

# CHAPTER 5

## CREATIVE TOOLS

*Methods are tools.  
It takes people with spirit  
to make them work.*

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## 1. Introduction

All of us have experience from primary school up to university that the problem solving techniques we have learned and practiced involved cases that:

- Have been solved many times,
- Have an obvious standard form,
- Have a clearly formulated goal,
- Have all the information needed,
- Have standard rules to follow,
- Have one right answer, and
- Have as a main motivation an external approval.

Creative problem solving is what millions of people use to survive every day, yet we get no practice about these skills in our structured, deterministic, safe, and supervised learning environments. Creative problem solving deals with situations where one or more of the characteristics outlined above are negated.

The creative tools presented in this chapter can support the different stages of the creative processes. They are designed to help you to devise creative and imaginative solutions to problems, and help you to spot opportunities that you might otherwise miss. The creative tools presented in this chapter have been used in practice to deal with problems such as:

- Improving products or services,
- Creating new products or services,
- Developing new strategies,
- Generating many radical ideas,
- Making creative leaps,
- Widening the search for solutions,
- Looking at problems from different perspectives, and
- Solving everyday problems.

In Section 2, a simple case study related to the design of a project by a group of students is presented. This is an example of the use of divergent and convergent thinking in problem solving. Furthermore, it is shown how these processes can be supported using the following creative tools: Brainstorming, Mind Mapping, and SWOT-analysis.

In the next section, Section 3, a set of creative tools is introduced; this can be used to support fluency, flexibility, originality and elaboration in the problem solving process. The presented tools are those that are most used in practice.

A classification of creative tools is discussed in Section 4. These tools are grouped following three categories: paradigm preserving, paradigm stretching, and paradigm breaking. A whole series of creative techniques are introduced following this classification.

The rules governing divergent and convergent thinking are further presented in Section 5. Then, in Section 6, the use of creativity in the solution of large and complex problems is

elaborated. Especially, the approach known as the Creative Problem Solving process is presented.

In Section 7, an extension of the original CPS approach known as the Simplex approach is shortly outlined. Section 8 presents the final remarks concerning CPS. Other popular creative methods are outlined in Section 9. Finally, the last section presents the final remarks.

## **2. Case Study: Selecting a topic for a project**

Since 1998, a course entitled Creativity and Problem Solving has been offered to engineering students at The Technical University of Denmark. The main objective of this course is to create a space to discuss, reflect and experiment with creativity, creative processes and creative methods of relevance for engineering students of any speciality. We assume that this reflective and experimental approach will indirectly influence on the development of the students own creativity. In this respect, the focus will be centred on the role of the engineer as supporter or facilitator of problem solving groups.

The course has been designed for 30 students. The whole course runs for 14 weeks. We meet one morning every week from 9.00 a.m. to 12.00 p.m. In the first part of the course (7 weeks), *the introduction*, a series of lectures will be given and the students work in groups of 5 persons preparing an oral presentation of some creative approaches. In addition, two guest lectures coming from the real world will give talks about the use of creative techniques in practice and innovation in organisations, respectively.

The following 7 weeks, the students will work in groups with a practical project selected by them. The students will search for information, interview relevant stakeholders, discuss in groups, use creative techniques, and they will be supervised to write a paper about their project. The students are encouraged to integrate the activities that belong to different parts of the human brain, logical as well as intuitive, factual as well as imaginative, quantitative as well as qualitative. The course ends with a conference where every group presents the result of their work to the other students.

Let us see the creative process that the students have to go through to identify and formulate a project.

The group process of project identification and formulation is composed of the following four stages:

1. *Diverge* (one hour): using brainstorming or other creative tools the group will produce as many ideas as possible of projects. Table 1 shows an example of the ideas produced by a group of four students.

Air conditioned cloths Consumption.com DTU-rating.dk Heated cloths Interactive classrooms Meal for one Parking cars compactly Parking cars in water Portable conveyor belt Shoes providing massage Substitute candle	Animal generating electricity Smoker's system Foot massage machine in malls In phone services MSN holograms LCD in S train Parking cars in 2nd floor Phone watch Self cleaning shoes Space travel agency Video rental web
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Table 1. Projects in divergent stage

2. *Converge* (one hour): the generated projects will be discussed and maybe structured using Mind Map or other technique. Then the three most promising projects will be selected, a voting procedure will be used if needed. Table 2 shows the selected projects of the above mentioned group.

<ul style="list-style-type: none"> <li>• Smoker's system</li> <li>• DTU-rating system</li> <li>• MSN hologram</li> </ul>
--

Table 2. Selected projects

3. *Final evaluation*: A SWOT matrix will be constructed for each of the selected projects in stage 2, based on this information a final project will be selected. Table 3 shows the results of the SWOT analysis for the selected project: Smoker's system.

<p><b>Opportunities</b></p> <ul style="list-style-type: none"> <li>• High demand</li> <li>• New market</li> <li>• Recycling</li> <li>• Smoking bans</li> <li>• Clean air for no-smokers</li> <li>• Improved health</li> <li>• Smoke everywhere</li> <li>• More profit in restaurants</li> <li>• Changing regulations</li> </ul> <p><b>Strengths</b></p> <ul style="list-style-type: none"> <li>• Very creative students</li> <li>• Use resources in technical design</li> <li>• Good cooperation with other universities</li> </ul>	<p><b>Threats</b></p> <ul style="list-style-type: none"> <li>• No market</li> <li>• Un-cool</li> <li>• Annoyance</li> <li>• Law against it</li> <li>• Patents</li> <li>• Other players on the market</li> <li>• Cigarettes will be banned</li> <li>• Cigarette is a threat</li> </ul> <p><b>Weaknesses</b></p> <ul style="list-style-type: none"> <li>• No money</li> <li>• Limited time</li> <li>• Mass production</li> </ul>
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Table 3. SWOT matrix for the selected project

4. *Problem formulation*: The purpose and boundaries of the project will be specified. This is shown in Box 1 for the above mentioned group.

Our group wants to develop a system which allows the smokers to smoke in public places without disturbing non smokers. Generally, we identified three main problems. The first problem is to identify problems that smoking brings to smokers and no smokers. Next, we have to find out how the smoker's system will deal with these problems. The third problem is related to the technical elements of the system. The product will be used by smokers causing no annoyance to the no-smoking people, in countries or places where it is forbidden to smoke in public.

Box 1. Problem formulation

### 3. Creative Tools

A variety of abilities that characterises creative individuals or groups have been presented in Chapter 1. Four of the key abilities will be discussed in this section as well as tools to enhance them in concrete problem solving situations. These abilities are:

- Fluency,
- Flexibility,
- Originality, and
- Elaboration.

In Chapter 1, three creative tools were already introduced; in this section we will expand the previous presentation. Other tools will also be presented in this section (Vidal, 2004).

Higgins (1994) presents many other tools which are not discussed in this chapter. At the end of the list of references some Web pages are presented where many creative tools are described.

### **Fluency**

Fluency is the production of multiple problems, ideas, alternatives or solutions. It has been shown that the more ideas we produce, the more likely we are to find a useful idea or solution. Fluency is a very important ability especially in the creative problem solving process. To have too few alternatives is not a good thing in problem solving. Especially if you have to be innovative. There are many tools for producing ideas, alternatives and solutions. Several researchers have shown that training and practice with these tools cause a better fluency.

One creative tool, which has been widely used with big success for generating many ideas, is *Brainstorming*. Osborn (1953) invented it for the sole purpose of producing checklists of ideas that can be used in developing a solution to a problem. The tool is directed to generating unconventional ideas by suppressing the common tendency to criticise or reject them summarily. Osborn tried to separate idea-evaluation from idea generation because he believed that if evaluation comes early, it reduces the quantity and quality of the ideas produced. Therefore in a Brainstorming session no criticism is permitted and freewheeling generation of a large number of ideas and their combination and development are encouraged. Brainstorming is founded on the associative premise that the greater the number of associations, the less stereotyped and more creative the ideas of how to solve a problem will be.

However, nothing in Brainstorming is directed at changing the assumptions or paradigms that restrict the generation of new ideas. This is an excellent technique for strengthening fluency, fantasy, and communication skills. It is a good idea to have a facilitator to prepare and warm-up the Brainstorming session, to lead and support the session, and to evaluate the whole process. This tool gives the possibility for the group to use more than one brain achieving a synergetic effect. Generate a multitude of ideas and some of them will be truly useful, innovative and workable. Asking individuals for inputs gives them an increased sense of importance and produces an atmosphere for truly creative and imaginative ideas to surface and be acknowledged. Brainstorming has been used for a wide diversity of problems, including not only marketing and product issues but also strategy development, planning, policy, organisation, leadership, staffing, motivation, control, and communication. However, this tool is not appropriated for broad and complex problems demanding high-qualified expertise and know-how. Some of the ideas produced may be of low quality or obvious generalities. Brainstorming is not a good idea for situations that require trial and error as opposed to judgement.

In the two boxes below, the rules of Brainstorming are formulated as well as the positive and negative behaviours in a Brainstorming workshop.

*The rules of brainstorming*

Rule 1: Criticism is ruled out

Rule 2: Free-wheeling is welcomed

Rule 3: Quantity is desired

Rule 4: Combination and improvement are sought

*Good behaviour:*

- sharpen the focus,
- playful rules,
- number your ideas,
- build and jump,
- stretch your mental muscles,
- get physical
- use a facilitator

*Bad behaviour*

- the boss gets to speak first,
- everybody gets a turn,
- experts only please,
- do it off-site,
- no silly stuff,
- write down all

Box 2 and 3. Brainstorming

## **Flexibility**

Flexibility is the ability to process ideas or objects in many different ways given the same stimulus. It is the ability to delete old ways of thinking and begin in different directions. It is adaptive when aimed at a solution to a specific problem, challenge or dilemma. Flexibility is especially important when logical methods fail to give satisfactory results. Looking at modern paintings requires flexibility, they demand looking from different perspectives in order to see different objects, images and symbols. Seeing persons or objects in the clouds requires the flexibility of seeing concrete shapes in cloud formations. Flexible thinking provides for changes in ideas, detours in thinking to include contradictions, differing viewpoints, alternative plans, differing approaches and various perspectives of a situation.

A family of creative tools, known as *verbal checklists*, has been developed to enhance flexibility in the creative process. Usually this is a checklist of questions about an existing product, service, process, or other item to yield new points of view and thereby lead to innovation. Osborn (1953) has also developed a very extensive verbal checklist while he was a partner of a major US advertising firm. The idea behind the verbal checklist is that an existing product or service can be improved if one applies a series of questions to it and pursues the answers to see where they may lead. The main questions take the form of verbs such as Modify? or Combine? These verbs indicate possible ways to improve an

existing product or service by making changes to it. Then you add definitional words to the verb, for instance combine ideas, combine appeals, combine purposes, combine units, etc.

Elberle (1971) developed a short verbal checklist known as the *SCAMPER* technique to assist people in improving their flexible thinking, see Box 4. When using such checklist, you will usually follow the following steps:

- Identify the product or service to be modified
- Apply each of the verbs on the checklist to suggest changes in the product or service
- Make sure you use many definitional words for the listed verbs, and
- Review your changes to determine which one meets your solution criteria.

SCAMPER
S: Substitute
C: Combine
A: Adapt
M: Modify
Magnify
Minify
P: Put to
E: Eliminate
R: Reverse
Rearrange

Box 4. Scamper rules

Another important tool for encouraging flexibility is the use of *provocative questions*. These questions will open up a situation to a broader and deeper direction of thinking which otherwise might not be produced or considered. They encourage people to think about ideas or concepts they have not thought about previously. Some provocative questions can be: What would happen if: water tasted like whisky? Cats could bark? Women could fly? How is: A PC like a ship? A flower like a cat? A sunset like a lake? A car like a fork? What might happen if: It never was Sunday? It was against the law to be perfectionist? People were not creative? Image what might happen if: By law it was forbidden to have children? Cars could fly? Men could have children?

### **Originality**

Originality means getting away from the obvious and commonplace or breaking away from routine bound thinking. Original ideas are statistically infrequent. Originality is a creative strength, which is a mental jump from the obvious. Original ideas are usually described as unique, surprising, wild, unusual, unconventional, novel, weird, remarkable or revolutionary. You need courage to be creative, because as soon as you propose a new

idea, you are a minority of one. Belonging to a minority is unpleasant. In addition the original thinker must be able to withstand the ridicule and scepticism, which will be directed toward his/her ideas and himself/herself. To enhance creativity we have to be respectful of unusual or crazy ideas or alternatives.

*Picture Stimulation* is a very popular technique used to provide ideas beyond those that might be obtained using brainstorming, see Box 5 below. The members of the group will look at a set of selected pictures and relate the information gained from the picture to the problem, otherwise the rules of brainstorming should be followed. Photo excursion uses the same principles of picture stimulation but instead of using prepared pictures for stimulation, participants are required to leave the building walk around the area with a (Polaroid or digital) camera, and take pictures of possible solutions or visual ideas for the problem; when the group reconvenes, ideas are shared. Another related technique is the Object Stimulation tool where instead of pictures a variety of different objects (e.g. a hammer, a pencil, a board game, etc.) will be used. Sometimes you can use words instead of pictures or objects, an associate them to your problem.

*Picture Stimulation:*

1. Select pictures from various sources.
2. Each participant describes what he/she sees in the picture.
3. The group members are then asked to relate the information gained from the picture to the problem.
4. This process is then continued until the group has run out of ideas.
5. A new picture is selected and then go to 2. until enough ideas have been developed.
6. The ideas are discussed, developed and evaluated by the group.

Box 5. Picture stimulation

There exist a number of computer programs that can be used to generate alternatives and otherwise add creativity to the problem solving process. They will include a huge amount of words and phrases together with many idea-associations that are linked to several thousand questions. The words, phrases or questions, randomly selected, will provoke ideas and associations that have to be related to the problem in question and solutions might be generated.

Originality can also be enhanced by *analogies and metaphors*. An analogy is a comparison of two things that are essentially dissimilar but are shown through the analogy to have some similarity. A metaphor is a figure of speech in which two different universes of thought are linked by some point of similarity. In the broadest sense of the term, all metaphors are simple analogies, but not all analogies are metaphors. Nature is a good source to provide analogies. Poetry is a good source of metaphors. Similes are specific types of metaphors that use the words "like" and "as" - for instance, the wind cut

like a knife; his hand was as quick as a frog's tongue, he sees like a condor and digs as fast as a mole. Similes can be used to suggest comparisons that offer ideas for solutions.

### **Elaboration**

*Mind Mapping* is a visual and verbal tool usually used to structure complex situations in a radial and expanding way during the creative problem solving process. A mind map is by definition a creative pattern of related ideas, thoughts, process, objects, etc. It is difficult to identify the origin and the creator of this technique. It is quite probable that this tool has been inspired by research on the interplay between the left and the right hemisphere of the brain. It can also be dated back to the Bulgarian doctor and psychiatrist Lozanov who experimented with the brain and accelerated learning. It has been, among others, Buzan (1983) who has made Mind Mapping a well-known technique with many applications.

The principles to construct mind maps are few and easy to understand. The best way to learn it is by practice. After short time you will do it automatically. If it is difficult for adults it is because they think linearly and take notes in a linear way (using the left hemisphere of the brain). To make mind maps you have to draw ideas from the centre of the paper and move in a radial and parallel way, to do that you have to use both your creative and your logical brain. With some experience you develop your own style, your own pallet of colours, your own symbols, your own icons, etc.

A Mind Map contains usually the following elements:

- The subject or the problem that has to be studied or analysed will be placed in the centre of the paper
- Keywords (names or verbs) are used to represent ideas, as far as possible only one word is used in a line
- The keywords are connected to the centrum through a main branch and sub-branches
- Colours and symbols are used to emphasise ideas or to stimulate the brain to identify new relations
- Let ideas and thoughts flew free; avoiding too much evaluation during the period of elaboration of the map.

When I construct a mind map, I will start from left to right building main branches in a circular way. Then, I will continue drawing sub-branches moving in a circular way until the whole sheet of paper is filling up with ideas. That is, I have been moving following an expanding spiral pattern. Then, I will move in the reverse way following a contracting spiral pattern supplementing the map with new ideas and connections. These spiral movements provoke the interplay between the creative and the logical brain to be able to combine holistic thinking with particular details of the subject or the problem in question. An example of a shopping mind map is shown in Figure 1.

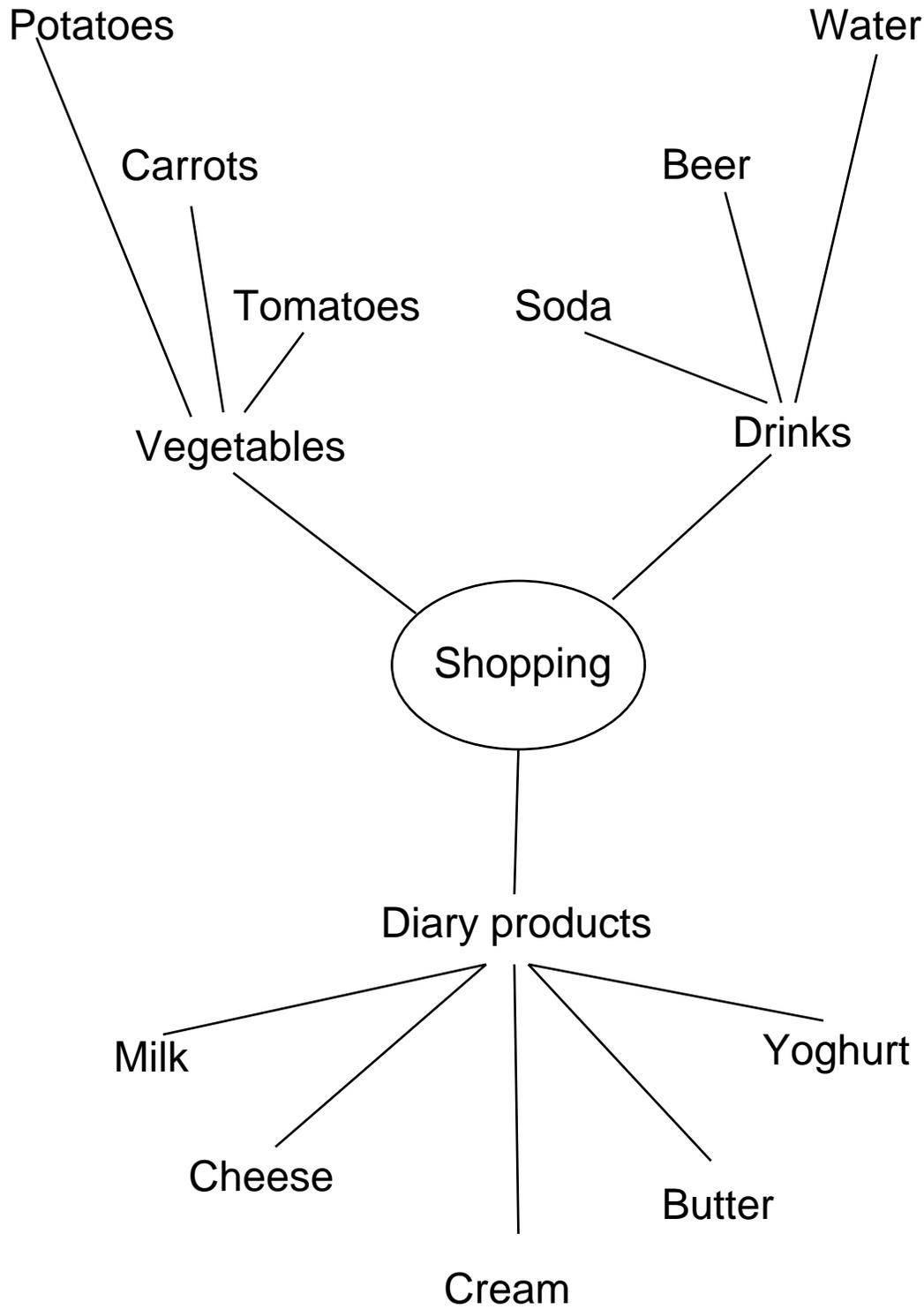


Figure 1. Mind Mapping for shopping

#### 4. The Creativity Continuum

Creativity tools can be classified in many different manners. McFadzean (1998) has developed a framework for classifying creativity tools using three categories:

- *Paradigm preserving*, where neither new elements nor relationships between the elements of the problem are introduced,
- *Paradigm stretching*, where either new elements are introduced or new relationships between the elements of the problem are conceived, and
- *Paradigm breaking*, where both new elements and new relationships between the elements are introduced.

##### **Paradigm preserving tools**

We have seen that brainstorming does not create many ideas that challenge or break away from the prevailing paradigm. This is so because this tool only uses *free association*, not forcing the persons to use their fantasies to produce new ideas or to think in an expanding way. Let us see another technique within this family.

*Force Field Analysis* is usually used in situations related to changes. Each participant has to write two scenarios. The first one is the description of the situation if a disaster were to occur. The second scenario would be a presentation of the ideal situation. The non-ideal and the ideal scenarios will be placed on a continuum with a centre line drawn between them. The participants will be asked to list the (negative) forces that will make the situation non-ideal and those (positive) forces that will make the situation ideal. Thereafter, the group has to generate ideas to reduce the negative forces and enhance the positive forces.

The *(5W+H)* tool is simple and very useful. The five W's and the H are acronyms for Who? What? Where? When? Why? And How? It is a good tool for gathering information systematically about a mess or a problematic situation.

*Word Diamond* is a technique developed in order to generate ideas from the problem statement. Four words or phrases will be chosen from the problem statement. These will be placed in a diamond shape so that each word or phrase is located in a corner. The participants combine two of them and tell the facilitator the associated ideas due to the combinations. The facilitator writes on a flip chart all the ideas. This process is repeated until all the combinations are examined.

These and many other tools for creative thinking do not necessarily encourage the individuals and the group to regard the problem from different perspectives. That is the participants will tend to preserve their paradigms. These tools are valuable because they are somehow "safe", people usually feel comfortable with their use. Free association and hitchhiking is used to spark off other ideas and then produce new solutions. Paradigm preserving techniques are very popular because they are easy to use from the participant's and facilitator's viewpoint. In addition, these tools create usually fun and a good atmosphere and therefore they can be used as warm-up techniques before going to other more advanced tools. The use of these tools does not demand experienced groups and facilitators.

### **Paradigm stretching tools**

These techniques will encourage the participants to regard the situation from a new perspective. They may use new relationships between new elements to develop a new element to create a new solution. This is usually called *unrelated stimulus*. Let us see some of these tools.

We have seen that the *checklists* described above are well known approaches within this family. They use unrelated stimuli to spark off new ideas. They demand more imagination and expression than paradigm preserving techniques.

*Metaphor* is also a tool belonging to this family. The facilitator first constructs metaphor categories, for instance: journey, nature, people, food, music, countries, and so on. Afterwards minor categories are stipulated, for example for journey: in space, on land, under sea, etc. The participants are asked to describe the problem using the metaphor category. The facilitator needs to stipulate whether the description should be at the present situation or the ideal situation. Using the descriptions developed by each person, the participants can generate new ideas. These new ideas can be related back to the problem situation.

Another technique is *Role Storming*. This tool involves the group generating ideas from someone else perspective. You could be Leonardo, Edison, Picasso, Robin Hood, Donald Duck, Bush or some Super Heroes. Each participant is asked to describe a character and together with the others, generates ideas related to the problem using the character's profile or his tools and implements. The ideas will be discussed and developed by the group.

*Heuristic Ideation Technique* can be used to create new concepts, ideas, products or solutions. The group will first make two lists of objects or concepts. An object from list 1 is then chosen together with one object from list 2. The participants are then asked to force a relationship between the two. For instant forcing together a telephone with a PC can give origin to the Internet. The participants continue until all ideas have been exhausted. The ideas are then discussed and developed into innovative solutions.

*Reversal* is a tool that can help the group to look at the problem from a different platform. Reversing the problem statement can often provide a new perspective and therefore new ideas. The participants will be asked by the facilitator to reverse in someway the problem statement. They can change the subject, the verb or the object of the sentence. For instance: how to increase production? Can be reversed to: how to decrease production. Using the reversed statement we can use another tool, for example brainstorming, to generate ideas. Continue until enough ideas have been generated. Discuss and develop the ideas into innovative solutions.

A similar tool to the last one is the so-called *Assumption Reversals* technique. Here the assumptions regarding the problem situation are stipulated. Reverse each of the assumptions and generate new ideas in a similar way as in the case of Reversal.

All these tools enhance creativity by looking at the problem from a variety of perspectives and by breaking old mind patterns and forming new connections and perceptions. De Bono (1995) called this process *lateral thinking* or moving sideways in order to try different concepts and perceptions.

### **Paradigm breaking tools**

These techniques will encourage the participants to completely break down the paradigm. In other words the participants can regard the problem or situation from a variety of different and probably contrasting perspectives. Incorporating both new elements and new relationships to the problematic situation will create innovative solutions. Let us see some of these tools.

We have already discussed *Picture Stimulation* as a technique that enhanced the production of original ideas. This is a very popular technique that provokes visual thinking, a very important ability of creative individuals.

*Wishful Thinking* is another technique in this family of tools. The facilitator emphasises that everything is possible and that the participants have to use their fantasy. Each participant is asked to develop some fantasy statements about the future using formulations as: In the future, it would be nice if ... If I was the leader in this situation I shall do... The participants then examine each fantasy statement and suggest ideas and actions about how these fantasy statements could be achieved. Thereafter the new ideas are linked back to the actual problem. This can be achieved by using formulations such as: Even if it is difficult to reach, we can ... It will be possible, if ...

Another well-known technique is *Rich Pictures*. The facilitator asks each participant to draw two pictures. The pictures might be a metaphor of the situation. The first drawing should be a picture of how the participants would like to see the situation in the future. The second picture should be a drawing of how the participants see the present situation. Each participant explains first the picture of the present situation; the (5W+H) technique could be used to structure his explanation. Next, the participant describes the future in the same way. All the participants may then generate ideas of how to move from the present to the future.

*Imagining* is a tool that can generate many creative ideas but it will not work with very conservative groups. This tool is ideal for groups with visionary participants and for groups where the participants feel rather confident each other and like to have fun. These kinds of groups are like a dream for a facilitator. The facilitator chooses a word and one participant starts to make a story around this word. After a minute somebody else should take over the story and continue. Anybody now can jump in when they please. The participants should be encouraged by the facilitator to be as wild, exotic and colourful as possible. The richer is the description the better. Changeovers can be steered by the facilitator to introduce a factor of surprise. The images can be written down by the facilitator and then used as unrelated stimuli to create ideas relating to the problematic

situation. This technique is usually called *Wildest Ideas* if instead of a word it is used a wild idea to start with.

As we have mentioned above, these paradigm breaking tools should be used only with experienced groups or groups that feel rather comfortable with the facilitator. These tools are demanding from the participants the ability to use fantasy, intuition, and feelings and to play. Due to the above mentioned mental locks many people will be afraid and anguished to participate in such sessions. Some can react very negatively and consider the workshop a waste of time.

### **The continuum**

Creativity tools can be located in a creativity continuum ranging from paradigm preserving tendencies to paradigm breaking tendencies as suggested by McFadzean. Paradigm preserving tools are considered to be "safe", that is they do not provoke anguish to the participants; they do not demand imagination and expressivities from the participants; they use free association to produce ideas and they do not demand experienced groups. At the other extreme, we have paradigm breaking tools that can be viewed as "unsafe"; they demand imagination; they use fantasy and unrelated stimuli to generate original ideas demand experienced groups. In the centre of this continuum are the paradigms stretching tools.

O'Dell (2001) presents a similar way to locate creativity tools in a continuum but using a different scale. At one extreme we will have the more structured tools as for instance checklists and in the other extreme are the less structured tools, for instance picture stimulation.

Creativity tools can also be classified according to the four styles of creativity suggested in Chapter 1: Modifying, visioning, experimenting, and exploring. Technical people, like engineers, prefer to use more structured or analytically oriented tools whereas behaviourally oriented participants tend to prefer less structured or intuitive tools. Research has shown that pragmatic-minded persons usually overlook paradigm breaking tools; they prefer logical or rational modes of analysis while artists are more willing to use their intuition and fantasy. Although, logical and rational type of approaches can be useful for well-structured problems, it will not work as well with most ill structured problems. Different tools are therefore useful for different types of problems. Paradigm stretching or paradigm breaking techniques may be more useful for ill-structured problems whereas paradigm preserving tools can be used to solve more structured problems or well known situations. If a problem is open-ended and ill structured, it is probably a good idea to generate a fantasy or a metaphor in order to explore a desired scenario for the situation. When dealing with ill-structured problems it is often a good idea to start with a paradigm preserving tool to warm-up and then switch to paradigm stretching or paradigm breaking techniques.

Selecting one or more creativity tools to facilitate a group in a creative problem solving process is a difficult decision-making problem where the facilitator has to reflect about three (usually incompatible) forces:

- The organisational *culture* behind the group and what they represent,
- The *task* or problem and its complexity, and
- Your *style* as facilitator and your own goals for the process.

### 5. Divergent and Convergent Processes

Experience has shown that it is recommendable in a creative process to start with divergent thinking to produce as many ideas or solutions as possible and thereafter to switch to convergent thinking to select the few most promising ideas. This is usually illustrated in the form of a diamond as shown in Figure 2.

Some of the rules for **divergent thinking** are:

- Imaging, reframing and seeing issues from different perspectives,
- Defer judgement (criticism or negativity kills the divergent process), be open to new experiences,
- Quantity breeds quality, to have good ideas you need lots of ideas,
- Hitchhiking is permitted, in this way a synergetic effect can be achieved,
- Combine and modify ideas, in this way you can create many ideas,
- Think in pictures, to create future scenarios you can even simulate potential solutions,
- Stretch the ideas, imagine ideas beyond normal limits, and
- Do not be afraid to break paradigms, avoid destructive criticism, and add value to the challenged concept.

Some of the rules of **convergent thinking** are:

- Be systematic, find structure and patterns in the set of produced ideas,
- Develop ways to evaluate ideas, assess qualitative and quantitative measures of ideas,
- Do not be afraid of using intuition, this is the way most important decisions are taken,
- Avoid quickly ruling out an area of consideration, take your time or better sleep on it,
- Avoid idea-killer views, try the impossible,
- Satisfy, do not expend too much time in looking for the optimal solution of an ill-structured multi-criteria problem,
- Use heuristics, use common sense and experience based rules, and
- Do not avoid but assess risk, this does not mean being blind to risks, for serious consequences be sure to have a contingency plan.

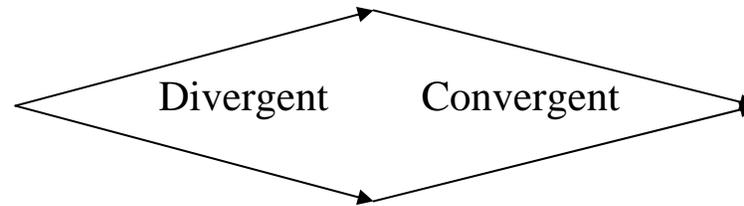


Figure 2. The creative diamond

Creative problem solving processes always contain phases of divergent and convergent thinking. Divergent thinking produces as many solutions as possible within the available time. The participants will vary in the way they prefer to produce ideas; some will do it by association, others by unrelated stimulus. Convergent thinking on the other hand requires the participants to use skills in reality testing, judgement and evaluation to choose the one or two best options from a number of possibilities. It is not unusual that in a group some members will very easily diverge, that is build a list of alternatives, while others will converge very fast by trying to select the best solution from the list and the rest will be passive not knowing what is required of them. Hence the need of a facilitator, he or she designs a clear and visible process to align the group. In Chapter 2, it was shown how these processes are included in the Vision Conference.

## 6. The CPS (Creative Problem Solving) Process

Osborn (1953) described several basic steps to support groups and individuals to be more successful in creative problem solving. Later, based on these proposals, several researchers have formalised and extended these ideas into a systematic approach to creative problem solving known as the CPS model or process. 4-steps, 5-steps and 6-steps models have been proposed. Here we present the most general version. It is called the 6-diamond model, where the upper part of each diamond represents the divergent sub-processes and the lower part corresponds to the convergent sub-processes:

- *Mess finding*: Identify areas of concern. Generate ideas about possible problematic situations from a holistic viewpoint. Identify the three most critical and general problems. Select one for further work,
- *Fact finding*: Observe carefully, like a video camera, while collecting information and data about the problem situation. Both objective facts and subjective experiences should be collected, explored and identified,
- *Problem finding*: Fly over the challenge or the problem by considering different ways of regarding it. Think about those possibilities,
- *Idea Finding*: Search for a variety of ideas, options, alternatives, paths, approaches, manners, methods and tools. Select potential solutions or ideas,
- *Solution finding*: Dig about the ideas in new and different ways, from other viewpoints and criteria. Assess the consequences, implications, and reactions to the selected ideas. Select ideas and solutions to develop an action plan, and
- *Acceptance finding*: Develop ideas about how to implement the action plan. Search for ways of making the ideas or solutions more attractive, acceptable, stronger, more effective, and/or more beneficial. Develop a working plan for implementation.

**Project Title: Managing Community Change through CPS – A Case Study of the Burchfield-Penney Art Center (BPAC)**

**Rationale and Questions:** Creative Problem Solving (CPS) is a proven method for facilitating change. CPS facilitators have frequently put to use the framework that guides CPS in developing action plans for large group initiatives. The outcomes of these action plans have not been well documented. This project will document how CPS was modified to approach a community-based project. The questions that will guide this study are:

- How to use CPS to facilitate change in a community-based project?
- Why was CPS perceived as being useful in a community-based project?
- What was the value of using CPS in this community-based project?
- In what ways did CPS enhance the BPAC outcomes as part of these initiatives?
- What steps need to be taken when implementing CPS in a large scale?

**Statement of Significance:** To enrich the success of building a new BPAC museum, curator Ted Pietrzak decided to implement the CPS process. This case study will highlight the reasons why CPS was selected as a process method to assist this project. As limited documentation is available today for community based CPS projects, this case study will serve as a research source. The breadth of this research will record the steps of the CPS process in 1) building and understanding real world community-based relationships, and 2) will follow and study the success of the CPS process with the new BPAC museum. Project results will be important as an instructional resource for the Creative Studies department and students. Documentation will be gathered from various perspectives including the college, community, architect and BPAC staff. This project will serve as a model of the CPS process for other similar projects. Finally, this research may demonstrate a process model on how-to construct a new museum utilizing CPS.

**Description of the Method and Process:** This qualitative case study will reconstruct the steps taken to identify what happened in the CPS process. I will analyze how CPS was implemented through a triangulation of sources including facilitators, planners and committee members. The following steps will be used:

- Participate in the meetings of a committee for experiential learning;
- Collect supporting CPS process data for planning the new BPAC including documentation and reviewing meeting / planning notes;
- Select interview participants from those who supported the use of CPS;
- Create and distribute debrief sheets to all facilitators of the process;
- Complete interviews of selected participants and facilitators; and
- Meet with the Creative Studies program director to investigate how-to create new action paths for the department from this case study.

**Learning Goals:** To help me gain experiential learning in the following ways:

- To understand the breadth of the CPS process in a real world intervention
- To learn how I can become a better facilitator by initially identifying the client(s) vision statements
- To become well-versed in the benefits of CPS as a practitioner

**Outcomes:**

- A case study report
- CD-ROM of the photographs that captured the CPS process
- A summary of usefulness to include the value of CPS application
- Ideas for a summary piece of art from the brainstorming sessions
- An Executive Summary
- Ten Creativity Based Information Resources (CBIR) annotations

Box 6. See further [www.buffalostate.edu/orgs/cbir/Readingroom/conceptpapers/Billokcc.pdf](http://www.buffalostate.edu/orgs/cbir/Readingroom/conceptpapers/Billokcc.pdf)

Box 7 shows the different types of creative sub-processes that are needed at each step of the 6-diamond model.

*Mess finding:* Fluency, flexibility, originality, deferred judgement, and evaluation  
*Fact finding:* Analysis and evaluation.  
*Problem finding:* Synthesis.  
*Idea finding:* Fluency, flexibility, analysis, originality, and deferred judgement.  
*Solution finding:* Synthesis, elaboration and evaluation.  
*Acceptance finding:* Synthesis, evaluation, originality, and flexibility.

Box 7. Creative sub-processes at each stage

As we can see at all these stages creativity tools can be used, but depending on the problem or the situation under study, other both "hard" and "soft" rational methods can also be applied especially in the convergent phase of each step in the CPS process.

Depending on the size and complexity of the problem the whole CPS process might take a long time. During this process the group at some stages will need a facilitator, an expert, or a supervisor to support the different types of decisions to be taken. These are some of the roles I will play as the adviser or mentor of a group of students at the university working on theses or projects. On the other hand, a very important aspect in this respect is learning. The use of creativity tools and the CPS process can be learned by every person that has a "proactive" stance to life because of their simplicity many of these tools can be used in everyday life. Children at school and elderly people can creatively empower their life by being proactive instead of reactive

In practice, as a problem solver and /or as a facilitator, you need a very important skill: Intuition (Goldberg, 1983). Intuition is usually defined as the sixth sense, the power of knowing, or knowledge obtained without recourse to inference or reasoning. It is important to emphasise that intuition is not something contrary to reason but something outside the province of reason see further Box 8.

*Intuition* is an unconscious form of knowledge. It is immediate and often not open to rational/analytical thought processes. Intuition differs from an opinion since opinion is based on experience, while an intuition is held to be affected by previous experiences only unconsciously. Intuition also differs from instinct, which does not have the experience element at all. Intuition is trans-intellectual, while instinct is pre-intellectual. A person who has an intuitive opinion cannot immediately fully explain why he or she holds that view. However, a person may later rationalize an intuition by developing a chain of logic to demonstrate more structurally why the intuition is valid. Intuition is one source of common sense. It can also help in induction to gain empirical knowledge. Sources of intuition are feeling, experiences and knowledge.

Box 8. From Wikipedia, the free encyclopedia

## 7. The Simplex CPS Approach

Simplex is a group process for finding and solving problems; identifying and overcoming challenges; and establishing and achieving goals. Use of Simplex allows individuals and organizations to be creative, innovative and to succeed in a world where fast-paced change is the order of the day. The Simplex process has been developed over a number of years by Basadur (1995) and is being used by many business and technological organizations in North America,

Simplex is a "complete" process of creative problem solving with four stages and eight discrete steps. The process provides a framework for using various tools. Simplex is represented as a wheel to reflect the circular, perennial nature of problem solving.

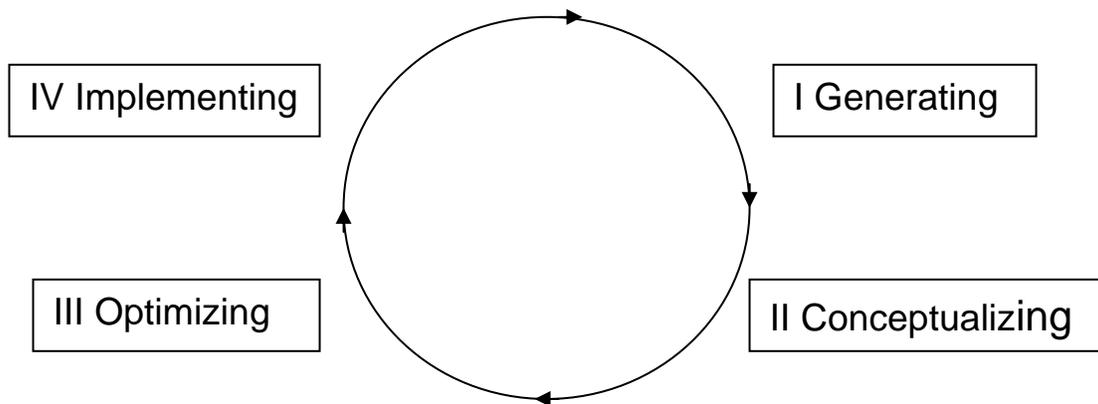


Figure 3. The Simplex creative process

Its four stages and eight steps include:

*Stage I Generating:* Creating options in the form of new possibilities/problems that might be solved and new opportunities that might be capitalized upon. It is composed of two steps:

- Problem finding, and
- Fact finding,

*Stage II Conceptualizing:* Creating options in the form of alternate ways to understand and define a problem or opportunity and good ideas that help to solve it. It is composed of two steps:

- Problem defining, and
- Idea finding,

*Stage III Optimizing:* Creating options in the form of ways to get an idea to work in practice and uncovering all the factors that go into a successful plan for implementation. It is composed of two steps:

- Evaluating and selecting, and
- Action planning,

*Stage IV Implementing:* Creating options in the form of actions that get results and gain acceptance for implementing a change or a new idea. It is composed of two steps:

- Gaining acceptance, and
- Taking action.

Three skills are required for participants to use the creative problem solving process at each stage effectively: divergence, convergence, and the deferral of judgment – the ability to consciously separate the two previous steps. And obviously, many of the creative tools we have discussed previously can be used at each step of the Simplex CPS approach.

### **8. Final Remarks about CPS**

More than fifty years ago, Osborn (1953) introduced creative tools and a model for solving problems in creative ways. Since that time, this model, called Creative Problem Solving, has become one of the most widely used approaches for nurturing and applying creative thinking. Some early research by Torrance (1972) showed that CPS was one of the most widely adopted models in educational programs that empirically examined the extent to which creative thinking could be taught. His research also showed that CPS was the most effective method for enhancing creative-thinking skills.

Since its inception, CPS has undergone numerous revisions. Originally, this work was undertaken by Parnes (1997) and his colleagues, and more recently by Isaksen and his colleagues (Isaksen et al, 1994). CPS has also spawned other process models, such as Simplex (Basadur, 1995). Recent developments in CPS have transformed the model from a more *prescriptive* to a more *descriptive* process approach. In fact, the Simplex version of CPS possesses metacognitive attributes and thus has been referred to as the metacognitive view of CPS. As a prescriptive model, CPS had a linear aspect in which all challenges entered the process at a common front-end stage. Once into the process, work progressed, without deviation, through the same series of stages, regardless of the characteristics surrounding the challenge.

Today, as a descriptive process, CPS can be entered into at any stage, and the stages and tools are then applied in a flexible manner according to the specific needs of the task. We have seen that the Simplex version of CPS is organized into four stages and eight steps. In addition to these stages and steps, CPS contains many tools which can be used interchangeably within any of the stages. These tools are selected according to the needs of the task and are either divergent (i.e., used to generate options) or convergent (i.e., used to evaluate options).

To fully understand the metacognitive feature of CPS, it is necessary to discuss the preparation (design and planning) that precedes the use of CPS, whether applied individually or in a group. There is an explicit component that guides this preparation called Task Appraisal and Process Planning. This component adds the metacognitive feature to the CPS framework and thus, provides a departure from previous versions. To

further explore this feature of the CPS process, it may be helpful to provide a definition of metacognition.

Metacognition has been described in two ways: "knowledge about cognition" and "regulation of cognition". Knowledge about cognition refers to information about one's own or someone else's cognitive processes. Regulation of cognition refers to the planning, monitoring, and checking activities necessary to orchestrate cognition. With this definition in mind, let us now turn to a discussion of Task Appraisal which includes four elements: (a) personal orientation, (b) desired outcomes, (c) situational outlook, and (d) CPS methodology (Isaksen et al., 1994).

Personal orientation involves determining who owns the task and the degree of ownership; desired outcomes involves defining what outcome(s) the owner(s) would like as a result of using CPS; situational outlook entails assessing the background circumstances and present environment surrounding the task; and CPS methodology includes a determination of the appropriateness of CPS for this particular task based on the previous three elements. When a facilitator uses CPS with a client, all four of these factors are explored before CPS is applied to the task.

This exploration involves extensive questioning so that the facilitator can gain a working knowledge of the client's thoughts, feelings, and desires surrounding the task. Ideally, Task Appraisal is not complete until the facilitator believes he or she has elicited both "stable and stable information" which may be representative of the thoughts, feelings, and desires of the client. In other words, through questioning and discussion, the facilitator may gain "knowledge about cognition"; the cognition of the client. The end result of Task Appraisal is to determine if CPS is the appropriate method given the client's thoughts about the task.

Given this view, Task Appraisal appears to have features in common with the first of the two elements of metacognition. If the Task Appraisal indicates that CPS would be useful, given the client's perception of the task, then the next step for the facilitator is to engage in Process Planning. The purpose of Process Planning is to determine where to enter the CPS process and which tools to use so that the task evaluated in Task Appraisal is properly attended to. This implies adhering to the thoughts, feelings, and desires of the client. Given the explicit planning aspect of Process Planning, there appears to be a direct connection with the "planning" element within the definition of metacognition above.

However, in what ways does CPS relate to the "monitoring" and "checking" features of the given definition of metacognition? During a CPS session, the facilitator is in direct contact with the client and the work group and thus, has an outstanding vantage from which to monitor the process as it unfolds. One technique used to do this is to check in with the client to determine if the direction of options, during a divergent thinking phase, is going in the right direction. If it is not, the facilitator may suggest another approach that could assist in the proper generation of options that may be more relevant to the thoughts, feelings, and desires of the client. In this way, as well as others, CPS may

possess the "monitoring" and "checking" features of the given definition of metacognition.

## 9. Other Approaches

Let us shortly present other popular creative approaches to problem solving.

### Synectics (Gordon, 1961)

This approach to creative thinking depends on understanding together that which is apparently different. Its main tool is analogy or metaphor. It is an advanced brainstorming. The approach, which is used by groups, can help participants develop creative responses to problem solving. It helps users break existing minds sets and internalize abstract concepts. The facilitators can use Synectics in group work by leading the participants to:

1. *Describe the Topic:* The facilitator selects a word or topic then asks the participants to describe the topic, either in small group discussions or by individually writing a paragraph.
2. *Create Direct Analogies:* The facilitator selects another word or topic then asks the participants to generate a list that would have the same characteristics as those words or phrases listed in Step 1 (a direct analogy is set up to make comparisons between the two words, images, or concepts).
3. *Describe Personal Analogies:* Have participants select one of the direct analogies and create personal analogies. Participants "become" the object they choose and then describe what it feels like to be that object.
4. *Identify Compressed Conflicts:* Ask the participants to pair words from the list generated in Step 3 which seem to contradict each other. Always have the participants explain why they chose the words, which conflict. Then have the participants choose one by voting. How are auditory symbolism and personal inclination different?
5. *Create a New Direct Analogy:* With the compressed conflict pair voted upon by the participants, ask them to create a different direct analogy by selecting something that is described by the paired words. How are auditory symbolism and personal inclination like a painting, poem, movie, political party, etc.?
6. *Reexamine the Original Topic:* Return to the original idea or problem so that the participants may produce a product or description that utilizes the ideas generated in the process. They may concentrate on the final analogy or use analogies created in the other four steps.

Synectics puts into action the idea of making the familiar strange. It is a method for a group of individuals working on a problem in an unconventional manner. The technique emphasizes the non-rational elements of thinking in the anticipation that such an approach will provide a novel and a fresh outlook on a problem. The use of metaphors cultivates the employment of material which on first sight seems totally irrelevant to a problem.

### Sociodrama

Sociodrama is a way of simulating what happens in life in order to: explore social issues; develop greater understanding between groups and individuals; problem-solve and make

decisions; experiment and try out new options; rehearse new roles and strategies and predict outcomes. Sociodrama is concerned with social learning and problem solving in a group by dramatic methods. A sociodramatist will base their work around an understanding of the roles people play, the systems within which they work and the social forces which impinge on the situation being examined.

By using role reversal, doubling, sculpting and role playing within a number of different scenes, sociodrama is based on many of the principles of adult learning: it draws on people's experiences; is relevant to their concerns; it engages people in the learning process and follows the learning cycle of people being involved in a learning experience, which they have time to reflect and theorise upon afterwards before planning new actions. Sociodrama is a very useful creative tool to deal with conflicts in organisations.

Sociodramatists are always concerned about the wider social, political and economic influences operating in any particular situation. The real world doesn't always work according to text book formulae. People make decisions from a combination of external and internal factors and sociodrama gives people the opportunity to explore these different facets.

In the context of education, sociodrama can be used in teaching to enable students to explore situations from a variety of viewpoints and gain a better understanding of why decisions were taken and what other options were on offer. See further Sternberg and Garcia (2000).

### **Storytelling Workshops**

The purpose of this workshop is to use stories to build common understanding of a problem. When people participate in a common experience, many assume that there is shared meaning about that experience. We will invite participants to explore a situation from individual points-of-view with the intention of gathering collective information. Through personal stories we will build a group story about a problem. Then we can unravel the collective story to identify the underlying strands that define the problem.

The session will uncover about the problem:

- Shared history,
- Myths that exist,
- Assumptions held by individuals,
- Unique points-of-view,
- Archaeological foundations that are the underpinnings, and
- Existing/pre-existing roles.

The intended results of the session will be:

- Mindset focused on hidden problems,
- Patient listening to others' stories,
- Deepened learning/thinking,
- Talking in the "and" mode,
- Expanded examination of what a problem contains,

- Option-oriented thinking,
- Involved parties at one "table",
- Suspension of judgment, and
- Creating a container for the problem and problem solvers.

The session will create a space to learn, inquire, and reflect to enable the problem definition to emerge from the stories told. The purpose of this workshop is to use stories to build common understanding of a problem.

When people participate in a common experience, many assume that there is shared meaning about that experience. We will invite participants to explore a situation from individual points-of-view with the intention of gathering collective information. Through personal stories we will build a group story about a problem. Then we can unravel the collective story to identify the underlying strands that define the problem. See further the book of Allan et al (2002).

### **Disney's Strategy: For turning dreams into reality (Dilts, 1991)**

According to this method a creative person should be: a Dreamer, a Realist and a Critic.

This method follows somehow the following steps:

#### *1. Go into Dreaming Mode*

Step into the space you have chosen, where you can dream away to your heart's content. Dreaming is all about pictures in your mind's eye; so you will be standing upright, and your eyes will be up - because that is where we file pictures, in our brains. The trick, in this space, is to allow your dreams to be as crazy as they want to be - this is just the dreaming space: your realist and your critic will have their turn in due course - so let your dreams run riot! When you have dreamed the ultimate dream, step out of that space, and choose another space.

#### *2. Go into Realist Mode*

In the realist's space, you are going to become the logistics expert. What is going to have to be done, in order to achieve this dream? What resources will you need to provide? What modifications need to be made to the dream, in order to make it achievable? In this space, you will be detached from the dream, and have your feet firmly on the ground. It is practical questions you are dealing with here. When you have worked out how to achieve each step, and made all the necessary modifications to the dream, step out of the realist's space, and move to the critic's space (an equal distance from the dreamer and the realist - in other words: the critics space forms the third angle of an equilateral triangle).

#### *3. Go into Critic Mode*

The critic has a very important job. He/she is there to make sure you do not make a complete fool of yourself; lose all your money; get sent to prison, and so on. The critic's advice is vital: the critic's job is to keep you safe. Most of us try to ignore our critic - which he or she may well become. Whatever you say or do, your critic will persist in trying to keep you safe, so it would seem sensible to pay attention in the first place! The critic's job is to think up everything that can possibly go wrong with your master plan; and every possible bad side effect - so that you can be prepared for anything. In critic mode, you may find you have your hand by your mouth, as you talk things through with

yourself. You may be looking down, towards the hand you do not write with, as you discuss yes/no questions with yourself. Once again, you are detached from the dream. And, most importantly, it is the dream you are criticizing, not the dreamer. Listen carefully to everything that comes up, and be prepared to modify the dream still further. For example: your realist may have worked out how to fly a pair of red knickers from the top of the church tower, but you need to pay attention to the critic's warnings that this may upset not only the church, but also your friends and neighbours. Ask yourself what your outcome is for flying the red knickers. How can you achieve this outcome without upsetting the people you do not want to upset? Then you can modify the dream accordingly. When you have dealt with everything to the critic's entire satisfaction, move on to.

#### *4. Back into the Dreaming Space*

Dream the modified dream. What does it look like? Does it still achieve what you want to achieve in its more workable form? Test it out. Dream some more: now that the original dream is more workable, what other ideas come up? Once again, allow yourself plenty of time and space. Then move on.

#### *5. Back into the Realist's Space*

Now apply your practical, logistical mind to the modified dream. How are you going to achieve it?

#### *6. Back into the Critic's Space*

The dream has been modified according to your suggestions (and maybe more has been added), and the realist has worked out how to achieve it. So what do you think of it now? Is there anything else you are not happy with? Talk it through with yourself and, once again, pay careful attention to anything that may come up. If there is anything new, go through Steps 4, 5 and 6 again, until all three of you are completely happy with the whole project. And, when this is so, move on to.

#### *7. Getting Your Act Together*

You have been playing three different people in order to separate your project into its component parts - rather than having all your thoughts swirling around your head in a muddled mass. Now is the time to get it all together. You are going to turn your triangle into a circle by walking through the three spaces four or five times, to bring each task - and the thoughts and attitudes that go with them - back into yourself. You might like to sing a song, as you walk the circle - to distract your conscious mind, and allow your unconscious mind to absorb and enjoy all the benefits you have received from your dreamer, your realist and your critic.

You are now all set to turn your dream into reality.

### **9. Further Remarks**

Creative tools and methods can be useful in problem solving specially in situations where the problem identification, formulation and solution are found by creating options. There exist in the literature a huge amount of creative tools and methods. A complex problem in practice is the selection of the most suitable tools for a designed problem solving process.

In this chapter, the best known and most popular tools and methods have been presented and classified, enhancing their advantages and outlining some of their weakness.

Selecting a suitable method or a set of methods is a decision problem that has to be solved in a creative way. This is part of the art of problem solving.

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Some useful web addresses:

- [http://members.ozemail.com.au/~caveman/creativity/index\\_html/](http://members.ozemail.com.au/~caveman/creativity/index_html/)
- <http://www.thinksmart.com/>
- [http://www.creax.com/creaxnet/creax\\_net.php/](http://www.creax.com/creaxnet/creax_net.php/)
- <http://www.creativity-portal.com/>