produce this bangle, iron bangle how can it be produced? I can produce pipe. We have to cut that. The only there certain set of the ideas which are in the mind, but sometimes the people who are working in a shop flow, there are certain ways to get them involved in the idea stimulation.

So, in this case we can encourage creativity and there are certain examples where the employees or the people who are not in production have helped or have given the ideas which have produced the tremendous results in the terms of cost production, in the terms of productivity improvement and in the terms of having green products.
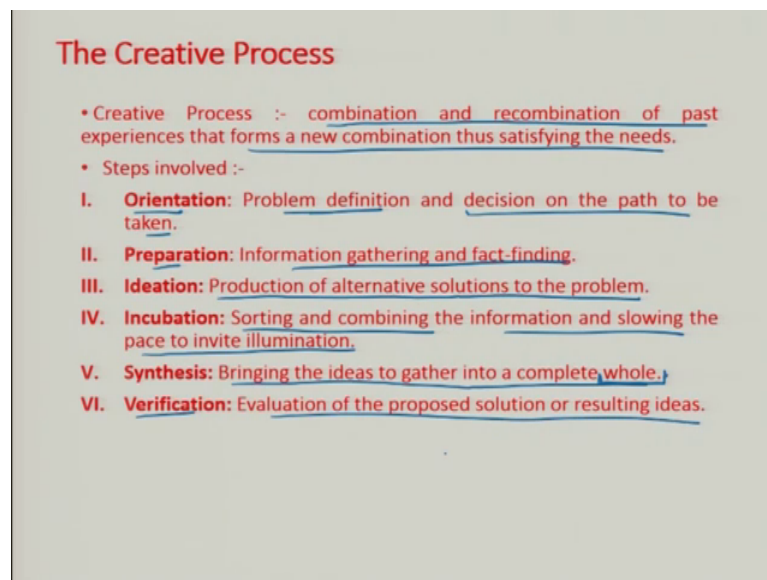
(Refer Slide Time: 03:04)

So, let me introduce creativity. The most unique phase in value analysis or value engineering program is creativity phase. Why is it unique? It can be defined as a development of ideas that are new to individual which lead to the dis creativity of alternative designs methods systems processes that will help us to complete the basic

function at the minimum cost because new ideas come. So, an idea of function by using creativity is called a root of value engineering, Ok. We think of the function. Let us try to compress this function using some creative techniques, then the ideas are generated.

Two general approach is to problem solving are Analytical approach and Creative approach that is analytical approach. The aim of analytical approach reach is the final solution through which standard step by step or a systematic procedure whereas, in creative approach idea generating ability of the problem solver and his ability to embark on the best out of a number of possible solutions is emphasized.

This is the general cost reduction that we discussed about, Ok. This is step by step and this is number of solutions generated and then, these are the ideas number of solution generated, then it is smaller solutions possible, ok. Then we finally come up into a one solution this was creativity phase in value engineering, this was our 2nd I can say evaluation phase and this one can be said as our implementation phase or development phase finally one is implementation.

(Refer Slide Time: 05:26)

Now, the creative process. The creative process combination and recombinations are past experience is that form a new combination thus satisfying the needs. So, this is creative process. So, how do we start working on the creative process? Very first step is orientation. The problem definition and decision of the path to be taken, it has to be given to the people who are participating in the creative process, then preparation

information gathering and fact finding. I will just discuss various creative techniques like brain storming, Delphi technique, then attribute listing. So, the very first thing is we have the orientation the problem definition.

What is the problem definition? Sometimes I will show you the techniques in which we do not even show or do not even disclose what is the actual problem, Ok. We just say we need something to sit like the design of chair. We do not say we need to design a chair. Finally we would come up with a design of a chair within the mind of the manager or the facilitator or the leader who is conducting the creative session, but the problem definition can be in direct or indirect, but we need to see the ideas. Those would help us to develop the final desired product.

So, then is ideation production of alternative solutions to the problem, then incubation sorting and combining the information and showing the pace to invite illumination, Ok. This is the same thing which I am telling here. So, these are the steps we are going on, Ok. This is step, these are the steps for creativity. Now, then synthesis bringing the ideas to gather into a complete whole. So, as the ideas which are sometimes you get a number of ideas. We do not discourage or we actually encourage the idea generation. So, whenever the idea is coming, we do not just this idea is not acceptable.

For instance when I say designing a chair, someone can say let us put some stones or stack, certain cottons and let us sit on that ok. Let us stack some boxes and let us sit on that. That idea does not seem very good in an office ok, but we do not discourage ok. This is the idea. Sometimes the ideas come, sometimes we have to just record the ideas and the first let me say 60 percent of ideas we say these are not feasible, these are not preliminary feasibility is not there. The 40 percent of ideas we take into account, but ideas are always encouraged.

So, then after bringing the ideas to gather complete whole, complete to a whole means we think of what is the final product, then start taking the ideas into consideration then and verification the valuation of the proposed solution of resulting ideas.

(Refer Slide Time: 08:18)
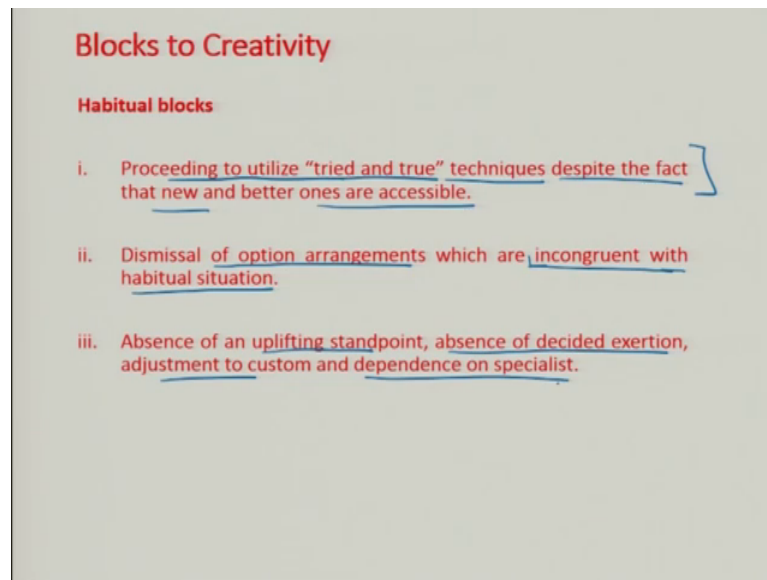
So, this is the general creative process. Then blocks to creativity, blocks to creativity - habitual blocks the certain blocks to creativity we generally think or an engineer thinks it has to be a systematic way to do the work. We cannot just think out of box. If they even do something, they are much concerned about the risks those are involved. Yes in the sort term there might be some risks, but encouraging creativity has proved to have the better results in the long term in the overall design of the firm.

I will tell you a story. My friends kid who is around 5 years old, he was my friend was going to purchase a speaker for his mobile phone and his kid was playing with a paper. He just turned the paper into a conical form, truncated it from the one side and the cone become his just produce just producing his own voices.

The kid was playing like that. So, when he learned that his father is trying to buy a speaker he had already identified that when the sound passes through a conical shape, the sound amplifies. What he did he put his father's mobile into the end of the conical horn that he has made though the bamboo speakers and they I show you the green products green speakers those are available in the market which this was something that went to the mind and my friend said he did not buy the speakers because his room was small. It was around 8 feet by 8 feet. The area room 8 feet by 8 feet 10 feet may be and that size speaker worked in that room.

So, sometimes the certain habits those we trust in we proceed or we utilize it ideas we tried and true the techniques which tried and true in spite the fact that new and better ones are accessible, Ok. Sometimes this happen then dismissal of option arrangement which are incongruent with habitual situation the certain this was you know these papers and cones are already listed in his own, but he just dismissed them ok.

We need to buy a speaker. I have to spend around 500 to 1000 rupees to buy a speaker for my home, this room and he did not think of how loud speaker does he need, ok. Room speaker is there the certain range of products which are available online, but that idea was incongruent, but that worked with him.

Then absence of when uplifting standpoint, absence of decided exertion adjustment to custom and dependence on specialist are certain habitual blocks, we sometimes think of a specialist would only work any manufacturing concern one just thinks ok. We need to design something and we put we need to depend up on the computer aided designer the person who is a well converse with all kinds of curve which are in CAD2 CAD3 D curves all the kinds of free form all those things.

(Refer Slide Time: 11:25)
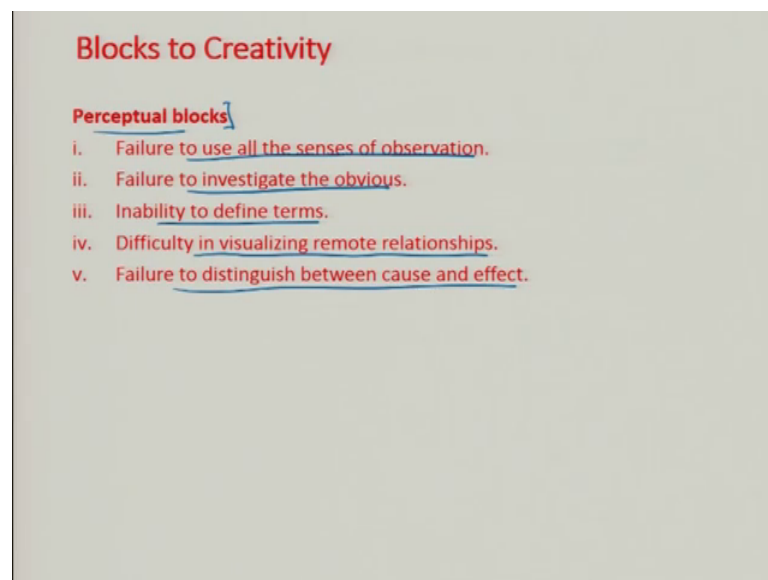
So, next comes perceptual blocks. Certain perceptions that the senses our failure to use all the senses of observations, what senses do we have? We can hear, we can see, we can smell, taste, sometimes we perceptual process is such that we do not use all the senses and we fail to use all the senses failure to investigate the obvious.

We cannot investigate the obvious. Sometimes this perceptual blocks hinders the creativity process that inability to find terms, then difficulty in visualizing remote relationship which are not visible directly, the failure to distinguish between cause and effect. Sometimes this is a perceptual block. Now, emotions and behavior and organization and interpretation of the perceptual blocks is sometimes difficult.

(Refer Slide Time: 12:26)
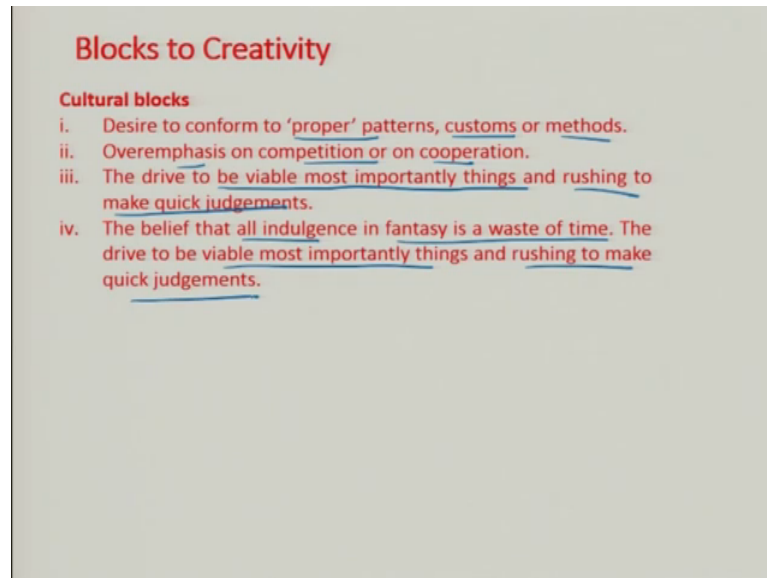
Next is cultural block. Some cultural thinking also sometimes blocks creativity desire to conform to proper patterns, customs or methods overemphasis on competition or on cooperation. This is sometimes the cultural block. So, cultural awareness or cultural knowledge or cultural skills, all those things are there. Sometimes cultural desire is there, but having confidence and faith only in regional logic sometimes hinders creativity, the drive to be viable most importantly things and rushing to make quick judgments. So, these sometimes are cultural blocks. The belief that all indulgence in fantasy is waste of time, the drive to be viable most importantly things and rushing to make quick judgments. So, these are cultural blocks.

(Refer Slide Time: 13:20)

So, emotional blocks similar to cultural blocks we can have emotional blocks. Emotional blocks are sometimes fear of making a mistake or of appearing foolish ok. Risk sometimes this kind of emotional block is there. There is situation in fear of supervisors who do not encourage creativity or colleagues or subordinate distrust over motivation to succeed quickly, refusal to take any reroute in achieving an objective, failure to dismiss choices which are satisfactory yet which are clearly sub ideal. Sometimes these emotional blocks also blocks creativity.

(Refer Slide Time: 14:00)

Next is Factors Conducive to Creativity. The problem sensitivity being mindful that an issue exists this is important. This is the factor this is conducive to creativity, ok. Then idea of fluency being ready to create a lot of thoughts, you know most of the people are not even able to generate the ideas. If I say let us come up with 3 words 3 words which are very random ok, then pick the 2nd word come up with another 3 words, a word have to be very random.

Sometimes this fluency of idea the people who are creative they can only come up with the ideas. The people who are I will show you how creativity depends upon age. If this is the creativity I would say the creative potential and now this I will have age you know how creativity works. It starts from here and it is something like this and what is this age that which the creativity age. What do you think what should be this age ? 10 years 12 years your age 20 years 30 years, this is 4 to 5 years.

4 to 5 years, then what do we have ? Why do we started becoming less creative? Because we get to have a formal education which is very important this is formal education, ok. After this with work experience and all those things whatever we think the creativity starts decreasing, this is work experience. Now, creativity training which I am trying to emphasis in this lecture what would creativity training or creativity techniques help us to achieve?

Now, if one conducts a creativity training or creativity sessions to stimulate the ideas, so these are this is something that comes, these many ideas are creative, these many ideas and these many ideas are judicial. This is how creativity depends upon age and the fluency of ideas is not every ones cup of tea, ok. Fluency of ideas comes with training at this point. In general this is a general chart. Sometimes there are people who are very creative at the older age and such an exception would always come, but this is a general trend which is identified by the research. I have read it somewhere.

Next is Flexibility. Flexibility is a factor that is conducive to creativity, open, disapproved and versatile in a way to deal with an issue. This is flexibility. Now, originality the capacity to deliver an incredible number of new and one of a kind thoughts. Originality is the idea is that idea that is really original something I have seen somewhere something. Sometimes what happens I will show you an example here?

(Refer Slide Time: 17:26)
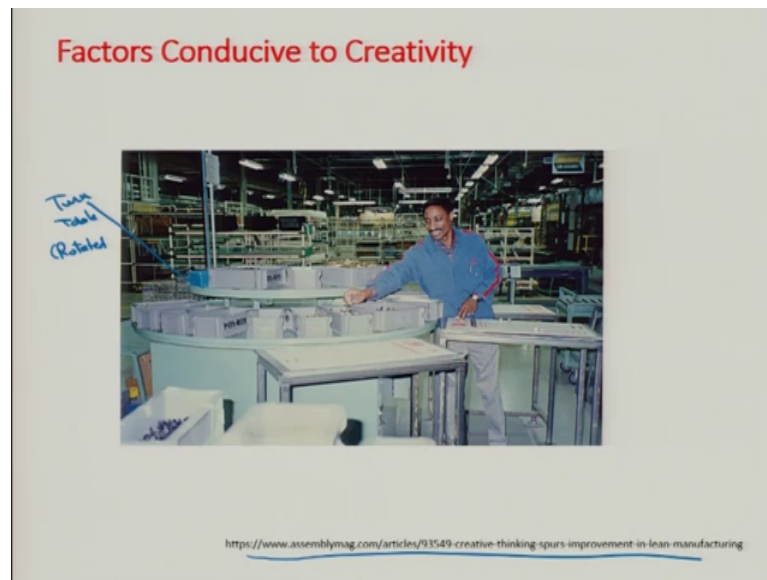
This is the assembly, this is the turn table. I have read this example on this link how creativity thinking spurs improvement in lean manufacturing. Now, what happened there was this was a company who were they concerned with the assembly and disassembly process. There are certain components which are there they encourage creativity and one of their employees came up with the idea.

They said that in Chinese restaurant they washed a plate in the center of the table and other single have been rotated all other foods, all other dessert orders rotated. There was one chosen at the center that idea they implemented which was given by an employee. Please note idea was given by an employee who is not even concerned with the production. He only said put this put this thing that was there in Chinese restaurant could this work in here.

Yes they established turn table which can be rotated and these employees can pick the nuts and bolts and all the components for assembling or disassembling. So, this was the inspiration that we have got. They could not design these if they had not encouraged creativity, ok. So, this is one of the examples that originality of the ideas do come then constructive discontent a disappointment with the existing conditions with a disposition of mind which looks to enhance the conditions. This sort of individual normally inquires as to why and how these are the questions that one asks.

(Refer Slide Time: 19:10)

Now, other factors are Observation-one has to be aware or alert to the environment what is happening. Facility at combination-the capacity to join and recombine data in an assortment of ways in a number of ways in orientation development of the best possible attitude towards imagination, the motivation-the summoning of the essential vitality to work towards an objective and accomplishing it. Then permissive atmosphere-this has to be provided by the upper management an environment in which new thoughts are empowered. These are the factors those are conducive to creativity.

(Refer Slide Time: 19:50)

Now, Creativity Techniques I will discuss a certain ground rules. In creativity techniques, generation of new ideas and their judgment should not be simultaneous because if we start judging something ok, this idea I could not say people would not just come up with the ideas ok. So, this has not to be simultaneous if we are coming with the ideas and their judgment should not be simultaneous. They should be separated by time, space, people. If possible time is one day I just have creative session. If next week or the next after a few days I can have the judgment session do these ideas work or not space is then people can be I can have ideas from one set of person and the judgments from other set of person of for the feasibility of those ideas. So, they have to be separated, then possible solutions should be generated in a large quantity.

First multiply the ideas produced by inspiration by 5 or even 10, ok. This one idea we need to stack something and sit on a in an office, what do we need to stack, what can we do ok? Can we have one can come ok? I will just show you attribute list. Attribute this thing is getting deeper into one idea. There is a this one idea stack sitting in an office, ok. There is one function sitting in an office, we need to produce chair stacking, stacking books, stacking boxes, stacking cushions ok. Now, stacking cushions for where would the cushions come from? Organic cloth from thermo coal sheets may be, ok. So, these attribute list is kept on going step by step 2. These are the ways we multiply the ideas by 5 and 10 and they kept on multiplying further, then seek a broad spectrum attack approach [noise, ok.

Broad spectrum is developed as I said this is a broad spectrum, then we converge and converge, then watch the opportunities to combine or improve ideas as they are generated ok. Only we are combining the ideas. We are not judging, then consider all possible ideas even apparently impractical. Do not ridicule them. Never eliminate any idea summarily.

Next is our first creativity technique which is brainstorming technique. You might all know what is brainstorming. You might have heard of it. Brainstorming is getting a number of ideas from a group of people without even considering what are the facts. Just coming up with the ideas that is all, but there is a way to conduct brainstorm properly. So, brainstorming technique in light of incitement of one individuals brain by the psyche of another. So, this is brainstorming. The normal gathering comprises of 4 to 6 individuals lounging around a table and precipitously creating thoughts intended to tackle a particular issue.

Rules to be followed in brainstorming- criticism is ruled out, freewheeling is welcome, any number of ideas is welcome and desirable combination and improvement are sought. There are certain rule, ground rule that we have discussed. Those are the same rules. Brainstorming technique what does this all involve?

So, how do we conduct brainstorming? First is define the issue. When you are meant to brainstorm something, the first thing you need to do is to understand the definition of what you are brainstorming. Once you come up with the definition of what you are brainstorming, make sure you confirm your definition with something to sit. Something to sit, can we sit on the floor? You need to just confirm something to sit comfortably that has to be at height of a normal chair. Those definition as to be there and that needs to be confirmed as well.

If you are brainstorming during a consulting case interview, confirm your definition with the interviewer because if you are brainstorming as a part of strategy engagement, confirm your definition with your colleagues and if your interviewer is there it is it should not be that this mismatch between you and the person who is asking the questions in their thought person there should not be difference, ok.

The majority of candidates and consultants unaware of this step jump right into brainstorming without carefully considering the definition of the issue what happens sometimes this not the clarity of the question sometimes they say I need to develop a furniture out of the biodegradable material and if I say such as bamboo such as bamboo sticks into the mind of the person who has heard my definition sometimes may be he might just come up with the bamboo, various designs made up of bamboo and all those things and he does not even think of the other biodegradable or the green materials.

So, we have one has to clarify what is the question ok. That verification has to happen. So, these people who just jumped brainstorming is usually have a vague idea of what the definition is, but not much thought goes into defining the issue. So, definition is important.

(Refer Slide Time: 25:34)

Then build a decision tree. If you cannot write down or visualize the decision tree, you are not brainstorming. Decision tree is this is the idea where each idea this is something coming ok. This we are diverging, then we can even convert for the this is the decision tree you can read this theory. We can share you the links to that. So, decision are to be put on a paper. Decision tree has to be put on a paper. Key questions is then spilt into sub questions or drivers in a logical and in a methodical way.

So, once one is happy with the definition of the key questions then one is happy with definition of productivity, definition of designing a chair. The next step is build a decision tree, so that the key question is split the decision into d rivers on a logical methodical way, then those sub questions are further split into drivers of sub questions ok. Your brainstorming analogy is which usually not go further than a 4th level of a decision tree, ok. This is the level 1 2 3 4 ok. This specific idea this cannot go further. So, we continue with this analysis until we can prioritize the key drivers to move on to develop the hypothesis finally.
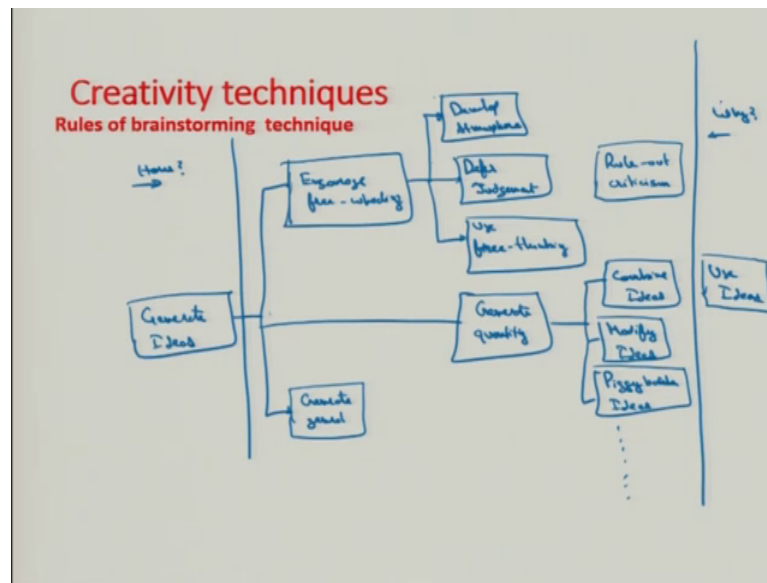
So, we can even develop like we had a fast diagram with how and why. Similarly we can say generate ideas as our highest pro-function highest pro function, then the first functions can be encourage freewheeling ok, then this is freewheeling, then generate general generate general is we are generating with general idea which are having some facts. This is freewheeling completely new. For this what we need to do? How do we generate freewheeling?

We develop an atmosphere freewheeling atmosphere, then we defer the judgment use free thinking ok. This is something linked here and here this is for these generate general ideas also. We can have large quantity of ideas as a 2nd level or generate large quantity. Quantity here means large quantity of ideas ok. This can connect here, then at the next level what we can have we rule out how do we do this. We rule out criticism, then we combine the ideas, then we modify ideas, then we sometimes piggy back or pick someone elses ideas, then different techniques can be used, similar techniques like brainstorming different techniques can be used.

So, this is something that is that come from here. Finally, we use idea or may be ideas which are generated. So, this is our scope here. How and this is why I think makes you more clear how do we conduct the brainstorming session, right.

(Refer Slide Time: 30:36)
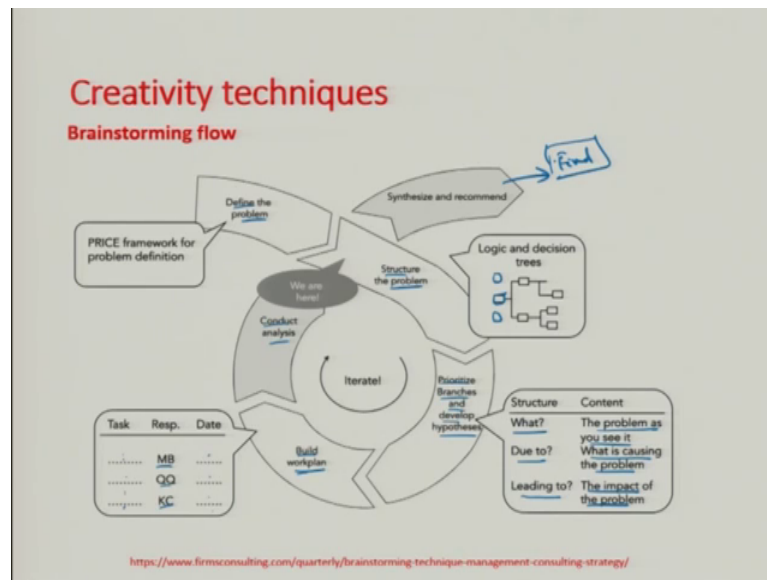
Now, brainstorming flow its the same one and same thing. We define the problem, we structure the problem, we provide branches and develop the hypothesis, then build the work plan, conduct analysis and then, again we structure the problem, keep on doing these. We have this kind of decision tree. I can say decisions tree can start from one problem definition we can even have multiple definition, sometimes in then we can confirm it or combine into one definition ok, then while prioritizing the branches we structure what to do, what the problem is as you see it due to what is causing the problem, what does it lead to, what is the impact of the problem

So, then we have this task, different task and person responsible for this and the date all those things when we bring the work plan for this, then is something we get the final idea conduct analysis and we get the final idea. This is brainstorming. Brainstorming is general in the most used technique. In creativity other techniques are there and certain difference is from brainstorming. Just have a quick glance on the techniques.

Gordon technique is the one which firmly identifies with the conceptualizing, with the distinction that the gathering pioneer opens the session with an announcement of the expensive zone to be examined, not pinpointing the genuine issue.

For instance, the problem is to review procedure for cleaning windows. The topic is remove dirt. Remove dirt is the function and it is identified, then they work on that. Based on brainstorming sometimes we can say we need to develop a chair, we need to we do not we do not sometime say in this case we can say we need something to sit it is better. So, we do not disclose the genuine or the original issue in Gordon technique. Only group leader know the exact nature of real problem. Under consideration the people who practice this technique claims that this technique generates better ideas.

(Refer Slide Time: 32:37)

Now, Gordon method involves developing new ideas when the individuals are unaware of the problem. This implies that group members do not know the exact nature of the problem; the entrepreneur begins by mentioning the general concept associated with the problem. At last the actual problem is revealed enabling the group to make the suggestion of the implementation or refinement of the final solution, the combine ideas. They refine ideas ok. Actually first they refine, then they combine all these things happen here.

(Refer Slide Time: 33:19)

Next is check listing techniques. As the name suggests in this strategy agendas are planned to tackle a particular issue. They help our flawed memory. The certain questions or certain points at the backend of our brain which are not we just does not come, but check listing is just putting all the questions and making the respondents of participants just check list whatever are conducive whatever are related to present problem.

The questions can be what is it certain questions that what does it cost, then what does it do so on. What else can it do? Who can do it? All those things that can be done and using a set of structured questions encourages both broad and deep analysis of your situation or problem the questions that themselves may be simple, but when used as part of checklist they become a powerful management tool.

This tool uses a question hierarchy. In this hierarchy what broadly states the situation or the problem all though why is arguably the most powerful question you can ask why is something everyone runs behind? Why is this problem ok?

(Refer Slide Time: 34:50)

Asking why forces you to significance of the problem and thus nature of the responses. It can be especially valuable when applied as a part of well known problem solving techniques, 5 whys. I show what is 5 whys; different kinds of why's. Why we this problem is there, why we are doing this, why we cannot do something else, all those questions can be repeated asking of why can enable deep analysis of the problems essential for getting to root causes.
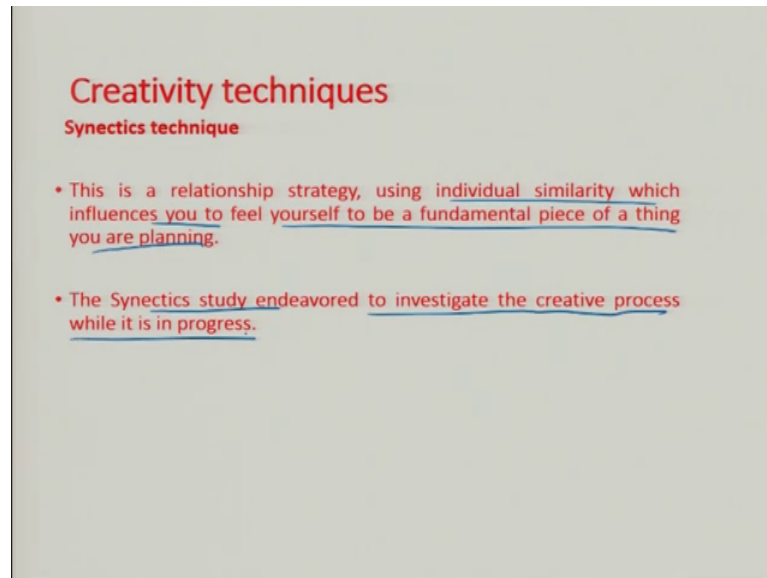
Next you should use how, where, who, when. These questions are designed to both deepen and broaden analysis. When combined into a question checklist, they become both a tool for analyzing and solving problems and the basis for an action plan. So, it becomes a tool number 1, it becomes the basis for an action plan all these questions.

(Refer Slide Time: 35:45)
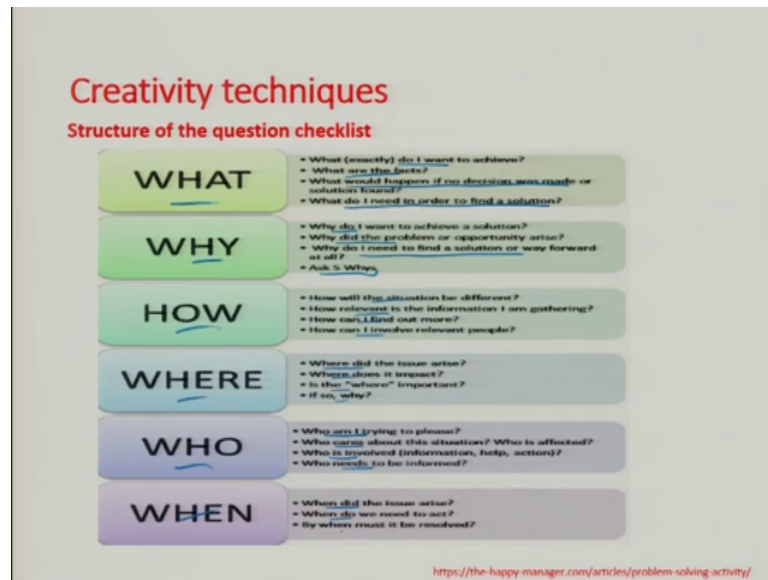
So, these questions can be asked what, why, how, where, who, when, what exactly do I want to achieve what, are the facts, what would happen if no decision was made, what do I need to do, what do I need in order to find a solution, then why do I want to achieve the solution, why did the problem or an opportunity arise, why do I need to find a solution or way ask 5 why? At least then how questions are there, then where is this going to happen, so is why. The who is going to do, who else can do it, who is involved already, who else can be involved further, when it has to be done, when do we need to act, when did the issue arise, when it must be resolved ?.

(Refer Slide Time: 36:34)
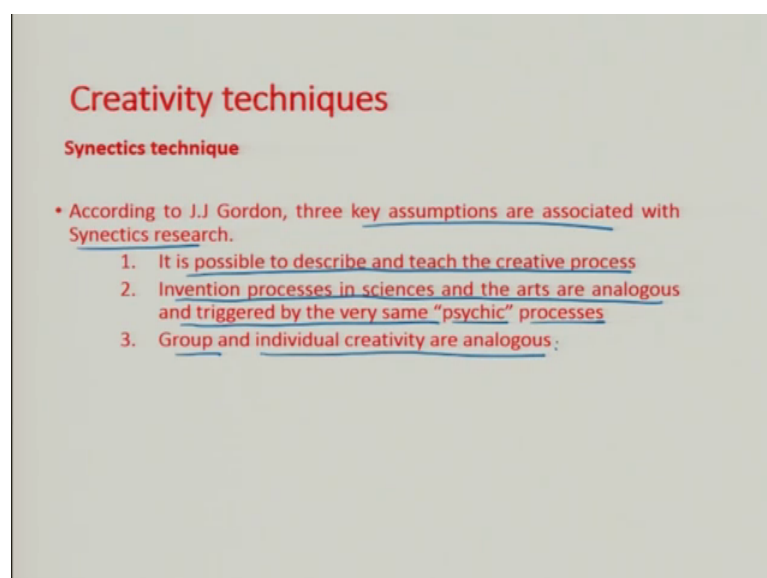
Then is Synectics techniques. This is a relationship strategy using individual similarity which influences you to feel yourself to be a fundamental piece of a thing you are planning sometimes. We use synectics like we say we need to have the manufacturing system or the factory or as glass, green as garden, we need to have washroom, factory as clean as the dining room. We do not get to eat food in the wash room, but we are comparing it with something. This is comparing it to we just like as strong as horse, as sharp as a pin. We compare it with some other word. So, this Synectics study endeavored it investigation of the creative process while it is in progress.

(Refer Slide Time: 37:25)

So, according to this also developed by Gordon. So, according to J. J Gordon the key assumptions are associated with synectics research. Number 1, it is possible to describe and teach the creative process in this way invention processes in sciences and the arts are analogous and triggered by the very same psychic processes group and individual creativity are analogous.

(Refer Slide Time: 37:51)
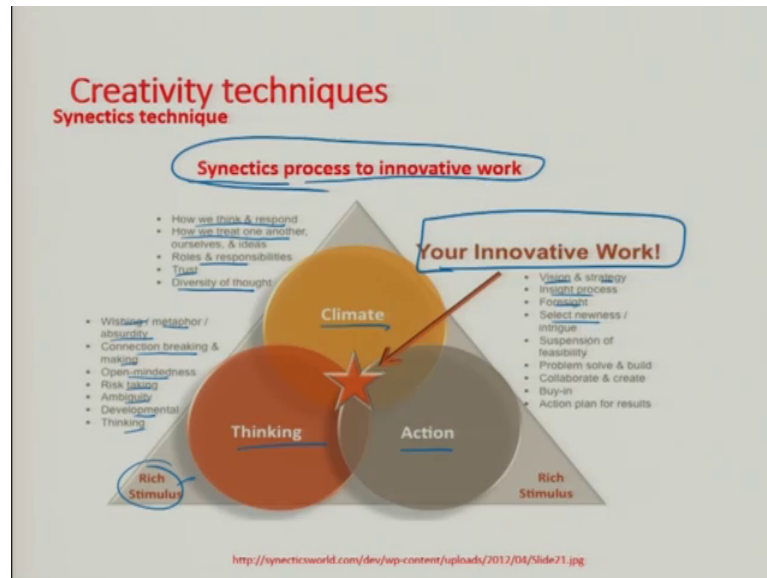
Now, this is Synectics technique illustration. This is our innovative work, the star whether it has come from the climate, the thinking, the action.

So, how do we think what kind of climate is roles and responsibilities, trust, diversity of thoughts, how do we treat one another, how do we think and respond to each other, then thinking is wishing metaphor for you obscurity, then connection breaking and making open mindedness, risk taking, ambiguity, developmental thinking. This is which stimulation that happens here ok. That helps us to have a synectics process to innovative work and then, action can be vision and strategy, insight process, foresight, select newness.

Then come Morphological analysis is nothing, but we just get the list of all the parameters like I said we have the steps a, b and c, not step we have the processes 1 to 3, we have the materials a, b and c and we have the further you know assembly process is x, y, z. All this we get all the combination, all the combination whichever is best we select that.

So, it is organized extensively to list an inspect numerous conceivable mix is that might be valuable in tackling an issue. This analysis has to do with recognizing the structural aspects of a problem and studying the relationships among them. In general morphology, the problem of representing and visualizing more than three dimensions is overcome by placing the variables in a column beside each other. Their valuable range is listed below them and this is called a Morphological field.
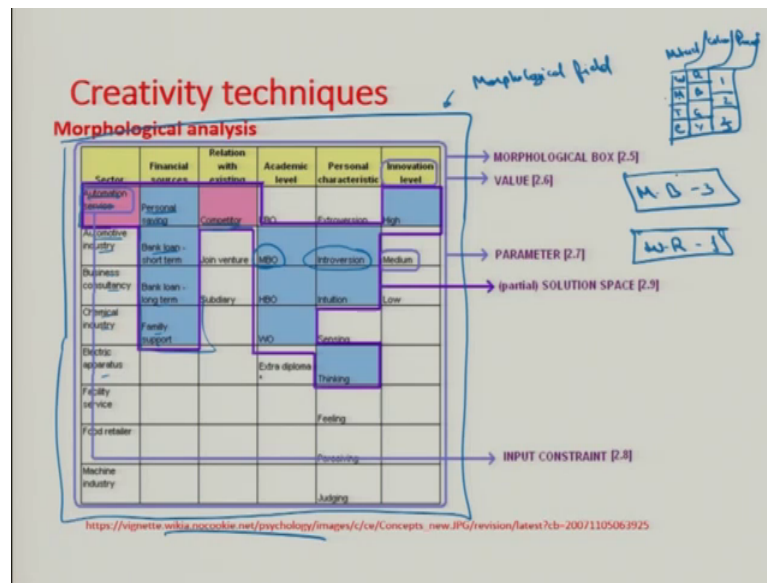
So, what is morphological field? This is a kind of a morphological analysis which I have taken from here this table or this chart is called morphological field ok. We have the sector automation service automotive industry, business consultancy, chemical industry, all those things and we have financial source is personal saving bank loan, short loan, bank loan from short term bank, loan from long term family support and we have relationship with competitor joint venture subsidiary.

Now, what morphological can do let us focus on the automotive service. This purple block is if you say automotive service in all this financial issues and only competitive has to be considered, then academic level at different levels of academics are there. Finally these can lead to certain things for instance let me pick one automotive service.

Automotive service financial sources would be personal saving and we are need to see the relationship with the competitor and academic level is MBO, then we need to person characterize introversion, then at medium level of innovation what does it come to. Another way we can think of is we are having martials let me say this is wooden metal, then thermo coal this is material, this is material, this is color, this is process we are going to join this, wooden metal, then a thermo coal, then we can have a cloth or fabric color is red, blue, green, yellow.

Let us have a metal piece with blue color with let me say these are processes to join 1, 2 and 3. With 3rd process what is the cost of this next? Next combination can be wooden

piece with red color printed on it with process 1. What is the cost, what is the ecological impact of this, this is Morphological analysis.

(Refer Slide Time: 41:58)

So, what do we do in morphological analysis? Problem is what is not equal to what is desired. This is all given by different researcher. I have put it here ok, then dimension prolong the issue, the dimension, the policy problem, these all can be parameters in our morphological field.

(Refer Slide Time: 42:12)

Then morphological box is important in which we work. Morphological field I have defined the value of the product. The value is representation of the possible relevant conditions that each issue can assume.

(Refer Slide Time: 42:26)

Then the parameters, different parameter, input constraints, solution space you can read these notes. I am just having a quick look into this.

(Refer Slide Time: 42:37)

Then is attribute listing technique that two steps in attribute listing technique. First is to list all the various characteristics of the study object, the 2nd is to purposely change or

alter these attributes by a method for this system. This is conceivable to unite new mixes of qualities or traits that will satisfy some current needs in a better way. Attribute listing is a great technique for ensuring all possible aspects of problems that have been examined.

Attribute listing is breaking the problem down into smaller and smaller bits and seeing what you discover when you do attribute listing. For instance I had different combinations wooden, metal, thermo, coal and if I say wood what kinds of wood we have, what are available wood materials and how could we paint? Red is it red paper, how could we paint, how could we color the wood red, is it red paint, red paper or some red may be chalk colors, red chalk? All those things smaller and smaller would lead us to deep understanding what all what else we can do.

(Refer Slide Time: 43:47)

So, this is an like this is an example. Example of attribute listing feature is casing, switch, battery, bulb, weight. Can casing be of plastic? If plastic, but plastic is there can attribute is what kind different kind of plastic can be listed here, Ok. If you know if the switch has to be on/off, the battery power and it is rechargeable the bulb has to be of glass and the weight has to be weight can be heavy or light ok. These are attributes and ideas. This can be listed in this way.

Next is evaluation comparison technique. This is a constrained inventiveness procedure for creating one kind of a verbal arrangements by framing quantifiable correlations between the components of the measurements, physical properties, mechanical properties, electrical and magnetic properties, cost consideration and different properties.

This came to be evaluation comparison that we saw in our value engineering process value engineering function phase, but there is an add on in here while we do comparison, we also think of the new ideas. We do QFD this week only. So, this is evaluation comparison technique. A structured evaluation process is necessary in order to identify the ideas that are most likely to succeed as innovations for the company. Ensure that complex ideas are reviewed by people with appropriate expertise necessary to understand what would be necessary to implement the ideas and what might go wrong.

So, next is Buzz session technique. Buzz session it is valuable to create innovative thoughts from expansive crowd circumstances to start with the gathering of people is isolated into an expensive number of gatherings of 6 individuals each. There is a large group from which the teams are generated ok. In each team we have for instance we have 100 people here; we have around 6 people here in each team. So, small teams are generated here now. Then what happens inside each gathering a leader and recorder are delegated, they ought to be chosen and advised before the meeting if conceivable.

Issue going to be handled ought to be declared before the meeting begins, utilizing the gathering, conceptualizing strategy, each gathering creates innovative choices after a timeframe and a flag from the pioneer. Each gathering quits delivering thoughts and starts assessing the thoughts and choosing the best arrangement. So, what happens? So, each gathering has a list of thoughts a list of thoughts ok. For some time they come up with these things these likes are there. Now these thoughts finally are combined into the developed or you can say selected ideas better. Common ideas are selected here.

(Refer Slide Time: 47:08)
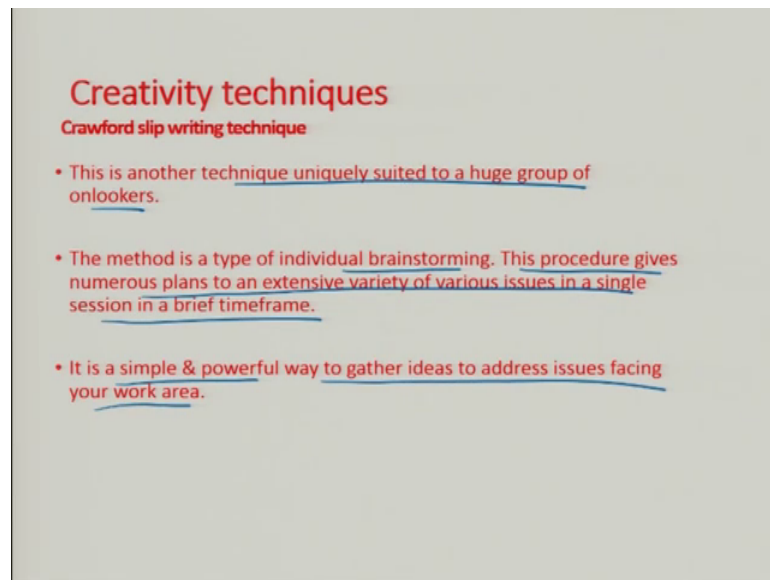
Next is Crawford slip writing technique. This is another technique uniquely suited to a huge group of onlookers. The method is a type of individual brainstorming. This is this procedure gives numerous plans to an extensive variety of various issues in a single session in a brief time frame. It is a simple and powerful way to gather ideas to address issues facing your area.

(Refer Slide Time: 47:34)
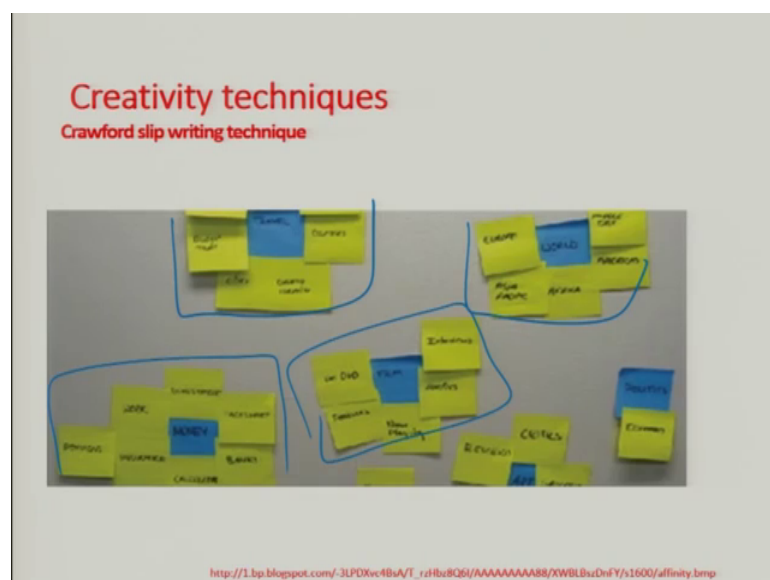
What happens in Crawford slip writing techniques the number of slips are given to the different individuals, but this is kind of an individual brainstorming were number of slips

are given to each person and they come up with their ideas and they just generate slips, write their ideas on the slips and they paste the slips like this is one individual, 2nd individual, 3rd individual. They all have these slips ok. By writing down the ideas everyone will have an equal chance to be heard which is not usually in case of traditional brainstorming.

This is first benefit. Second thing is one can address both general and specific problem with this method making it quite versatile. It is a tie efficient way to gather ideas rather than having an open brainstorming session when people are talking over one another and they can even get out of track and they can even sometimes the time get wasted. So, there is a plenty of time to review all of the ideas after the meeting has ended.

Meaning one can take a clear picture of thoughts that what individual think of our product from different ideas. The certain ideas become very common certain ideas which will be close to each other. So, like we discussed these functions of a pen record data, write notes or provide information those are the similar things, that is can that can be combined by the group leader 1 who is conducting this session. This is Crawford slip writing technique.

(Refer Slide Time: 49:05)

Next is Delphi technique after brainstorming this is the most used techniques. It is a method of pooling a large number of experts judgments through a series of increasingly refined questionaries t. The Delphi method was originally developed in early 1950s at the

Rand Corporation by Olaf Helmer and Norman Dalkey to systematically solicit the view of experts related to national defense and later in controversial sociopolitical areas of discourse. So, what happens at certain features in this, we have facilitator? A facilitator gives a list of questionnaires to the people. Questions given people have to people have to mark the right option, then he collect the questionnaire. Now in this what happens is when he provides the participants with initial questionnaires, he collects the answers to these questionnaires and comments the facilitators, then filters out irrelevant information.

First thing is he provide questionnaires ok, next is he collect the questionnaires and filter irrelevant information. This process provides good thinking and the problem associated with the group dynamics, the facilitators then creates the questionnaires for the second round and send them to the participants, recreate the questionnaire ok. This is step. This is 1st feature I would say 2nd feature. I can say is the series of information collection rounds series of rounds are there, ok.

These are the steps with series of rounds. In these rounds the participants can change the previous focus or previous perception, the previous ideas anonymously because they won't have to get their names disclosed in series of rounds. What happens is the participants can change their previous forecasts, they see new information which is coming from the other participants and they can comment on it.

So, in face to face meetings people tend to stick to the originally stated opinion to avoid losing face. In Delphi method, the person or the who has given the answer the questionnaire is not disclosed. For in brainstorm session, sometimes it happens for instance if you have if I have given an idea and there is an emotional block would not let my reputation down. Whatever idea is there in my mind I would not change. Each I will justify and try to defend my idea even though if I think that my idea is not acceptable I might not take it off because I have given it to once I was the one who coined it the or who gave that idea.

In Delphi technique, the person is not disclosed. He is a questioner. One can change his idea whenever because it is only the written his name. Sometime is there is option given even do not have to write his or her name ok. So, these are the series of rounds those are conducted in Delphi technique. In Delphi method one can change his mind at any moment there like the next is.

Next I can put has a feature only the same thing anonymity of participants that their names are not disclosed. It is normal for the participants to remain anonymous at all stages to enable honest opinions to come through the process. So, this is a structured variant of traditional expert polls and is usually used in forecasting. This is Delphi technique.

(Refer Slide Time: 53:00)

Delphi technique involves circulating questionnaires on a specific problem among group members sharing the questionnaire results with them and then, continuing to recirculate and refine the individual responses until a consensus regarding the problem is reached. This is what I have defined administrator's. The administrators of the Delphi method make a decision based on the results of the rounds. The Delphi method helps the group reach consensus without the influence of strong members of the group and the tendency to rush a decision at the end of a meeting. So, this is Delphi technique. So, these are the general creativity techniques which are practiced by various organization.

This I will like to give you a task to recapitulate. We have gone through these things, what do you understand by creativity and what are two general approaches to problem solving analytical and creative problem solving, what are steps involved in creative process, what are the main blocks to creativity, what are the factors conducive to creativity, what are different creativity techniques which helps in identifying and solving the problems?

Let us try to continue our previous task again. You have already selected a product, you have identified the functions, you have ranked the functions, then you have identified poor value functions. Now if possible in your hostels if you are in a group, try to have a team of at least 3 members not 2 at least 3 members. 3 to 6 member team can be developed. This is the task for today. 3 to 6 members and pick one of the creativity techniques.

First technique because you are all peers and you might not have a group leader if a teacher is there teacher can be the group leader. He can even provide questionnaires or checklist. Those things can be practiced, but brainstorming can happen or Delphi technique also. In Delphi also you need a facilitator any technique in which you can participate within peers. You can pick Crawford slip packing technique to walk individually, you can pick Buzz session technique to walk in groups, ok. Pick any of the techniques and come up with the ideas. You please create ideas to counter to address better to address the poor value functions.

If possible you can separate your sessions. Your creative sessions with time have one session today. Wait for one day. Do not over think of the ideas that you create in the next day. Next day just relax, ok. Creativity would only work if you are not thinking of that previously. For instance you work on one idea in one day. Tuesday do not do anything. Wednesday again start working on the ideas; try to have these successive steps or different ideas you can work on.

You know it is said that mind is like an umbrella. It works only when it is open. So, to open an mind, focus the truth fact. Just come up with the ideas, list those ideas, then we can you can further do the evaluation phase in value engineering or we can do QFD quality function deployment that we will discuss.

So, let us meet in the next lecture where I will discuss Frugal innovation. I will show you certain examples where people have used creativity to develop the products which are green, which are frugal and. Next we will take QFD Green Quality Function Deployment in this week.

Thank you.