Creative Design Methods: A Critical Analysis.

By: Niall O'Cinneide
Tutor: Gerry Walker

4th I.D. 1996

Contents:

Chapter One:

Introduction:

The introduction will consist of the reasons this particular subject was undertaken, along with a brief look at the background to the subject. An outline of the essay will also be included along with the aims of this dissertation.

There are a number of reasons that I have chosen this particular topic for this dissertation. The first and main reason is that as a designer and artist I have often reached a stage in the process of creation and realisation where I am unaware of how to proceed. This can manifest itself in the form of a mental block, where no new ideas seem forthcoming. There also exist times when it seems to me as though my ideas are lacking in originality. These feelings are common to most designers and artists, to varying degrees. Some have found these periods of creative drought to last for more than just a few hours, sometimes extending to months. At the same time some people do not ever experience this. A friend once suggested, whilst I was afflicted by such a period, that creativity was something that could be learned and that solutions could always be found to the most complex of design situations once a person knew how. I was soon to discover that a number of methods had been devised by which ideas could be produced, and problems could be solved. These were known as creative design methods. The quest began and ended rather abruptly. All of the literature that I found on these methods represented little more to me than psychobabble. Eventually, it was suggested to me that I try reading 'Design Methods', by Christopher Jones. At once, I began to understand the nature of the design process, the ways in which it breaks down and the ways it can be reinstated. The actual methods themselves appeared to have little relevance to my own, problems however, and seemed to concern themselves with groups of designers and corporations. It was a disappointment to me that few, if any, of these methods could be used by the lone student designer.

A few years later, I was introduced to a design method, produced by Sarah Cox and Graham Hitchings, that used random numbers to produce ideas and help solve design problems. Here was a method that could be used by individual designers and artists who might not have the time or the resources to instigate a brainstorming session.

Further analysis into their work showed how random numbers could be incorporated into earlier design methods to improve objectivity and allow certain methods be used in new areas. Fresh ideas inspired me to take a fresh look at these and other design methods. Perhaps, certain ones were more apt for certain situations than others. Perhaps methods could be combined, re-jigged and resuited to situations other than those they were originally intended for. This dissertation unravels formerly inaccessible processes, analysis their uses and suggests new applications and directions.

The essay will first take a look at creativity, what it means and if /how it can be measured. Chapter Two, although not specific to the task at hand (analysing creative design methods) is crucial in setting the context and purpose of this report. Following that, Chapter Three will look at the earliest research into design methods which will be analysed. This section includes brainstorming and synectics. Chapter Four then continues analysing the methods up to the modern day where random numbers conclude our journey. The methods will be dealt with in chronological order, each method being given a description and brief discussion . Another of my aims is to simplify design methods so they are accessible by all. Finally Chapter Five will conclude the essay and will draw together the ideas presented on each method and will look to the future of creative design methods.

Chapter Two:

Creativity:

This chapter will concern itself with creativity, what it means and it will also deal with both the truths and misconceptions about the nature of creativity. This is necessary to provide a strong background to understanding creative methods. This information is also of extreme importance when analysing methods and their success rates. The chapter will then focus on the reasons why design methods were derived and the intended uses for the methods.

First let us look at creativity and what is meant by the term. The dictionary definition tells us the verb to *create* is to bring into being or form out of nothing. To be *creative* means having the power to create and showing or pertaining to the imagination and originality. (Chamber's dictionary.) If one believes that creativity is something that cannot be learnt or that it is a talent granted to only a few worthy mortals, then surely there cannot exist methods that enable people to solve problems and create when otherwise they wouldn't be able to. The first section of this chapter will therefore commit itself to dispelling with the myths surrounding creativity.

Many of the great achievements that we learn of seem to leap far beyond the previously known. Take, for example, home computing systems. There was a time when the electro-magnetic disk, capable of storing a whopping great one mega-byte of information, was considered to be technologically advanced. Then, CD-Rom technology was released. State of the art laser technology was suddenly providing us with indestructible disks that could store up to 670 mega-bytes of information. The change occurred so rapidly that the technological leap appeared miraculous and swift but it wasn't. It took years to develop. It consumed more "person-power" than anyone can care to remember. Another even finer example is that of Isaac Newton. It is generally considered true that Newton suddenly discovered gravity on being assaulted by an apple that fell from a tree and onto his head. "Eureka?". Newton had spent a great number of years studying physics. He had therefore developed quite an extensive knowledge of the subject. His discovery did not just happen. It was the culmination of much experience in a particular field, at a particular moment.

"Genius is 1% inspiration and 99% perspiration", Einstein.

This mythical view of blinding flashes of inspiration, and of thoughts appearing out of the blue, has been fueled by many of the innovators of our time. Psychologists and others studying creativity and problem solving would argue that, in instances when an innovator experiences a blinding flash of inspiration, it is actually the case that they are just unaware of the mental processes that brought them to that particular revelation. In general, people do not describe their thought processes. They only tell us what happened and when. If we are lucky, we might learn of a few of the steps between the problem and the solution. This, however, is rare. (Rothenberg, 1979.) This is not to say that designers and creators do not want to disclose such information as to how a solution was reached. It is often the case that such persons cannot keep track of their own processes as they are creating. It is almost impossible for a person to analyse a mental process as it occurs. This is why innovators are often awestruck at their own achievements. It is these factors that have led to an immense amount of research into the unconscious mental factors that lead to such sudden leaps of insight. It is this work that has added particular depth to design methods as we know them. Many people believe that creativity is not an exclusive talent but is an ability that we can all learn.

Another of the great beliefs about creative ability is that a touch of madness or insanity is quite necessary. One immediately conjures up images of Dali's not so common moustache and Einstein's innovative hair-cut!

"The mind cannot attain anything lofty, so long as it is sane", Seneca.

This is an extremely tricky topic to deal with and one which cannot be concisely concluded. Creative thinking, divergent by nature, deviates from the norm. Innovations are deviations from the norm. Many theorists argue that creators and innovators deviate from the norm and are often at odds with standards, rules and conventions. Rothenberg in his book "The Emerging Goddess" tells us how creative people often oppose and seriously criticize the dominant values of the society in which they live. This trait extends to problem solving. An individual is not content to use conventional methods in solving a problem and induces divergent and original thinking in relation to the problem. People with these deviant qualities are therefore not inherently creative but are in fact forcing the preferred mode of divergent thinking on themselves and are often not conscious to this.

What about insanity? There has been extensive research into the relationship between mental illness and creativity in the past. Most would agree that psychological disorders alone will not induce creativity into an individual. However, if a high tendency toward psychopathology is coupled with a high ego strength in a person, the result will be a more creative individual. (French, P.) In looser terms, disorders of the mind, in tandem with the ability to overcome them, will result in a creative mind. Perhaps both deviancy and mental disorders in an individual cause a perceptual shift from the norm. This is divergent by nature, and thus will give rise to new and possibly innovative creations. Suppose then that a system was devised to force the average person to view things from a different angle. Could we then say that such a system causes divergent thinking, creation and innovation? Most people would think 'yes'. It is from this hypothesis that synectics and many other design methods emerged, as shall be shown further on.

In terms of creativity and innovation it is therefore safe to say, that with the right training or once provided with a means, we are all capable of divergent thinking and perhaps even innovation.

There is also another line of thinking as to why design methods originated in the first place and, indeed, why they are so necessary for design quality in general. To discover this we must look to the writings of J.Christopher Jones and in particular his book "Design Methods - seeds of human futures". Jones argues that modern manufacturing methods and the demise of the craftsman are primarily responsible for the need for design methods. In the day of the craftsman, the acts of designing and manufacturing were one and the same. Evolution in design was a slow process as changes and modifications to a design had to be tested using the actual product. A craftsman's design could not change overnight. It could only change one aspect at a time. Of immense importance was the fact that the craftsman governed the evolutionary process of his chosen craft without any equivalent genetic coding from which to derive the often complex forms that he / she reproduced (Jones, 1970). Coopers did not have plans to follow when making barrels. They had been taught through working with an experienced cooper how to do the job. Jones, through analysing craft evolution, makes a series of five conclusions which are used to compare craft to design by drawing. These are:

- Craftsmen do not and often can not draw their works. They often cannot give

reasons for all aspects of their designs.

- Most craft products derive their forms from countless tests of trial and error. This is a costly system of product development but can lead to surprisingly balanced design close to the needs of the user.
- Discordant features can often be seen on craft products. At times, a particular aspect of a craft item might need to be redesigned. As the rest of the item will not be redesigned at the same time, this feature can appear out of shape with the rest of the product..
- The store of information used to create a craft object is primarily held in examples of the product itself and also in the mind of the craftsman who will pass it on to his / her apprentice.
- The two most important aspects of a design, the form of a product and the reasons for that particular form are not recorded in a symbolic medium. This means that investigations into the form must take place using experiments on the product itself.

Design-by-drawing, on the other hand, separates the design of a product from the manufacture of the product. A designer using a drawing board can explore complex forms through totally symbolic media. Trial and error is replaced by experimentation with symbolic media. Jones notes three important effects of this type of product evolution:

- By specifying the aspects of a design through a medium understood by all people in the design and manufacturing industry, both the design and production work can be split up amongst different people.
- Design by drawing also enables the planning of products that were are too big for a particular craftsman to tackle. As above, only when dimensions etc... are specified in a medium understood by all involved can the work be split up.
- This division of labour not only increases the size of the products but can also increase their rate of production. Specialisation and production lines can be used.

Design by drawing essentially splits up the process of designing from manufacturing, that was particular to the craftsman. Designing as a profession came into being. The two major flaws in the design-by-drawing process are that the designer is relying on previous experience and imagination to decide whether a drawn product

will or won't work. Also, drawings do not take into account user needs. It is because of this that designers must make and test prototypes and form models as the process is ongoing. We now have a slightly precarious situation developing where the designer's task may be too great for them to cover it from all aspects, in particular from the point of user aspects. Take a group designing a large building. Without some form of system to check that all eventualities have been explored perhaps a fatal flaw could exist in the design. Symbolic representation can also contain flaws within it's own language. Problems that would appear on a real product may not be apparent on a designers drawings. In order for design by drawing to succeed, certain design methods have evolved to deal with the complexity of problems that modern designers are facing. Many of these methods were not initially developed for use by designers. Often they were used by mathematicians, engineers and marketers. This is not a flaw in the methods but is rather the beauty of them that they can be applied to almost any field that requires answers to a problem.

There exist design methods to tackle almost every stage of a product's development. (These include: Prefabricated strategies; strategy control methods; methods for exploring design situations; methods of searching for ideas {divergent thinking}; methods of exploring problem structure and methods of evaluation.) There even exist methods to choose methods! A dissertation of this size cannot possibly hope to deal with all aspects of the design stage. For this reason, we will concern ourselves with that aspect of designing that requires divergent thinking and methods created to induce this type of thinking.

Chapter Three:

Overview of chapters three and four:

Various design methods will be critically analysed as we proceed. Of particular interest is the means by which each design method attempts to increase creative output usually by removing inhibitions and mental blocks that occur in both the individual and the group when trying to solve problems creatively. Also of particular importance is the success rate of the particular methods in increasing creative output in both the individual as well as the group. It shall be found that certain methods are useful only to the individual, others are useful only in group sessions, whilst a notable few can be used by both the individual and the group.

The chapter will however begin with a short look at measuring the output of any of the design methods. This is of particular importance as it is very difficult to measure creative output as it is both qualitative as well as quantitative. Whilst one problem-solving method might produce over a hundred solutions, only three of which are viable, another method might produce only thirty solutions, but could contain eight viable courses of action. Most of the methods that will be reviewed come equipped with statistics supporting their claims of increased creative output. Brainstorming has reportedly produced over 150 ideas in one session (Jones, 1970), quite a feat, which I know could be true from attending brainstorming sessions myself. Out of those 150 ideas how many were viable? We are not told. What results can we compare this to? It is shame that many of the studies conducted to measure the success rates of the various methods have either been produced by biased testing parties (Eg. the creators of particular methods) or have not been compared to a control group or other methods. We must also consider that even if these results were available, how could one measure qualitatively the ratio of success between the various groups? This is an immense grey area that surrounds these methods. Due to the lack of standardisation of results of a quantitative and qualitative nature, they will be of little use to the purposes of this dissertation. So, any results that are given serve only as estimates of the method's ability to free it's participant's minds of rigidity. Due to this, the evaluation of the methods will be concerned with aspects such as cost, time, effort / accessibility, appropriateness and the considerations that must be born in mind when choosing and using any of the problem solving methods. Without further a-do, we shall delve straight into the early research into design methods.

Early research into design methods:

This chapter concerns itself with the earliest significant work into design methods. The two most ground breaking works in the early stages of design methods were the work done by Osborne on brain storming and the work by W.J.J. Gordon on synectics. These are both of particular importance as most modern design methods are variations of these two particular methods. First, however, one must have a brief introduction to the work of G.Polya which predated most, if not all, of the modern design methods. Polya is considered by many to be the father of heuristic reasoning. It was Polya who first premised that, if a problem before us is too complex, we should adopt an assumption that simplifies the problem. By adopting the assumption, we can solve a simpler but similar problem and, by inference, use this information to solve the more complex problem.

"If we have a complex problem before us which we cannot solve, is there a more simple problem which bears likeness or similarity to the more complex one? The solution to the more simple problem should lead us to a better understanding of both problems and thence lead toward a solution to the more complex one." Polya, 1944.

For example, what if one wants to know the area of a circle but has forgotten the formula? Polya's thinking would suggest that as we know the area of a square, assume that the circle is a square. By overlaying the circle onto a square, we can then approximate the area, or indeed work it out by a number of sub-routines, provided by Polya (Cox & Hitchings, 1992). See figure 1. Polya's book "How to Solve It", published in 1944, proved an invaluable source to most of the inventors of design methods. Polya's influence will be apparent throughout the next two chapter

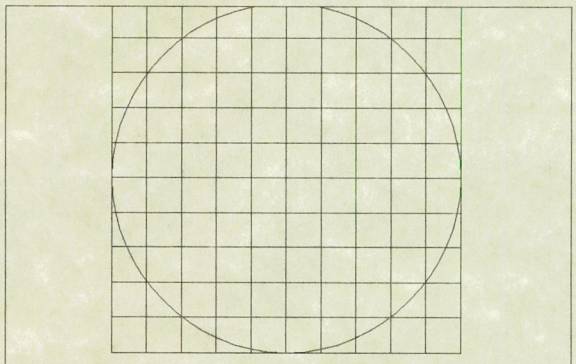

FIGURE 1: POLYA METHODS

Brainstorming:

So, let us take a look at brainstorming. Osborne first introduced the concept of brainstorming and defines it as "to practice a technique by which a group attempts to find a solution for a specific problem by amassing all the ideas spontaneously contributed by it's members". A brief outline of the process that takes place follows.

- Thirteen or so participants are chosen to take part. They should come from as diverse backgrounds as possible. This number is not absolute
- A group leader should be chosen who will be fair and who will ensure that all ideas are given an equal and fair hearing.
- The group should be informed that no ideas are to be criticized and that any ideas are accepted, even the wildest of notions.
- It is also important to stress that quantity of ideas is important and that participants can use already mentioned ideas to produce others by combining them or by improving on them.
- All ideas that are put forward should be recorded by the group leader (or someone not taking part in producing the ideas) where everyone in the group can see them.
- All of the ideas are then evaluated afterwards.

This is the basic approach to brainstorming although as we shall see later on in the essay that this particular method has been developed and there exist many alternative forms of it.

Essentially the basic system uses the diversity of it's participants to produce various approaches to the solution of a problem which might not otherwise be seen by people of the same interests / profession. The recorded solutions are then used to produce other solutions. The final, and in many ways the most important, aspect of brainstorming is that it defers criticism of solutions put forward by participants (until afterwards) and encourages deviant answers or wild ideas. Often it is found that a wild idea put forward in a group, that may seem very irrational, triggers an idea in another member of the group which could be used effectively in solving the problem that is being tackled.

It must be noted, however, that Osborne did not regard brainstorming, or

indeed any of the other methods, to be the be-all and end-all of maieutics. He viewed it as a technique to be used in conjunction with others. This particular piece of wisdom extends to all methods analysed in this dissertation and, as we shall see later on, there are even design methods that concern themselves with correctly choosing particular methods for particular problems.

In general, a brainstorming session is very easy to instigate. It also costs relatively little to do and takes only an hour or so to achieve results. Jones comments that the design team operating in the normal way might never appreciate the number of ramifications and points of entry of a problem (Jones 1970). It is fairly easily applied to most situations where the problem is relatively simple (most can be broken down into manageable chunks) for the group to understand and where the group's members have relevant experience. Brainstorming can also be used to generate information by getting the members of the group to ask questions about the problem and to suggest places where answers can be found. There are a great many applications for this particular method. Most of the difficulty is contained within the presentation of the problem to the group. This needs to be presented to the group as concisely as possible and in a manner that is understood by all. There are a number of methods that can be used to analyse problems and simplify them but these are not contained within the scope of this discussion.

As with any method there are a number of drawbacks and considerations that must be taken into account. The traditional way of brainstorming (as presented above), relies on people speaking up. Criticism is deferred from the proceedings but this is not enough to ensure equal participation from all members of the group. There is also likely to be a few particularly outspoken members in the group who will often dominate the floor. Thus many ideas from those who are shy will never get aired. If certain people do dominate the group, it is possible that the group can become fixated on certain areas when there are many more available that warrant attention. This works contrary to the aims of Osborne as he was attempting to remove social inhibitions in the members of the group in order to increase their creative output. As wild ideas are tolerated and indeed requested, it can also be the case that many of the suggestions are unfitting as solutions although this does not tend to pose as a problem as these solutions will usually only represent a small proportion of the large number of solutions generated. One final criticism before we move on is that there is little structure to a session particularly in comparison to the other methods discussed here. This can lead

to an eventual breakdown in the proceedings if the leader is not resilient in controlling the group. Arguments can ensue and / or the group can become demoralised by the chaotic nature of the proceedings...

Synectics:

The next of the earliest documented design methods that are of interest to us is that of synectics. First documented in 1961, by W.J.J. Gordon (although in use for some time before that) synectics is more complex and less accessible than brainstorming (as will be shown) but of equal importance. This method attempts to solve problems through the use of analogies and play. Piaget in 1959 wrote extensively on how children communicated verbally paying particular attention to the sometimes illogical and egocentric nature of children's talk. He noted that this sense of play could be used to solve problems or encourage adults to talk more freely in a group by reducing inhibitions. It is difficult to say if Piaget's work was of direct influence on Osborne but we can see similarities between his work and the hypothesis of synectics (as stated below). It is clear that they at least shared some of the same opinions.

- The creative efficiency of an individual or a group will increase if he/she/they understand the psychological process by which creativity / problem solving operates.
- When attempting to solve a problem the emotional component of the psyche is more important than the intellectual component.
- At the same time the irrational is more important than the rational.
- Emotion and irrationality must be understood to increase the probability of success with synectic methods.

Essentially Gordon is telling us that through understanding and the careful breaking down of the rational and other such inhibitors we can increase our creative output. A system of four analogical types was then devised for the synectics group to exploit in seeking solutions to problems. The four types were:

- **Direct:** How have similar problems been solved in the past? (Loosely based on Polya methods). Is there existing technology that could solve the problem? Biological analogies are also used in this part when one considers the animal kingdom and it's methods of overcoming certain problems using particular materials or structures.
- **Personal:** The idea here is to imagine oneself to be the problem in a biological sense or create biological analogies. If say one was trying to solve a problem concerning seating, one would imagine one's legs to be the legs of the chair, one's

thighs to be the seat, one's chest to be the backrest, and the arms of the chair would perhaps be one's own arms. This way, we imagine ourselves to be the object that is being examined. The example given is somewhat simplistic. This method has been applied to quite complicated engineering problems.

- **Symbolic:** Use symbols to define the problem. Metaphor and simile should also be used where aspects of one thing are identified with aspects of another. Examples would include, the *back* of a chair, the *legs* of a table, to *throw* a pot, *dead* weight, *red* hot.
- **Fantastic:** How would the problem be solved in a cartoon, fairy tale or surreal world? This particular type of analogy is not only easy to access but is also fun to use. Of all the above analogies, this is the one that will best encourage a group to revert to a child-like approach. E.g. if we had a little man to run back and forth with the cable...or, what we actually want is a light that floats in mid-air.

Figure 2, is an example extract of the conversation occurring during a synectics session. Gordon includes in brackets the particular mode of analogy that each person in the group is using. This particular session should not be viewed as typical in relation to the speed and quality of the result obtained. Often the process takes a lot longer and solutions are not usually reached with such ease.

The synectic process is also more particular than that of brainstorming in producing the desired results. For a start, the synectics group should comprise of carefully selected people that operate as a separate development department within an organisation. Ideally, the group should consist of two or three people from other organisations to the parent / host company, each of these persons having different academic backgrounds (biology is of particular use, as it aids in the case of personal analogies) as well as another two or three people from the parent company. All candidates should be chosen for their flexibility of thinking along with an extensive range of knowledge and experience. Those who have changed profession are of immense value to the group as this is a sign of both diversity and flexibility. The group itself needs to contain members of different age, sex and personality. Jones also notes in 'Design Methods' that further criteria include:

"...conversational behavior, bodily movement and the ability to participate with existing synectics groups".

It is also necessary for the group to be provided with separate premises, funding and

G. Okay. That's over. Now what we need here is a crazy way to look at this mess. A real insane viewpoint . . . a whole new room with a viewpoint!

T: Let's imagine you could will the suit closed . . . and it would do just as you wanted by wishing . . . (Fantasy Analogy mechanism)

G: "Wishing will make it so . . ."

F: Shh, Okay. Wish fulfilment. Childhood dream . . . you wish it closed, and invisible microbes, working for you, cross hands across the opening and *pull* it tight. . . .

B: A zipper is kind of a mechanical bug (Direct Analogy mechanism). But not air tight . . . or strong enough. . . .

G: How do we build a psychological model of "will-it-to-be-closed"?

R: What are you talking about?

B: He means if we could conceive of how "willing-it-to-be-closed" might happen in an actual model—then we. . . .

R: There are two days left to produce a working model—and you guys are talking about childhood dreams! Let's make a list of all the ways there are of closing things.

F: I hate lists. It goes back to my childhood and buying groceries. . . .

R: F, I can understand your oblique approach when we have time, but now, with this deadline . . . and you still talking about wish fulfilment.

G: All the crappy solutions in the world have been rationalized by deadlines.

T: Trained insects?

D: What?

B: You mean, train insects to close and open on orders? 1-2-3 Open! Hup! 1-2-3 Close!

F: Have two lines of insects, one on each side of the closure—on the order to close they all clasp hands . . . or fingers . . . or claws . . . whatever they have . . . and then closure closes tight. . . .

G: I feel like a kind of Coast Guard Insect (Personal Analogy mechanism).

D: Don't mind me. Keep talking. . . .

G: You know the story . . . worst storm of the winter—vessel on the rocks . . . can't use lifeboats . . . some impatient hero grabs the line in his teeth and swims out. . . .

B: I get you. You've got an insect running up and down the closure, manipulating the little latches. . . .

G: And I'm looking for a demon to do the closing for me. When I will it to be closed (Fantasy Analogy mechanism), Presto! It's closed!

B: Find the insect—he'd do the closing for you!

R: If you used a spider . . . he could spin a thread . . . and sew it up (Direct Analogy).

T: Spider makes thread . . . gives it to a flea. . . . Little holes in the closure . . . flea runs in and out of the holes closing as he goes. . . .

G: Okay. But those insects reflect a low order of power. . . . When the Army tests this thing, they'll grab each lip in a vise one inch wide and they'll pull 150 pounds on it. . . . Those idiot insects of yours will have to pull steel wires behind them in order. . . . They'd have to stitch with steel. *Steel* (Symbolic Analogy mechanism).

B: I can see one way of doing that. Take the example of that insect pulling a thread up through the holes. . . . You could do it mechanically. . . . Same insect . . . put holes in like so . . . and twist a spring like this . . . through the holes all the way up to the damn closure . . . twist, twist, twist, twist, . . . Oh, crap! It would take hours! And twist your damn arm off!

G: Don't give up yet. Maybe there's another way of stitching with steel. . . .

B: Listen . . . I have a picture of another type of stitching. . . . That spring of yours . . . take two of them . . . let's say you had a long demon that forced its way up . . . like this. . . .

R: I see what he's driving at. . . .

B: If that skinny demon were a wire, I could poke it up to where, if it got a start, it could pull the whole thing together . . . the springs would be pulled together closing the mouth. . . . Just push it up . . . push —and it will pull the rubber lips together. . . . Imbed the springs in rubber . . . and then you've got it stitched with steel! (See Fig. 4.2.1.)

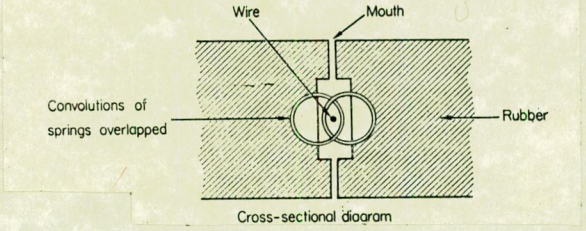

FIGURE 2: SYNECTICS EXAMPLE

a workshop in which the members can make form models and prototypes.

After one has formed such a group, the next step is to practice using the four types of analogies already stated. This is to help relate the spontaneous activity of the brain and nervous system to the problem in question. The group should also be taught to overcome personal inhibitions, feeling free to share their private thoughts with other synectors. This should be done by exposing the group to experienced synectors who should also be training the group to recognise the signs of an emerging solution to a given problem. The group should also be aware of the (apparent) excitement and pleasure that is experienced by a synector, if / as the problem is being resolved.

The process of solving the problem is broken down into five distinct steps:

- **The problem as given.** This is the original statement of the problem by whoever is commissioning the group.
- **Purging the group of obvious solutions.** This takes the form of a discussion, or indeed a brain storming session, where the group will eliminate solutions that are likely to be little more than variations on existing solutions.
- **Make the strange familiar.** At this point, the group resolves the complexities of the problem into more manageable terms, relating to the experience of the members of the group. Analogies are often used in an attempt to rid the group of assumptions regarding the possible solutions to the problem. This stage is very important and can also be used in conjunction with other methods.
- **Problems as understood.** The group should then familiarise itself with particular irreconcilable difficulties that prevent certain solutions.
- **Evocative Questions.** The team leader requests that the team work using one of the four analogies previously stated and uses evocative questions to ignite discussion on the problem in question. The "group plays in a leisurely and easy way with each evocative question," (Jones,1970). In the extract (figure 2) the team leader is 'G'. If we follow what he says, we can see how he teases the group in a playful manner with questions. The group would not function without someone like 'G' to direct the flow of thought. If the analogies get too abstract, or loose their relevancy, the team leader should direct the group's discussion back toward the problems as understood.

With practice, the group should be well versed in the methods of synectics so

now it can start to tackle the real problems as posed by clients etc.. using the above system. The extract already discussed shows how one synectics group came to devise a vapor-proof closure for space suits. The activities of the group are not however confined to discussion but also include the building of prototypes, mock-ups and other practical work.

The final stage of the group's work is when they present their output to their parent organisation or client. The idea is taken to it's conclusion and is accompanied by the usual presentation pieces, (technical drawings, models, visual aids and any other items deemed necessary to present the idea effectively.)

The most notable difference between brainstorming and synectics is that the original model of synectics (as proposed by Gordon in his book 'Synectics', and discussed here) is far less accessible than brainstorming. A synectics team requires a great deal of training for any kind of success as opposed to a brainstorming team that requires little or no training. This requires experienced synectors, for a number of months, to train the individuals. Further more a brainstorming session can be held impromptu with people who have never tried it before, whereas a synectics session requires experienced synectors, and takes a great deal of time and effort in organising the correct people for a team. Far more time and money needs to be invested in a synectics team as opposed to a brainstorming team. The members of a brainstorming team can also be replaced a lot easier than those of a synectics group.

The number of factors necessary for a successful synectics session can appear a little overwhelming. Jones also notes, with some concern, that synectors usually only synect for a few years before they leave the group (Jones,1970). This is largely due to the strain that this method places on the nervous system. Jones also suggests that mental health can be in jeopardy if synectors are not free to come and go from a group as they please.

One particular application of synectics that has not been documented is that to the individual. Direct analogies and fantasy analogies can be used by an individual to stimulate the imagination. One can easily imagine how their favorite cartoon character would overcome a problem or imagine one's body in the position of the object of the problem. It is also no mean feat to search existing technology for a solution to a similar problem. If the designer keeps track of their thoughts on paper using symbols or other

appropriate notation, a personal synectic session could ensue. Regardless of whether a solution is found, it is a good exercise for the brain and can increase the parameters of the search area. (Glover, Ronning & Reynolds suggest that even if solutions are not found that it is an excellent warming up session for the mind, [Glover, Ronnings& Reynolds, 1989]). This particular alternative to traditional group synectics is cost free, requires as much time as the designer wishes to invest and can be done almost anytime. The one drawback is that the designers attention can easily wander as this process of creating analogies is similar to day-dreaming when not being focused by a group and a leader.

Chapter Four:

Evolution of design methods:

At this stage, a clear understanding of the need for design methods, where they came from and the founding principles for creative methods have all been discussed. It is therefore time to examine the evolution and progress of the various methods in use. This chapter will examine the variations of design methods up to 1992. It will conclude with the work done by Graham Hitchings and Sarah Cox, through the University of Limerick, on the use of random numbers in design.

Removing mental blocks:

The first method that will be explored in this section is that of removing mental blocks. It can be said that all design methods aim to remove mental blocks (as shall be discussed later). This heading covers a number of ways of stepping around inhibitors to free thinking. This area is not attributed to any one particular theorist but is found in the later work of Osborne and the works of Broadbent, Crawford, Whiting and Jones. The basic idea of removing mental blocks is to find new directions / search space when no wholly acceptable solution is being found. It is at this moment that a designer might feel as though they had a mental block. Various methods by all of the above (and other writers on creativity) have been recorded by which a designer can induce in themselves a new approach to a problem. Most of the processes for removing mental blocks can be classified under one of the following types:

- Rules that can be applied to an existing unsatisfactory solution that cause it to transform parts, if not all, of the solution into an alternative one. (Metamorphosis).
- Search for new relationships between the components of a product / solution.
- Re-assess the design situation.

Transformation of the existing solution is achieved by using a thesaurus such as Roget's Thesaurus (as suggested by Broadbent, 1966), or by using Osborne's suggested transformations, (put to other uses?, adapt?, modify?, magnify?, minify?, substitute?, re-arrange?, reverse?, combine?). Different transformations can be applied to different parts of the solution and permutations can be made by swapping the transformations with the solution's components. It is easy to see how this solution will instantly increase the number of possible solutions to a problem.

Both Crawford and Whiting have contributed methods aimed at generating potential links between the component pieces of a product. Crawford uses attribute listing for the systematic searching for alternatives to the main attributes of a design. Whiting, on the other-hand, uses a matrix to explore every possible connection between the components of a product. Take a pendant lamp as an example. Is it possible to juxtapose the dimmer and the shade? Or perhaps wheel changing equipment. Can the wheel brace also be used to raise the jack?

Jones offers a form of transformation that can be applied to the design situation, essentially the same techniques as suggested by Broadbent and Osborne, but applied to a phrase describing each difficulty as perceived. The designer then substitutes words within the phrase for others thus altering the designers perception of the problem but not necessarily offering a new solution.

These are but a few of the many ways of tackling this particular area. Matchett, for instance, has provided lists of questions / checklists that can be used at the various stages of the design process to overcome mental blocks (Matchett, 1966, 1967, 1968). S.Gregory's book, 'Creativity in Chemical Engineering Research', summarises many of the above methods into two very manageable lists.

These methods for removing mental blocks are extremely easy to access and don't require a large group of people to perform. In fact, they can be performed rather successfully by the lone designer by simply redirecting the search for a solution away from areas that proved to be fruitless. They are also extremely cheap, require little time for the most part, and require no training.

There are two drawbacks to these methods. First of all, the methods are used to increase the search space and are not directly aimed (unlike the previous methods) at finding a solution. An assumption is made that the designer is unaware of the available search space. Jones points out that this is not characteristic of professional designers but of amateurs (Jones, 1970). This, coupled with the apparent belief of some designers that to resort to these methods is like resorting to mental trickery, puts many people off using these methods. It is also possible that an individual might not recognise that they are experiencing a mental block and so would not use these methods when most necessary.

In general, the negative aspects to these methods are minute and are merely matters of the ego or common sense. There is also little by way of concrete evidence to support these claims. Even if there was, very little time and energy is required to utilise these methods so there is little to loose by trying them.

Morphological charts:

The next method that shall be briefly investigated is that of using morphological charts as they have similar goals to the previous method. Morphological charts aim to widen the search area for a solution to a particular problem by using a form of listing. First the functions that an acceptable solution must have are listed on a chart (eg. fig. 3). Next, list as many solutions for the individual functions as possible alongside the functions. Investigate the feasibility of as many paths through the chart as possible until an acceptable solution is found. This is probably the single most accessible of all the design methods investigated so far. It requires little time and can be quickly applied to most situations where the essential functions of a product can be recognised and are independent of one another.

ESSENTIAL FUNCTIONS	SUB-SOLN. #1	SUB-SOLN. #2	SUB-SOLN. #3	SUB-SOLN. #4	SUB-SOLN. #5
AIR TEMP.	WARM AIR FROM A CENTRAL SOURCE	CONVECTOR IN ROOM	CONVECTOR RADIATOR IN ROOM	INCIDENTAL FROM RADIANT SOURCE	
RADIANT TEMP.	HIGH TEMP. ELEC. HEATING	HIGH TEMP. FROM FLAME	LOW TEMP. FLUID PANELS	LOW TEMP. ELEC. HEATER	INCIDENTAL FROM SURFACES
AIR MOVEMENT	NATURAL	FORCED	NATURAL CONVECT.	FORCED CONVECT.	
HUMIDITY	NO SPECIAL PROVISION	EVAPOR. HUMIDIFIER			
TEMP. GRADIANT	BY DISPOSITION OF APPLIANCE				

FIGURE 3. MORPHOLOGICAL CHARTS

The designer must be aware that all paths cannot possibly be investigated due to time restrictions and that the individual will be biased when choosing paths to investigate. Random numbers could be used to ensure that the designer would have no personal input in the choice of paths to be investigated. More about this further on.

Developments:

By the early 1970's conferences on design methods were commonplace, particularly throughout the United Kingdom. The news was spreading fast and more and more people began to experiment with these ideas. In 1970, the first edition of "Design Methods" by Christopher Jones, was published. This book has become a bible of sorts to design methods, allowing professionals and students alike access to information on nearly all of the methods in common use. Most of the work that has since been done in this field, particularly with the divergent methods that concern this dissertation, has either been in evaluating the quality of results from the methods or enhancing/adapting them to particular fields and situations. Research had been conducted by a number of psychologists and theorists into synectics, possibly the most complex of the methods examined. This was often conducted in parallel with research into the creativity of the mind in general. O'Doherty (1963) came to the conclusion that biological analogies resulted in high speed creative skills among his test groups. Newman (1966), worked on how a synectics group could learn to recognise that they were on the right train of thought in order to realise a solution. He suggested that, when the correct path was found, there would be a decrease in mental activity as some of the many patterns of thought would begin to map over each other onto the same piece of brain network. To reinforce solutions, different types of analogies should then be used until one particular track had held fast for a number of different situations. Matchett (1968), the pioneer of Fundamental Design Methods (F.D.M.), pointed out that the two major factors that block creativity are the inherent mental rigidity / desire for certainty in man and inhibitions relating to confidence, social factors (when in a group), etc... If the inhibitors could be decreased, creative output would increase.

Cropley (1970), found that data relation that is not obvious was a characteristic of creativity. Therefore, by the very act of creating analogies in synectics that one wouldn't usually use, one is altering ones mind toward a natural state of creativity. Glover, Ronnings & Reynolds, in their book "The Creative Handbook", urge fellow writers to use the idea of analogies from synectics to overcome writing blocks. The example given is that a writer has to do an article on the office but cannot come up with an angle with which to approach the subject, he/she should choose a subject of the top of his/her head and create analogies between that and the subject of their writing. Suppose we chose the African Jungle. The office aquaport could be likened to the

watering hole, section managers like vultures circling their unsuspecting prey and what about the monkeys upstairs who think that they are high and mighty? One could go on. Perhaps the most important point that is made is that synectics can be used as a warming up tool. It is not a means to an end/solution, but is an excellent means of warming up the imagination.

Tony Buzan in his book " Make the Most of Your Mind " (1980), asks the reader to write down on a piece of paper as many uses as they can think of for a paperclip, allowing only two minutes. Most people, we are told, produce between two and eight ideas per minute. Buzan goes on to suggest that, amongst other things, it is the rigidity of the mind that holds back creative ideas. In the test, most people assume that 'uses' refers to ordinary, sensible applications and that, if we are freed from this, we can become far more creative. Perhaps we could melt down a few billion paperclips and make a space ship out of them? The creative mind, changes the words "uses for" to "connections with." Realising that the mind can make connections between almost any two objects, we can produce an unlimited amount of use for the paperclip. Then, the reader is confronted with the same test, but this time is allowed look at a list of forty words (fig.4). Buzan asks if we cannot find forty uses connecting the paperclip with each of the forty listed items. All of a sudden the reader is awash with ideas. This method is similar to that suggested by Glover, Ronnings & Reynolds and of course to synectics itself. By comparing seemingly unconnected data, perhaps through analogies (synectics), we can tap an almost limitless source of inspiration.

ORANGE	PIGEON	WATER
WATCH	BOTTLE	HOLIDAY
WINDOW	SHOE	DINNER
LEAF	BOOK	GARAGE
TABLE	CUP	TEA
RADIO	CLOUD	TREE
LIGHTBULB	PEPPER	HOUSE
HANDBAG	GLASS	WINE
PEN	CHAIR	MAID
TYRE	GARDEN	NEWSPAPER
EAR	GERMANY	PUB
POTATO	WOOD	BANANA
KITCHEN	RAIN	MIRROR

FIGURE 4: BUZAN'S LIST

During the rest of the eighties, further advances were made especially in the field of synectics. Collins and Gentner (1980), wrote how an ideal balance of methods could be produced by combining brainstorming, synectics and listing. They suggested that these methods could all be used both separately and together, in any combination deemed necessary, to increase creative output. Caccamise (1981) concurred, adding that when a group feels as though it has run out of ideas, it usually hasn't but has only exhausted a particular search set. Then analogies, lists, etc... should be used to find new areas in which to find a solution. Much of the work in the 70's and 80's concerned itself with the analysis, classification and organisation of design methods. Much was added by the various individuals mentioned but it wasn't until 1988, that new ground was discovered by Nicholas Roukes.

Triggers for synectic thinking:

Roukes has done a lot of research into synectics in his years as a design professor publishing his much acclaimed book 'Art Synectics' in 1984 of his earliest work. Then in 1988, his book 'Design Synectics was first published. Roukes concerned himself with that aspect of synectics that encourages the comparison of seemingly unrelated data and situations. In this book Roukes proposes 21 "trigger mechanisms" that can be used to induce creative thinking. These are:

- **1: Subtract.** Simplify, eliminate, dispose of the unnecessary.
- **2: Repeat.** Echo, restate, duplicate, control the sequence of events.
- **3: Combine.** Mix, arrange, merge; combine the materials, connect dissimilar things.
- **4: Add.** Expand, magnify, advance in time.
- **5: Transfer.** Move the subject into a new situation, or out of it's natural environment.
- **6: Empathise.** Give your subject human qualities. Become the object. Relate to it emotionally.
- **7: Superimpose.** Overlap ideas on top of one another to create something new.
- **8: Change scale.** Make the miniature gigantic and the huge microscopic. Change proportions.
- **9: Fragment.** Split into pieces, and examine separately.
- **10: Isolate.** Chose one element, crop it like a picture, and examine it in detail.
- **11: Distort.** Bend it out of shape. Make it fatter, weirder, crush it. Rip apart, and reassemble it.
- **12: Disguise.** Camouflage it, deceive the viewer. Create a meaning for the subconscious.
- **13: Contradict.** Take the original purpose and flip it. Contradict gravity, time, human anatomy.
- **14: Parody.** Make it bazzare. Make it a caricature. Transform it into a visual pun.
- **15: Prevaricate.** Bend the truth, fictionalise, fantasise. Purposefully mislead or confuse.
- **16: Analogise.** Compare, seek similarities, make metaphors.
- **17: Hybridise.** Marry your subject onto an unlikely mate. Combine colour,

materials, organic and inorganic elements.

- **18: Metamorphose.** Imagine the subject changing. Picture changes in sequence and out of order.
- **19: Symbolise.** Give the object a visual reference by making it into a symbol of something else.
- **20: Mythologise.** Build a myth or story around the object. Transform the object into a mythological idol.
- **21: Fantasize.** Trigger preposterous ideas, "what-if" thoughts, like "if cars were made of clay...", "if cats were the dominant species on earth..."

This is a very long list of transformations that not only stems from synectics but also from methods used to remove mental blocks, as discussed earlier. Figure 5 , shows a few examples of these transformations as used on a toaster. It is easy to see how ideas can be very easily generated using this technique. The process requires little or no instruction and can be used by both groups and the lone designer. It is also as cheap a method to instigate as is likely to be found. Certain drawbacks exist once again as with those for mental blocks. Some designers are extremely put off by lists and also designers may not necessarily realise when is appropriate to use this method. From looking at figure 5 , one could be lead to believe that solutions to problems will not be generated by using this method. All one could hope for is a better understanding of the subject matter and the implications and reasons for certain aspects for both the objects existing and potential design direction. It is in my opinion and experience that this is not the case. Indeed, if one only gains a better understanding of the problems, one is much closer to an answer. One also finds that, by and large, designers use transformations to generate ideas without being consciously aware of doing so. Roukes has merely demystified a process that naturally occurs in many innovators.

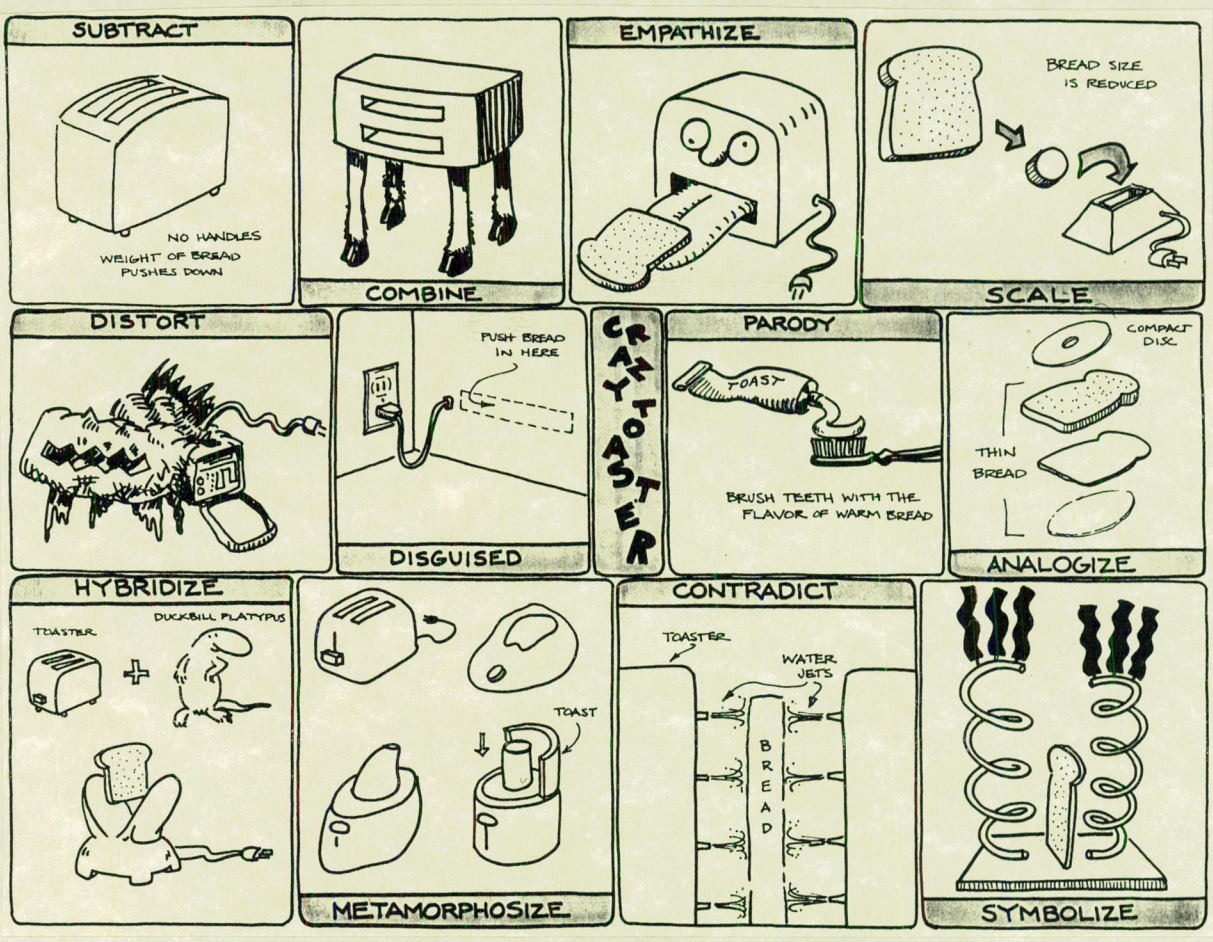

FIGURE 5: TRANSFORMATIONS

Designing using random numbers:

And so finally we arrive at the work of Cox and Hitchings, released publicly in 1992. This work increases access to most of the methods discussed and can force lateral thinking in the designer. Much of their work has roots in Edward De Bono's "Lateral Thinking for Management" (1971), as well as the works of Jones and Polya.

Both Cox and Hitchings had a fundamental belief that anyone can be creative and that it is not something that people either have or do not. They open their paper on "Designing a Course in Design Methods" (1992), by telling the reader that "The authors of this paper believe that all people have a creative flair and under the right conditions can develop this ability to a far higher level". They both felt that existing design methods were not as accessible as they should be (most of them are totally inaccessible to the solitary designer) and that the biases of the individual would prevent them from viewing search areas that they should. A factor was then sought that could be utilised to remove bias from decisions concerning search parameters and this factor was found, namely, random numbers. As they worked with random numbers, it became apparent that there existed numerous applications for them in the field of design methods. There are three main areas in which they applied their research that is of interest to us. Let us start with the area of attribute listing.

Random Attributes:

Generating ideas using attribute tables and random numbers is the first area that we will look at. Figure 6 is an example of a table of attributes that we can apply random numbers to. If we take six numbers from a random numbers list, say 4,7,2,2,9,5, we would have a toilet seat, made of plastic, that is round in shape, maroon, bumpy and robust. The designer must then try to make this combination work. If a new product is not sought, the last column is eliminated from the table and the attributes list is applied to whatever product is in question. This list is obviously not an essential aspect of this method. A list of attributes suggested by a design team could be used, etc... Cox and Hitchings maintain that this method will induce non-linear thinking and will also serve to broaden an individual's thinking in design

NO.	MATERIAL	FORM	COLOUR	TEXTURE	SPECIFICS	PRODUCT
1	LEATHER	CONIC	BLUE	RIBBED	LIGHT	SCALES
2	GLASS	CYLINDER	MAROON	BUMPY	SIMPLE	FUEL BOX
3	BRASS	PRISM	WHITE	SMOOTH	USER-FRIENDLY	DOOR
4	PLASTIC	CUBIC	YELLOW	FUR	CHEAP	KETTLE
5	STEEL	RECTANG.	AMBER	WOVEN	UP-MARKET	TOILET SEAT
6	CERAMIC	SQUARE	CRIMSON	WOOLY	HEAVY	LAMP
7	CARD	ROUND	RED	DIMPLED	COMPACT	PHONE
8	ALUMIN.	TRIANG.	ORANGE	SHINY	PORTABLE	OVEN
9	WOOD	ELLIPTIC.	BLACK	PRICKLY	ROBUST	BOOT
10	COPPER	SPHERIC.	GREEN	SCALEY	ORGANIC	BIN

FIGURE 6: TABLE OF RANDOM ATTRIBUTES

This method is a great way to warm up and is good fun to use. Often it can give a design team a fun breather whilst helping to free up their thought patterns. It can also be used to come up with new ideas for products. Once again, it is cheap, requires no training or practice and requires little time. This technique can also be applied to

morphological charts (discussed earlier) as the designer must pick a list of functions for the product. Why not use random numbers to choose them? It can also be used if a designer wishes to randomly juxtapose a few components of their product. This method, however, will rarely lead directly to a solution but is useful in overcoming mental blocks and, as the authors claim, induce non-linear thinking, altering one's perception of any problem.

Sampling 3-D space with random numbers:

The second area that we will look at is product redesign using random numbers. The essence of this method is to randomly sample in three dimensional space potential locations for the parts of a product. Once again this method serves to force the process of lateral thinking. The example they give is to take a toaster and draw it in two dimensions as though the object had been unfolded. A grid is then superimposed over the plan (fig. 7). Lets say we wish to reconsider the location of the temperature control knob. We take sets of random numbers and locate around ten sites on the grid for relocation of the control. We must then try to make the control a feasible proposition for each of the locations. In almost all locations, it is possible but perhaps uneconomical, hazardous or over-designed to locate the control. It is however possible to overcome most of these problems by further consideration.

As when using random attributes, even if the designer does not use the results of the method itself, one finds that the search space has opened up, the imagination is flowing and non-linear thinking is in effect. Quite often the results can be surprisingly valuable and can solve relatively tricky problems. As with random attributes, this method is cheap, time-efficient and requires little or no training.

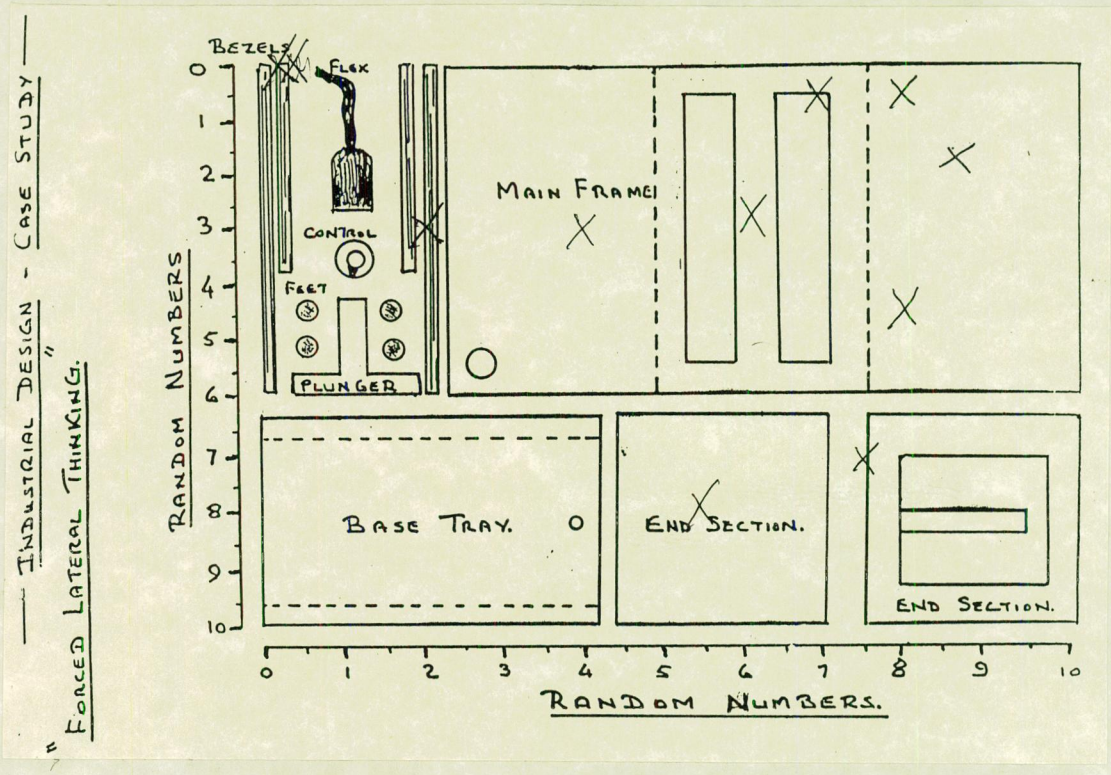

FIGURE 7: RANDOM SAMPLING IN 3-D SPACE

Brainstorming using random numbers:

The third and final application of random numbers, of relevance to us, comes in the form of a familiar method updated. Cox and Hitchings, although believing in the power of brainstorming to produce ideas quickly, were very aware of the drawbacks to this method. It was felt that in any given group that:

- There will exist dominant members, a situation that is not conductive to free creative design.
- A group could easily become fixated on particular ideas, impairing the search for new ones.
- Regardless of how comfortable people could be made, inhibitions would still exist as people do not like to appear foolish. This was a problem that had been tackled in the past but had never been properly solved.
- There is also a lack of structure in traditional brainstorming sessions which can lead to a breakdown in the production of new ideas.
- As there are so many ideas being bounced around, there is little time for the absorption or evaluation of ideas suggested within the group.

And so, they developed a novel approach to brainstorming that applies structure to the session and overcomes most if not all of the short comings of brainstorming, using random numbers.

Part I:

- Thirteen or so participants are chosen out of which a leader is picked. This can be done using random numbers.
- Each participant is randomly assigned a letter from A to L.
- Each participant is given a "talking tube", a piece of cardboard tube about 10cm diameter and 40cm long.
- Each member sits at in the space assigned to their letter. At each space are two sets of cards, one marked for transmitting, the other for receiving.
- The problem is given by the leader, in as concise a manner as possible. As many questions as possible should then be asked about the nature of the problem. Note that this stage is not for producing ideas and solutions, it is for finding out the depth of the problem.
- In clockwise direction from any starting point, the participants convey one of

their ideas to the person next to them. Complete silence is observed. This should continue until there is a lull in activity. Each participant should jot down ideas received, and those transmitted.

- Next, the direction should be reversed following the steps as before.
- The participants should then be reseated randomly, in the same way that they were to begin with, and ideas should be conveyed again, starting going clockwise and once again reversing the direction.
- These steps should be repeated until the group leader feels that there is little more to be gained or an hour has lapsed.

Part II:

- Participants are randomly placed into four groups by drawing numbers (or by similar means) a leader is appointed to each group at random.
- At this time, Cox and Hitchings recommend that a break of about 20 mins is given where discussion of the session's possible outcome is actively discouraged.
- Each of the four sub-groups reassemble and each member gives a ten minute talk on their ideas to their group, the other members taking notes.
- The subgroup leader then writes up a summary of all the ideas put forward.
- Another break is advised at this conjecture.

Part III:

- All group leaders present their summaries to the entire group. Sub-group members should ensure that their leader airs all ideas / solutions from the group. Questions are invited, comments proffered and discussion is welcome.
- Each of the sub-groups reassemble into their subgroups and the sub-group leaders draw up a list of the three most popular ideas with the help of their team members.
- In the final stage, the group reassembles entire and the twelve ideas (three from each group) are discussed in detail. They are then prioritised and a final choice is made. The group leader writes a final report which should embrace concisely the outcome of the exercise.

The authors note that "what is proposed is not problem solving by committee. The problem is now far better understood and, with the large number of ideas generated, fruitful design can commence".

It is easy to see how this method is a dramatic improvement on traditional brainstorming. The authors claim that social inhibitions are almost totally removed as much of the work occurs on a one to one basis. This version of brainstorming, although requiring more time, cost and effort, is a great improvement on the original technique. It also provides for a convergence of solutions, down to a recommended few, which none of the other methods supplies. It is also very fair and arbitrary to all participants and ideas which neither synectics nor traditional brainstorming are.

It can be argued that this method will not produce the same diversity of thought as the original brainstorming sessions would. The environment could stilt creativity by it's silence and very formal structure. One could also say that, by maintaining silence, a lot of the fun is removed from the exercise and fun, as we know, is an aid to creativity in most circumstances (as maintained by Piaget and Gordon). Also, perhaps not enough ideas are being bounced off the members of the group and that the rate of transferal of ideas could bore certain people in the group. Ultimately, the decision whether to use this or the traditional method of brainstorming will rely on the experience of the organiser and the circumstances surrounding the session.

Chapter Five:

Summary and conclusion:

The final section of the dissertation will give a synopsis of the various conclusions drawn during the essay. Finally a speculation of the future of creative methods will be presented.

As seen, design methods are adaptable and can often be combined. The beauty of the use of random numbers is that the designer can be totally objective. Take morphological charts for example. There are numerous paths that can be taken, the designer rarely having the time to investigate all. Using random numbers to decide on for example, ten paths, would ensure that paths that would not be investigated, due to being viewed unlikely, might be investigated, possibly yielding innovationary ideas. No one particular method should be viewed as the "be-all and end-all" of methods as Osborne pointed out very early on. During the creative process methods should be switched regularly as some are more suited to particular situations than others.

Are certain methods better than others in general use? The answer to this question is yes. The jury is still out as to whether or not creativity can be measured. This means that the only reliable criteria of evaluation are accessibility, cost, time v output, adaptability and the objectiveness of the method. The original models of synectics and brainstorming are therefore of less use at present than the other, newer methods. The work of Cox and Hitchings, as well as that by Roukes, is possibly of the most use to the most people. However, it must be said that the only reliable judges of the merits and drawbacks of the various methods are the people that use them. I have my personal favorites, and so will you. In a situation of limited time, the latter methods are far more appropriate, as they are more accessible. They can also be utilised by the lone designer and cost very little to instigate.

Methods that can be used by the individual can also be viewed as more important than group methods. It is impossible to remove all social inhibitions in a group session of any of the methods above. Within any group certain individuals will invariably speak less than others. Even a group utilising the modified version of brainstorming suggested by Cox and Hitchings will suffer a degree of social inhibitions. This will give rise to all of the problems associated with blinkered thinking, negating

the success of the method.

The success of any method will also largely rely on the success of the design process both before and after the creative stage. If the problem / design situation is not properly explored and understood by all dealing with it, the methods discussed will be of little use. Ideas produced will often be unsuitable or simply inappropriate as all aspects of the problem and ramifications of various known solutions are not known to the group / individual. Even if the process succeeds unhindered to this stage, there is no guarantee that the correct solution will be chosen or, if many solutions are available, that the most appropriate is chosen. For this reason convergent methods must be used in conjunction with the divergent ones explored in this essay. An innovative feature of Cox and Hitchings modification of brainstorming is that it includes in it's process systematic managed convergence of solutions produced. Perhaps more methods will be devised in the future that provide for more than just one stage of the design process. There is, however, danger in one method being used throughout the process. If a mistake is made early on, it could jeopardise the rest of the project. It is also often the case that, in deciding on a solution, the designer must put a number of possibilities to the test to make the correct choice. As discussed early on in chapter two there are aspects of situations that cannot be explored solely on paper.

It is also necessary to point out that whilst certain methods are not aimed at directly providing a solution to a problem, they free the mind to think in unusual ways. On returning to face the problem, directly, the designer may well experience sudden inspiration and a solution to the problem. In this case, the problem is being solved indirectly by using a method to 'warm-up'.

So, to the future of design methods. What next? There is do doubt that methods will be continually adapted and enhanced for situations that exist now, as well as those yet to come. The more these methods are used the more they will improve. We must look to apply them to situations that one wouldn't think appropriate. The only requirement for the methods to be instigated is to have a problem or question that needs answering. One must merely state the initial problem or situation that needs exploring in the correct way to allow the method access it. Traditionally these methods have been used in business, manufacture, design and science, but what of the arts? What of English criticism? What of music? Much can be learnt by innovaters in these fields by the use of design methods. Much can be learnt of methods by their use in these fields.

The nature of design methods is to remove mental blocks preventing innovative thinking and to show us how to look at things differently. If one knows the blocks and understands the nature of them and the nature of creativity, one will become far more creative. By way of conclusion, I present Roger Van Oech's list of rules that inhibit free thought and, therefore originality. In his book 'A Whack on the Side of the Head' he suggests that we must strive to knock down the accepted ways of doing things. He suggests that these are the mental blocks that hold us back:

- **The right answer:** We must look at second, third and fourth answers as being just as correct as the first answer. Ask different questions. Not "what should this hammer look like?", but "how does the hand work?"
- **That's not logical:** Logic is not the only form of relevant thought. We must sometimes look to the illogical. What would a chair look like if our legs bent the other way?
- **Follow the rules:** Rules help keep order but don't encourage new thinking. Sometimes one must break out of a pattern to discover another.
- **Be practical:** Ask what if questions. What if we had seven fingers per hand. How would this affect the design of a typewriter? What if ugly objects were in?
- **Avoid ambiguity:** Sometimes it is in our best interests to be vague rather than precise. Use humor as it plays tricks on logic, and that is what ambiguity is about.
- **To err is wrong:** If you want hits, be prepared for misses. Risk takers are apt to fail, but when they succeed they succeed big.
- **Play is frivolous:** As we have already discovered, fun and play lead to creativity and originality.
- **That's not my area:** Everything in the world can be a source for great ideas. Don't ignore the unusual. Solutions are often contained within completely unrelated fields.
- **Don't be foolish:** Wrong! Practice foolish behavior and avoid groupthink. This leads to innovation.
- **I'm not creative:** The biggest inhibitor to creative thought. You are if you think you are.

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