What stimulates the creative process?

Abstract
A study has been carried out to explore the processes of creativity and innovation. This took the form of a three day workshop between scientists and designers. In particular, the study concentrated on the differences in approaches to idea generation between the backgrounds of science and art. The study has raised issues regarding the environments that are favourable for creativity, whether it is art or science-based. It has also indicated that conventional commercial modes employed to stimulate novelty, such as brainstorming, could be outmoded and restrictive. The study has identified gulfs between the areas of science and art in the techniques used for imagination; such as the tools and processes applied, which inspire the transfer of these techniques. In particular, the environment, and changes in this environment have been identified as important factors in the stimulation of ideas; this has implications for the present change culture strategies adopted by many commercial industries.

Innovation and creativity, and those skilled in the art, are in great demand in the late 1990s (Day, 1994). So-called *Innovators* and *Creatives* can command prestigious positions within large multinationals or as contractors via small consultancies. They are often responsible for everything from corporate identity through technical positioning and also corporate strategy. There is a current, supporting vogue to this trend in the appointments sections of the national dailies for high-level *innovators* and *creatives* to adopt the positions of blue-sky scientists, technical managers and strategists. Above all, the ability to innovate, stimulate and communicate ideas is a valuable currency in the present commercial world (Research-Technology Management, 1997).

It is surprising then that the actual nature of creativity (maybe defined as the ability to generate novel ideas) remains a mystery (Fitzgerald, 1990; Kawenski, 1991; Amabile et al, 1996). Very little research has been carried out to explore the environments and the rewards necessary to stimulate effective innovation. Neither has the process been adequately defined from the scientific *problem-solving* angle, nor has the artistic creativity process been explored. There have been some reports indicating that innovation could benefit from a different management approach (Bayley, 1990). However, it has been recognised for some time that effective innovation is a powerful competitive weapon (Wigston, 1994) in the commercial world.

The present work describes an experimental approach taken to explore the creativity process. An attempt has been made to study both the artistic and scientific approaches to innovation. This was done to test the hypothesis that any perceived boundaries between art and science imagination were artificial. This work attempts to test apparent divisions between art and science that have implied the requirement of different management styles (White, 1996) across these fields. To do this, apparent differences between the processes were recorded and highlighted. The all-encompassing aim of the work is to define a recipe for innovation and creativity, for the whole sphere of idea generation, such that creativity might be stimulated at will. This is a long-term objective and the present work represents an incremental step towards this aim.

To study the creative process two groups were brought together. BNFL supplied three scientists: an inorganic chemist, a materials scientist and a nuclear physicist. Whilst their vocations reflected their interest and training in science they all possessed contemporary artistic interests outside of their careers. These were in the areas of music and drama. From the Royal College of Art (RCA) there were five volunteers. These were all students of industrial design, with a variety of backgrounds including industrial design, furniture design, visual arts, film making and special effects. It is clear that there are strong complementary technical aspects to their specialist areas of art and design.

Furthermore, the work of the RCA is not wholly restricted to the art world. Indeed, it has a comprehensive network to technical centres of excellence, such as The Imperial College of Science, Technology and Medicine, and is helping to shape the future of computing and information technology. The Industrial Design course is of particular

Malcolm Joyce, Keith Franklin, Penny Neale

BNFL Research and Technology, Preston

Steven Kyffin and Bernard Veronesi

The Royal College of Art, Kensington Gore, London

interest since students are able to apply their artistic skills and talent towards the consumer products of the future. The emphasis is very much on new ideas and combining influences from a number of backgrounds. Past interests include the design of the laptop computer, stereo systems and cars. Similarly, BNFL places great emphasis on the creative potential of its scientists and engineers because it appreciates that novel ideas and lateral thinking, when applied to the company's core business, can lead to giant leaps forward in safety, cost effectiveness and efficiency. With this in view, BNFL embarked on a three day workshop with the RCA to exchange approaches and techniques used for idea generation and creativity.

The workshop took the form of a round-table discussion. Some preparation prior to the meeting was done by both parties so that case studies of likely scenarios could be discussed. Four such studies were submitted and discussed carefully over two days. On the third (final) day conclusions were drawn on the idea generation process. Similarities and contrasts between the approaches were studied more closely and valuable aspects were identified.

The representatives from BNFL submitted case studies based around the company's core business such as specialist materials and chemicals. A typical scientific approach was considered. The designers submitted case studies centred around their project areas. These were, in general, much more familiar to the technologists since they essentially involved domestic products and environments found in most walks of life. However, in most cases these suspected technically-benign areas involved aspects of considerable technical innovation. For example, future developments of the vacuum cleaner brought into question the science behind all issues in cleaning and domestic hygiene.

One of the first discoveries of the workshop concerned the tools used to aid our thought process. The technologists listed their ideas, in essence following the standard *brain-storming* route, while the designers (from the technologists' perspective) used a series of thought exercises to expand their thinking. They produced all sorts of pens, crayons, paints, fabrics and chalks from an apparently endless supply, and sketched ideas down in near frenzy. This can be attributed to the 'Fire' stage of Partow's work (Partow, 1994) The benefits of this approach were that once an idea was condensed on to paper it provided a reference point, or a space for additional memory. From this the seed of an idea could be developed and the sketch provided further stimulus. This was found to be considerably more beneficial than the usual process of throwing ideas at a facilitator in a brain-storm, where much of the potential can be lost. The use of several visual media was found to stimulate the imagination further. In addition to the sketching technique, some time spent away from the core workshop, in isolation, was found to be beneficial since it allowed ideas to grow at an early stage. Presentation and consideration of ideas to the group was found to be invaluable at a subsequent stage, in similarity to reported 'jamming' sessions (Fitzgerald, 1990).

It appeared useful to descope ideas so that scientific and technical issues were not addressed in the early stages. This is certainly not familiar to scientists, who often follow a narrow path between what is known to be technically possible and what is desirable. However, this is consistent with further reports (Fitzgerald, 1990). This neglect of technical constraints allowed more freedom of thought and imagination. In the majority of cases the developed ideas would come back into the realms of scientific possibility, or would do easily with some additional scientific development. Indeed, it has been reported (Fitzgerald, 1990) that too much concern for practical applications can restrict the innovation process. This is consistent with the present work.

A subsequent aspect of the workshop was for individuals to draw their idea generation processes. The responses to this were varied and diverse. Some impressions were tangled explosions of colour, depicting journeys from the apparent chaos and despair that precedes the elation and enlightenment when a good idea takes hold. Others described how the subconscious draws on influences from the surrounding environment and culture. Some thought processes were likened to the solution of a crossword puzzle or finding the way round a maze whilst others adopted the scenario of suburban journeys to doorsteps of inspiration, or river crossings via stepping-stones of development. The favoured environments for innovation might be museums, libraries or, conversely, familiar restaurants and bars. Idea generation pathways did not seem to divide between scientist and artist in any specific manner, indicating that formal training influences the development of ideas but may not always be the primary inspiration. Regular changes of working environment and irregular hours can have a considerable beneficial effect on the creative flair of an individual, and long hours at the bench in a laboratory or studio might not always inspire the best solution. On a broader scale, this observation implies that the change-culture strategy, adopted by many commercial industries, could be beneficial to technical development and innovation.

So what were these tools?

- *Use of analogies:* Don't just use an analogy to describe one part of a problem. Immerse yourself in the analogy and wander about in it before going back to your original position. For instance, if you are designing a new airport, consider them to be like the savannah with the people as great herds of animals looking for food, shelter, water etc. Start thinking along those lines and who knows you may come up with a new design for an airport terminal.

- *Odd links:* Take *anything*, and relate it to the problem in hand. For example, if your problem is corrosion of pipework. Take *bananas*, and a thought process may go as follows. Corrosion/Bananas ... corrosion + bananas = rotten bananas... .bananas rot to provide for the next generation of bananas trees... could corrosion perhaps be used to some advantage?... How about a coating whose oxidation products actually protected the rest of the pipe from corrosion? A trivial example perhaps, and one which many would say they would come up with anyway (these coatings actually exist (sacrificial coatings)), but it demonstrates the principle and in the end it matters not how you come up with an idea as long as it works. The object has to be truly random, so dip into a dictionary and point at a word (like de Bono suggested), or ask a colleague for a word.

- *Models:* Draw your idea, or make a model. This may be a trivial to a designer, but to a scientist it was a revelation.

- *Ideas in isolation:* As a contrast to communal brainstorming, sketch your ideas down in isolation and then discuss them in a conference-type atmosphere. This maximises both your personal creativity and that of a group.

- *Experimental approach:* This is a more scientific angle where variables in a systems should be investigated in isolation to determine the effect. For example, consider the development of the kettle; the incremental steps that have taken the simple pot on a hearth to a plastic, electrically-powered jug kettle are small but have resulted in an efficient, successful design. It is unlikely that one burst of inspiration could have resulted in such a development.

In summary, a great deal was learnt about what stimulates and inspires innovation and creativity. It is clear that there are a variety of new tools to use in our search for technical design solutions and great steps forward are possible. It has been observed that for artists and designers it is necessary to slip between many different modes of communication, media, analogies and manufacture. This requires great flexibility. However it has the benefit of providing the creative process with many tools whilst the designer gains a better understanding of the project of interest. Scientists are often fluent in their specialism but can be constrained by this fluency. Hence they are forced to exclude and eliminate options from an early stage unless information is forthcoming to justify interest in a specific area (Holschuh, 1992). Scientists look for and use information. Designers look for and use

RESEARCH

experience. In this respect, designers resemble divergent thinkers (Partow, 1994) whilst scientists resemble convergent thinkers. This hypothesis could revolutionise the teaching and exploration of art and science (Bayley, 1990).

Put more simplistically, *"Thinking about how you think"* would have been an excellent sub-title to the workshop. It would have been easy, speaking from a scientist's point of view, to say *"Why are we doing this?"*, when tackling one of the workshop exercises. The artists' approach, to put together seemingly unconnected concepts in order to come up with new ideas, seemed alien to a scientist who tends to look for a reason to follow a particular path. The artists were interested in the scientific experimental approach, where all variables in a system are tested, to find the most important variable in the system.

This concept is illustrated in Figure 1. The scientist resides in a plane of scientific training that is broad in comparison with the specialism that probably encompasses the solution; hence the science base is reduced to a discipline, in this example *Chemistry*. This layer can be further truncated to the sub-discipline *Catalysis* which might then lead to an embryonic problem solution. This is then refined until the scientific solution is complete. Hence, as time progresses the scientist's focus increases and becomes more refined, the process excludes avenues and the solution gains definition. The designer enters the process from the opposite approach. Without a specific discipline (as referred to the field of the problem) the focus is low and is drawn from experience of a number of fields. From this experience a number of solutions can be explored in essence since the constraint of discipline is not as strong as is often the case scientifically. Consequently, the designer arrives at a plateau where a number of solutions are viable and the understanding is high. The designer's path is a complete journey in which the solution is an incremental part. The scientist's path is a journey ideally as short as possible in which the solution is the target and the journey an inevitable period of development.

To capitalise on what has been found in this work, scientists may have to change their approach to thinking. Often, the ideas phase is a small stage in a large program of research. For healthy innovation, the balance of time needs to be changed to concentrate on thought as opposed to after-thought. What has been found holds enormous potential. However, more research is necessary to define the methods involved such that a tool can be developed for use by innovators in general. A further workshop is planned to explore these areas.

References

Amabile T M et al., (1996) Academy of Management Journal, 39, 5, 1154-1184.

Bayley, S (1990) Design, 61.

Day, C R (1994) Industry Week, 243, 9, 7.

Fitzgerald, K (1990) IEEE Spectrum, 67.

Holschuh, M (1992) Agric. Eng., March 1992, 7.

Kawenski, M (1991) Journal of Creative Behaviour, 25, 3, 263.

Partow, D M (1994) Home Office Computing,12, 6, 85.

Stimulating Creativity and Innovation, Research-Technology Management, 40 2 (1997) 57-58.

White, D (1996) Research-Technology Management, 39, 5, 31-35.

Wigston, I (1994) Banker, 144, 816, 12-13.

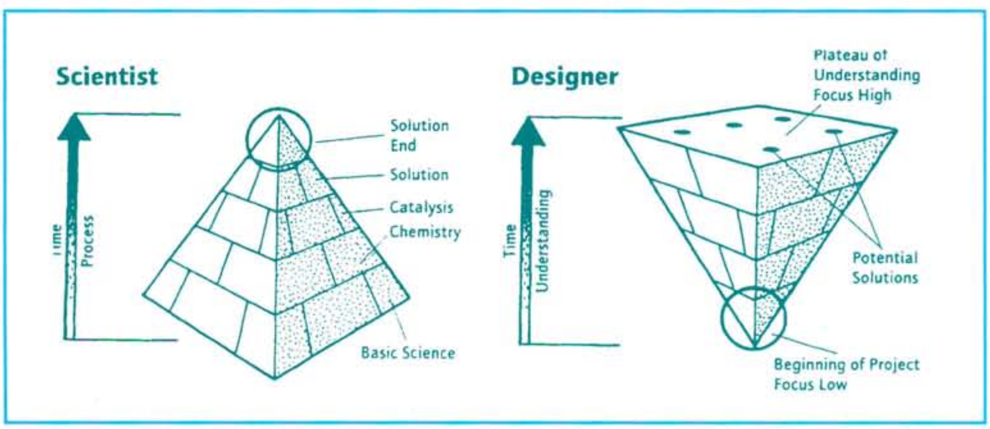

Figure 1: The creative process for scientists and designers