GENERATING NEW IDEAS BY PROBING PARADIGMS

Wilfredo I. Jose[1]

[1] Department of Chemical Engineering,
University of the Philippines, Diliman, Quezon City 1101
Philippines
Email : wilfredo.jose@up.edu.ph

Abstract Many techniques on creativity and innovation are available and they can generate new ideas. This paper presents a method developed in the last four decades. In my first job I developed a technique in creativity, which I used in my research when I transferred to UP as an instructor. I called my process, "probing paradigms". I used it in formulating teaching strategies and developing innovations, but it did not have the appropriate framework and theoretical basis. I applied the technique to researches in environment, biotechnology and biochemical engineering, energy, design engineering, I finally found the necessary framework in 2009. We probe the paradigms and map them in our mind. Connecting ideas in our brain (a powerful neural network computer) results in new ideas. Some examples of the results are presented.

Key words: paradigms, ideas, innovation, creativity

1 INTRODUCTION

According to David Gurteen (1998), knowledge management cannot have real impact if we do not change the way we perceive and utilize knowledge. We need to create new knowledge and apply it to make it productive. Fundamentally we have to focus on creativity and innovation. New ideas are needed. Normally, this activity is difficult and painful for many people. Creative thoughts are quite uncommon because to think creatively is simply unnatural. The most popular technique is brainstorming, usually performed by a group. Although the method can yield some results, its unstructured nature leads to unwieldy number of unrelated results that are difficult to evaluate and select. Hundreds of books on creativity and innovation are available, and dozens of techniques can be used to generate new ideas. (Plsek, 1997) This paper presents a natural way of spawning new ideas by probing paradigms.

2 BACKGROUND OF THE ACTIVITY

2.1 Period 1971 - 1987

Upon graduation from college, I worked as a researcher at the Research and Development Center of the Armed Forces of the Philippines in 1970. My major duty was to research on pyrotechnics, explosives, and solid fuel rocketry. Typical in a government agency, funds for procurement of materials and equipment were always delayed. The facilities were inadequate. Training on research and handling explosives was not available locally. Therefore, I had to improvise in preparing my setup and my formulations. A specific project assigned to me was to reverse engineer a pyrotechnic cartridge for artificial rain stimulation imported from the USA. As a chemical engineer, I knew that the first step was to find out its chemical analysis. This proved to be so daunting because interfering elements had been purposely incorporated, which prevented the detection of the elemental components of the formulation, even with the most advanced instruments. The recourse was to perform a thorough literature review utilizing several libraries within Metro Manila. I read numerous journal articles, books, magazines, and abstracts. Within the confines of the specific topic, I was able to view ideas in another context. The ideas seemed to be mapped within the area of the topic. While the information given by each reference was usually limited, the total information of the collection could provide more discernible data. The gaps could usually be interpolated. Thus, I was able to deduce the formulation of the cartridge and produce a prototype using improvised equipment. I then took a masters course in chemical engineering at the University of the Philippines. I continued my research in artificial rain stimulation, which eventually became the topic of my masters thesis. All along, I felt I was being creative. When an opportunity to teach at UP became available, I accepted a teaching position as an instructor in 1974. I liked the job with research as a major activity. I was able to apply the technique I learned earlier and performed many researches. I felt an urge to impart my knowledge on creativity in teaching but I did not have the proper framework and basis yet. It became to be an obsession since that time.

2.2 Period 1988 - 2004

In 1988, the National Research Council of the USA issued a Report on the Frontiers on Chemical Engineering. In this report, the paradigm of chemical engineering was described. (Commission, 1988) At about the same time, Proctor and Gamble, Philippines, invited me to a seminar on "Seven Habits of Highly Effective People" by Stephen Covey. In this seminar, Covey brought home his point by using paradigms. The said two events stimulated me to think about some specific applications in chemical engineering. It took me about seven years to accomplish something concrete.

Having analyzed the paradigm of chemical engineering, I thought about initiating new strategies my other areas of interest, such as in education, biotechnology, environment, energy, design engineering, etc. In 1995, I started revising my unpublished textbook, “Introductory Concepts in Chemical Engineering”. Based on analyzing the paradigm of chemical engineering, I restructured the textbook using a sequence of topics quite different from the recommended textbook at that time. I introduced easier techniques of solutions. I started using the experimental version of the textbook in my Ch.E. 31 classes. In my professorial chair lecture in 1998, I presented my first paper on probing the paradigm of chemical engineering, “The Wijose Strategy on Chemical Engineering Education: A Teaching Strategy Based on an Analysis of the Paradigm of Chemical Engineering”. Somebody suggested the term “probing” instead of “analyzing” and I started using the term “probing paradigms”. Based on probing paradigms, I was able to develop some teaching innovations. In 1999, I delivered a plenary lecture about the paradigms of chemical and environmental engineering at the National Convention of the Philippine Institute of Chemical Engineers. The lecture was received. Over the next six years, the theme of my professorial chair lectures was on probing paradigms. What was lacking in my technique is a conceptual basis or theoretical framework.

3 CONCEPT OF PARADIGMS

3.1 What is a Paradigm?

The term paradigm comes from “paradeigma”, a Greek word derived from “paradeiknynai” that means “to show side by side”. Originally a scientific term, it now refers to a model, a theory, a map, a perception, an assumption, or a frame of reference. Based on the Oxford dictionary, the word has various usages, the context of which often has to be explained. The term sometimes becomes a source of confusion and controversy if the usage is improperly conveyed. In a more general sense, paradigm refers to the way how man perceives, understands, or interprets the world not in terms of visual sense of sight. Therefore, the paradigms in the mind of different people may be different. A simple way of understanding paradigm is to see it as a map. We know that the map is not the "territory" but rather it is an explanation of some aspects of the territory.

An analogy in explaining paradigms is the concept that people have paradigms in their mind that they use in everyday life. Each personality will have a distinct paradigm. Differences often lead to conflict. We have to understand the paradigm of other people to be able to tolerate them. This we can do if we “shift” our paradigms.

3.2 Determining Paradigms

The initial work on generating ideas was based on author’s discipline of chemical engineering and is used as an example. Each profession has its own paradigm—a set of knowledge that defines or guides a profession. For chemical engineering, its paradigm refers to the characteristic set of problems and systematic methods for obtaining their solutions.

The logical way to determine the paradigm of a profession is to trace and examine its history. We have to critically note the developments, especially new ideas, themes, thesis, arguments, etc. that will lead to new directions or points of views not seen before. We should carefully find paradigm shifts, if any exists. Another source of information is the professional organizations. The practices of the members of an organization as well as the proceedings of conferences provide us valuable insights. Parallel to the practice of the profession is the development of the curriculum. These two aspects interact with one another and usually settle down to adapting the same paradigm. However, academic activities are not in consonance with practices in industry sometimes. The major reason is that the objectives or goals are different. Obtaining feedback from each other usually occurs. Textbooks, reference books, trade books, equipment catalogues, newsletters, and the patent literature, among others, all reflect data for paradigm determination. Stories, anecdotes, speeches, memoirs, biographies, recollections, etc., are good sources too. Current events and the prevailing conditions of the world certainly affect the paradigm of a profession. The paradigms of other areas that are more specific can be determined by using other relevant parameters.

3.3 Probing Paradigms

Like reading history, just noting the paradigm of a profession is not gainful. We should analyze, investigate and “probe the paradigm”. This means a total understanding of every aspect of the paradigm – like “feeling” its internals. Some equivalent terms are finding insights, viewing perspectives, observing points of views, outlook, stand, position, attitudes, and many others. The synonyms of the word probe such as contemplate, muse, ponder, brood, mull over, cogitate, ruminate, investigate, study, examine thoroughly, go deep into, and feel around among others can be found in a thesaurus, which certainly add more complexity of the term. Since paradigms are patterns or models we can consider paradigms as maps of knowledge.

After the evaluation, many new thoughts and ideas come out of our mind, which we have missed before. It could be because those ideas were covered up by more prominent ones in our mind. The combination of two or more ideas may reveal another point of view.

One of the products of this probing is a realization that probing paradigms is a generalization of the methods used by others. For example, Stephen Covey (1989) probed the paradigm of the character of the American people, and he was able to device his “Seven Habits of Highly Effective People”. Thomas Kuhn (1970) probed the paradigm of the history of science, which he presented as “The Structure of Scientific Revolutions”. The result was the introduction of the concept of “paradigm shift”. Probing the paradigm of chemical engineering showed that paradigm shifts may not be present at all. The presence of a shift represents an extreme and the opposite is the total absence. We will observe a spectrum of shifts between these two extremes.

I have included the method of probing paradigms in all of my activities such as in teaching, research, and extension service. I have formulated teaching strategies and innovations, developed inventions, and introduced new fields. I felt that I was more creative and innovative. As mentioned before, the technique lacked a framework or basis, which prevented me in fully disseminating the technique. The solution to that issue is discussed next.

4 ESTABLISHING THE CONCEPTUAL BASIS OF THE METHOD

Having obtained positive results from the activity of probing paradigms, I next concentrated in finding a suitable conceptual basis. I read several papers and books on creativity and innovation. According to Plsek (1997), we should understand the theory behind creativity and innovation to be creative on demand because of three reasons: (1) research has shown that common myths that block creative thinking are not true, (2) knowing the theory allows us to realize what we want to accomplish when we use a certain technique, and (3) proceeding without sound theory is not productive. The essential elements of a theory of creativity have surfaced over the past 60 years. (Gardner, 1985). The details of thinking and the mechanics of the mind points to the following: (1) Creative thinking is not a regular part of our normal thought processes (2) creative thoughts can purposefully be lead by our mental action (Plsek, 1997). The mechanics of the mind have four major components: perception, memory, judgement, and higher order thinking. Around us is the reality of the world, which we receive through our five senses. We make sense of them through our mental subsystems of perception and memory. We decide what to do about them through the mental subsystem of judgement/choice. Then we can change the reality we perceive. These actions are controlled by higher order thinking subsystem. The data and information we receive are collected and evaluated and becomes components of our beliefs and paradigms. We normally use paradigms in our mind as filters of the numerous information that we receive. The next topics influenced the formulation of my conceptual basis.

4.1 The Connectionist Model and Spreading Activation theory

In cognitive science the modern theory intimates the wide distribution and intricate interconnection of memories in the brain. This is acknowledged by the connectionist model and the spreading activation theory. A given concept in memory corresponds to a particular pattern of activity among billions of interconnected brain cells, called neurons. A network of neurons represents a large number of mental concepts. The activation in one part of the network indicates the start of thinking. The thinking then spreads progressively by electrical and chemical means.

Cognitive psychologists employ the Connectionist Model theory. Mental episodes can be represented by simple and uniform interconnected networks of units. Depending on the model, the units and the structure of the connections can vary. The neurons are the units and the synapses are the connection in neural networks.

Cognitive scientists use the Spreading Activation Theory. According to this theory, the activation of a unit spreads to all the other units connected to it. It is always a feature of neural network models.

As far as idea generation is concerned, the idea that is spread can still be connected to other ideas.

4.2 Mechanism of the Mind

According to De Bono (1969) The mind is similar to place consisting of high ground and low points that becomes with streams of run-off water that are disconnected. The flow of water corresponds to the flow of thought while the valleys represent perception that is channeled to the stream. Creative thinking can be pictured as linking valleys not normally linked. New streams can be carved or two existing streams can be connected, which can represent a new idea.

4.3 Knowledge Maps, Mind Maps, Concept Maps

Henry Small, (2003) an informatics scientist, came out with a practical idea of mapping scientific paradigms physically. He made a map based on citations of different authors and researchers on new ideas on particular branches of science. This knowledge map has a limitation in the sense that some citations can take place over a period of several years. The progress of the mapping is quite slow in this case. A new method is to collect on click stream data of scholarly journals that essentially maps scientists' online behavior. The online usage data was collected and normalized and converted into a map that gave the relationships among different field of knowledge. Trends in scientific research can thus be visualized. (Bollen, et al. 2009)

A mind map is a diagram used to symbolize ideas or other items linked together around a central idea or key word. It can be used to generate and visualize ideas and to study and organize information. Mind maps focus only on single word or idea while concepts maps connect multiple ideas or words. The above ideas have some influence in my conceptual basis.

4.4 The Human Brain as a Neural network

The brain is a powerful massive parallel computer. It has about 10 billion neurons. A single synapse is connected to about 10,000 other units. It is a biological neural network that scientists aim to duplicate. We input tremendous amount of data to the brain and it processes information although at a slower speed compared to that of man-made computers.

4.5 Stephen Thaler

Stephen Thaler is a scientist who built a synthetic brain capable of human level discovery and invention. He created a creativity machine with a neural network that was capable of performing activities, similar to what humans can do. When he inputted the rules of the English language, the machine created 1.5 million new words. It composed classical music when inputted with the knowledge of classical music. It also invented products and process. The performance of the machine is based on his discovery that a neural network invents (or hallucinates) when the some of the neurons are purposely destroyed. (Thaler, 1996, 1997)

With the above information I do not have to perform experiments with a neural network computer.

4.6 Integrating the information

The items above are the information that supports the conceptual basis of my technique.

When we probe paradigms, all the data and information are systematically organized and mapped directly to our brain. After some period of time, (about six months to two years) we voluntarily or involuntarily connect two ideas in our mind to come out with new ideas. This can be done either while awake or asleep. Noting that the mind is a powerful neural network computer we can expect it to produce many ideas. The technique is useful for formulating strategies and new methods. After a while, ideas for invention and innovation naturally come out.

5 DESCRIPTION OF THE TECHNIQUE

The method consists of the following: (1) analysis of paradigms, (2) systematic organization of ideas, (3) mapping of these ideas in one's mind, and (4) connecting ideas to form new ideas.

These ideas are basically stored in different parts of the brain. Referring to the Spreading Activation Theory and Connectionist's Theory from cognitive science, connecting two ideas will result in a new idea that could become an innovation. The connection of ideas can be done both actively (while awake or in the beta state) or passively (while asleep or in the alpha state). While awake we can use mind maps or concepts maps to organize the ideas or use the computer and consciously organize them in the mind. Passively, we lead our mind into the alpha state with recorded information fed using an earphone. We can also explain the process by considering that our brain is a neural network computer consisting of two layers (conscious and subconscious mind). By inputting the information the neural network computer learns and processes the information and produces outputs in terms of new ideas. The new ideas are inputted again for evaluation and for choosing the good ones. The following are the steps we have to follow:

1. Decide on the topic, area, subject matter, etc
2. Determine the paradigm
3. Probe the paradigm
4. Map ideas in the mind
5. Connect ideas to produce new ideas
6. Harvest the ideas
7. Evaluate and select ideas
8. Refine the selected idea

For example, the above steps can applied to a particular project on the biological treatment of wastewater. The relevant disciplines and representative knowledge involved are: environmental engineering, chemical engineering, biochemical engineering, biotechnology, microbiology, biochemistry, chemistry, waste management, etc. A review of related literature, patents, and state of the art knowledge comprise some sources of information. The probing is dependent on the researcher(s) or members of the team involved in the case of team project. Some detailed examples are discussed next.

6 EXAMP.E APPLICATIONS

6.1 Formulating Teaching Strategies

In the very first application of the technique I found it effective to formulate, explain, and emphasize ideas or strategies in various aspects on how to improve chemical engineering education. In one strategy, a student is given the fundamentals of the paradigm in a structured manner that promotes a reinforced understanding. The chemical engineering paradigm is "flexible" because of the numerous changes the profession has undergone. A realization of this fact will boost the students' confidence. (Jose, 1998) The application of the strategy resulted in the development of a textbook, "Introductory Concepts in Chemical Engineering." The major topic in the first course in chemical engineering is mass and energy balance calculations. Implicitly, problems are solved using algebra and arithmetic (or only algebra in some cases). All chemical engineering students have taken up arithmetic and algebra subjects in high school and first-year-college. They have solved verbal problems that deal with mixing, compounding, separation, etc. in arithmetic and algebra. The students were not aware that those problems are actually mass balance problems. The proposed strategy is to view or regard problems in mass and energy balance calculations (MEBC) under steady-state situations as verbal problems in algebra or arithmetic. The strategy is applied in a textbook that has been written by the author. The course is structured such that only a few new relationships are given in each chapter. The students are not overloaded. By the time all the relationships are given, (towards the end of the book) students are confident in solving MEBC problems.

In the first class meeting, we tell students that they have solved mass balance problems before in their arithmetic and algebra classes. By giving typical verbal problems in arithmetic and algebra, they will recall familiar situations. This usually builds up the confidence of the students. We then introduce the relationships necessary to solve those problems. The first is the mass balance equation: sum of mass inputs = sum of mass outputs, a simple relationship expressed as an algebraic equation. I emphasize that the technique used in solving mass balance problems is the same as in solving more complicated MEBC in other chemical engineering subjects or in actual practice.

Mass and energy balance problems require certain relationships for their solution. Using arithmetic, we use the operations of addition, subtraction, multiplication, and division (and other operations) to solve the problem using certain relationships. In algebra, we assign letters (e.g., x, y, and z…) to the unknowns. n unknowns need n equations. Using the relationships, we setup the system of equations. A limitation in using algebra is that if the number of unknowns is greater than three, manual solution is difficult. Therefore, the number of unknowns is kept to no more than 3. This is possible by using the arithmetic method together with algebra.

6.2 Environmental Research

Human activities cause many environmental problems that require multidisciplinary approach. Engineers recognize their role in solving problems directly concerning their field but they must also realize that some environmental problems require expertise from other disciplines such as social science, economics, natural science, and so on. This is the realm of environmental engineering, which can better be understood by identifying and probing its paradigm. The method of probing the paradigm of environmental engineering is based on its history, later practices, and present status. Since all disciplines of engineering are involved in environmental concerns, the paradigms of their respective disciplines reflect on the interpretation of the environmental engineering paradigm. Awareness of the paradigm can aid practitioners to have better understanding of the overall policies, procedures objectives, plans, and strategies.

Engineers from different disciplines can help in the solution of the problems such as in the management of solid wastes, municipal water and waste water treatment, agricultural, ground water and soil pollution, environmental management, air pollution control, industrial pollution abatement, waste minimization, clean technologies, and environmental impact assessment, among others.

Knowing a clear paradigm of environmental engineering will enable us to formulate teaching strategies that will result in more accessible learning. Research works can be planned better using the same techniques.

The objective of a related research is to provide and effective biological wastewater treatment system for industries as well as residential areas through the local government units (LGU's) in the Philippines. This research requires knowledge in many disciplines such as those mentioned above. The use of technology is optimized by process intensification, whereby the process rate is increased by combining new and old principles. For example, by immobilizing the microorganisms on support materials, the rate and effectiveness of the biological reaction is enhanced. The system is more robust, stable, and not prone to shock loading and process failure. System maintenance is less than that required by an equivalent activated sludge system. Attached growth systems can be designed to treat wastewater to produce an effluent with acceptable quality that passes regulatory standards. The cost of the usual microbial support materials is prohibitive. This research utilizes waste materials (plastics and biomass) as microbial support. The system, which consists of an anaerobic baffled filter reactor and an aerobic attached film reactor, is tested in bench, pilot-plant, and commercial scales. The system startup and operation in both continuous and semi-batch modes are tested. The system has been successfully implemented on a commercial scale. I attribute the success to the technique of probing paradigms.

6.3 Introducing a New Area of Study

In 2001, my professorial chair lecture was on "Mass and Energy Balance of the Human Body. I came up with the idea by interconnecting the paradigm of chemical engineering with the paradigm of my health experiences. It was merely a direct application of chemical engineering principles to another area of study and an illustration of a result of probing paradigms. I revisited the topic in 2010. With additional probing, the topics were extended until I realized that the subject is a new area of study.

Professionally, health and wellness is usually the concern of health and medical practitioners. However, the analogy and similarity between biological and engineering systems are striking that engineers become interested in studying potential applications. The human body is more complicated than many engineering systems. Applying engineering principles to the human body can logically improve its performance. Five major principles (mass balance, energy balance, momentum balance, charge balance, and moment balance) are applied to the human body. About 2 dozen auxiliary principles (fundamentals usually studied in physics and chemistry) supplement the major principles. Examples of practical applications are discussed. However, direct applications of some principles may not be simple and have some limitations. Genetic makeup, environmental factors, and lifestyle practices largely affect the performance of the human body. A more realistic alternative is to apply the principle of preventive maintenance of engineering systems to the human body. This will result in a well functioning and healthy body.

We possess an intricate machine (the body) and a powerful computer (the brain) but we do not get an "owner's manual" to operate them. The government should at least provide a basic manual that every person can follow. Of course, every person has his free will and consciousness, which make the human body superior than engineering systems at present.

I am now writing a book on the subject with many new ideas to be included as a result of probing paradigms.

6.4 Inventions

Inventions come as a bonus to the technique. After practicing the routine, new ideas will naturally come, which can eventually be developed as full blown inventions. The result depends on the type of background the practitioner has. A professional with a sound footing in his field will experience an increase in creativity and innovation after some practice with the technique. The sophistication of the invention directly correlates with the knowledge and information one possesses.

7 CONCLUSION

After four decades of work, a concrete result that concerns creativity and innovation has evolved. A logical technique in the generation of ideas has been clearly defined. We often take for granted the knowledge and information we obtain formally or informally. If we properly organize the information in our mind, then the paradigm in our mind can be strengthened. We can use that paradigm to filter the information that we receive. This can assist our brain as a neural network computer to become more efficient.

REFERENCES

Bollen J, Van de Sompel H, Hagberg A, Bettencourt L, Chute R, et al. (2009) Clickstream Data Yields High-

Resolution Maps of Science. PLoS ONE Vol. 4 No.3 e4803. doi:10.1371/journal.pone.0004803

Commission on Physical Sciences, Mathematics, and Applications (1988). Chemical Engineering Research Frontiers: Needs and Opportunities', Final report of the National Research Council Committee, Washington D.C. The National Academy Press, p.9 – 16.

Covey, S. (1989). The Seven Habits of Highly Effective People. New York. Simon & Schuster, p.23.

De Bono, E., (1969) Mechanisms of the Mind, Penguin Books, London.

Gardner, H. (1985). The Minds New Science, New York, Basic Books.

Gurteen, D., (1998). Knowledge, Creativity, and Innovation. Journal of Knowledge Management. Vol 2, No 1, pp. 5 - 13.

Jose W. I., (2003). Probing the Paradigm of Chemical Engineering to Formulate a New Teaching Strategy, Paper presented at the Regional Symposium in Chemical Engineering, Manila.

Jose W. I., (2009). Unraveling and Probing the Current Paradigm of Chemical Engineering as a Basis in Formulating Teaching Strategies, Paper presented at the Regional Symposium in Chemical Engineering, Manila.

Jose, W. (1998), The WIJOSE strategy on chemical engineering education: a teaching strategy based on an analysis of the paradigm of chemical engineering. The Centennial C.A. Ortigas Professorial Chair Lecture in Chemical Engineering. Quezon City, University of the Philippines.

Jose, W. (2003). Probing the paradigm of chemical engineering to formulate a new teaching strategy. Proceedings of the Regional Symposium in Chemical Engineering. De La Salle University. Manila.

Jose, W. I. (1999) The Chemical Engineer and the Environment", The 1999 C.A. Ortigas Professorial Chair Lecture in Chemical Engineering, Diliman, Quezon City.

Jose, W. I. (1999). Adapting the Paradigm of Chemical Engineering to Environmental Activities, Paper presesented at the 60th PIChE National Convention, Manila.

Jose, W. I. (2000) Probing the Paradigm of Chemical Engineering -- A Useful Tool for Many Aspects, 2000 Cerlito San Juan and Family Professorial Chair lecture in Engineering, Diliman, Quezon City.

Jose, W. I. (2001) Mass, Energy, and Charge Balance of the Human Body", 2001 Cerlito San Juan and Family Professorial Chair lecture in Engineering, Diliman, Quezon City.

Jose, W. I. (2002) Setting an Appropriate Paradigm for Chemical Engineering Design, 2002 Cerlito San Juan and Family Professorial Chair lecture in Engineering, Diliman, Quezon City.

Jose, W. I. (2003) Probing the Paradigm of Biotechnology for Engineering and Other Applications", 2003 Cerlito San Juan and Family Professorial Chair lecture in Engineering, Diliman, Quezon City.

Kuhn, T. (1970). The Structure of Scientific Revolutions. 2nd edition. Chicago. The University of Chicago Press, p.181.

Plsek, P., (1997). Creativity, Innovation, and Quality, ASQC Quality Books, Milwaukee

Small, H. (2003). Paradigms, Citations, and Maps of Science: A Personal History, Journal of the American Society for Information Science and Technology, Vol 54 No. 5 pp 394 – 399,

Stansfield, M., (1993) Introduction to Paradigms, Trafford Publishing, Victoria, B.C.

Thaler, S. L. (1996). "Neural Networks That Create and Discover," *PC AI*, May/June 1996

Thaler, S. L. (1997). US Patent 5,659,666, "Device for the autonomous generation of useful information", Issued August 19, 1997.