# An Improved Model for Understanding Creativity and Convention

Rolf A. Faste
Design Division, Mechanical Engineering Department
Stanford University, Stanford CA 94305-4021

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**Abstract**

This paper explores the relationship between creative and conventional thinking. An experiment is described which graphically demonstrated the risk-taking nature of creativity. Because it involves risk, creative thinking necessarily falls in both tails of any assumed distribution of idea quality. Based on this insight, an improved three-dimensional model is developed in which the ideas available to an individual, organization or society can be likened to the form of a poached egg with conventional ideas in the center and creative ideas around the periphery. This model is then used to visually explain the difference between invention and innovation. The same model is also able to reflect the differences in creative style between cultures, for example between the United States and Japan.

**The Nature of Creativity**

Creative behavior may be described as a human activity that leads to ideas, problem solutions or designs which are new and original to an organization, institution, and to society at large.

Most engineers, whether they work "on the board," as managers or executives, or as college professors, naturally assume that a distribution of individual creativity measured across any given population would resemble the classic bell curve. Likewise, a plot of idea quality versus frequency for any given individual would follow such a curve (Figure 1).

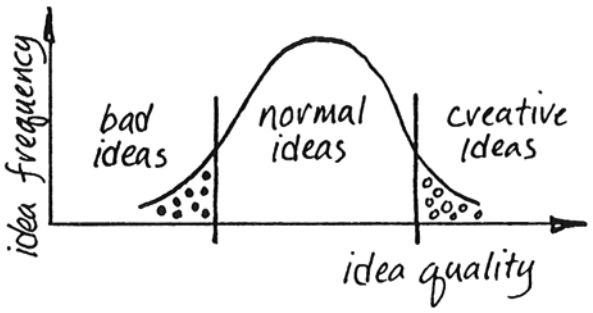


**Figure 1. The Bell Curve Applied to Creativity**

In this curve, low-quality or uncreative ideas are found on the left, the far more numerous, average or conventional ideas are in the center, and high-quality or creative ideas are found on the right. This implicit assumption is revealed when organizations and institutions try to maximize the right side of the curve while chopping off the left.

Businesses do this by encouraging their employees to be creative using financial rewards and promotion for success, and dismissal for failure. In schools the curve is often used literally to assign grades. It is taken for granted that such systems of rewards and punishments will encourage individuals toward a higher quality and presumably more creative performance.

Many years ago at Tufts University I conducted an experiment that inadvertently revealed that these logical assumptions are mistaken if they are expected to promote creativity.

In Cary A. Fisher (ed.), *ASME Resource Guide to Innovation in Engineering Design*, American Society of Mechanical Engineers, New York, 1993

At the time, I was examining the relationship between creativity and an engineer's ability to visualize problem solutions as evidenced by what was drawn and written down as he worked on a problem. The test assignment was to design a two mile high tower with a restaurant at the top. Twenty eight engineering graduate students were given an article from *Progressive Architecture* Magazine describing this problem as it had actually been given to Buckminster Fuller's engineering firm. The article described the difficulties involved and Fuller's best solution which was limited to a height of one mile by such problems as wind loading, icing and pressurization. The test subjects were challenged to take a more creative approach than the relatively straight forward structure the civil engineers had attempted.

In order to establish the connection between creativity and visualization, engineering professors ranked the results according to creativity, and a well known creativity firm in Cambridge (William Gordon's Synectics Educational Systems) scored the work according to the amount of visualization contained in each subject's scratch work. Any bias the creativity judges might have had due to variations in drawing ability, spelling or penmanship was eliminated by redrawing each solution in a similar style onto heavy stock paper. The judges were then given this stack of solutions and asked to return them in rank order from most creative to least. Ultimately seven individuals rank ordered the 31 solutions received (three subjects proposed two solutions). These rank orders were then averaged across the creativity judges and then correlated with the visual scores determined from the original scratch work by the staff at Synectics Educational Systems. As expected there was a very significant correlation between creativity and visualization. (Faste, "The Role of Visualization in Creative Behavior," Engineering Education, November 1972)

The thought-provoking result pertinent to this discussion about the true nature of creative thinking was contained in the raw data itself. To begin with, there was no agreement about which solution was the most creative. On the contrary, each of the seven judges had a different favorite. These seven first place choices received some support as four of them received second place votes from other judges, and a fifth received a third place vote. But after the rankings were averaged, only one of these seven 'most creative' results made it into the top four positions. Another way of saying this is that in the final averaged ranking, three solutions that did not receive a single 'most creative' vote by any of the seven judges made it into the top four positions. The reason for this curious result was found at the bottom of the rankings: four of the seven solutions ranked most creative by one judge were ranked last, or next to last, by one of the other judges.

What can be said about this result? To begin with, I don't think this is a case of some judges being correct, and others being wrong. In the middle of the rankings the judges were in remarkable agreement. Test number 12 was ranked 13, 13, 14, 14, 14, 11, 10. Taken together, the judges were correct: the most creative solutions probably will be seen by experts as being either interesting possibilities, or unworkable silly ideas. The most creative solutions to problems often appear stupid, or seem to involve rewriting the ground rules. In any case it is difficult if not impossible to predict whether proposed 'creative solutions' will work without actually testing them. Even experts can't really predict which way the result will go even though they are almost always inclined to give a guess rather than say they simply don't know.

Creative activity involves risk-taking whereas normal activity is safe activity. Taking a risk means you can't predict the result. It begins to sound redundant, but if a result could be predicted, it wouldn't be risky. Conversely, an activity is relatively safe if it is predictable. Thus the results of creative thinking will lead to either spectacular successes, or spectacular failures. In terms of the idea bell curve, creativity is in both tails.

**An Improved Model for Creativity**

A better image for creativity is created by visualizing the distribution of ideas revolved around its median thereby creating a three-dimensional form that resembles a poached egg. The center, or yoke, contains numerous conventional ideas, while the white of the egg, especially the oozing extremes, contain the unconventional, creative ideas (Figure 2). Rather than referring to this distribution as representing idea quality it is better to simply describe it as the distribution of ideas generated by an individual, an organization, a profession, an institution or an entire culture. The ensuing discussion will assume this distribution to represent the ideas available within a manufacturing corporation that has an engineering focus.

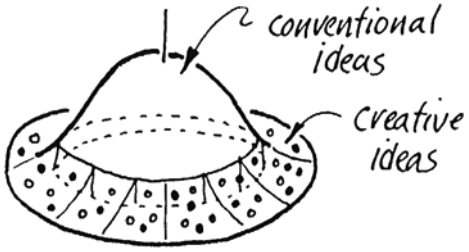


**Figure 2. A Distribution of Available Ideas**

Some of the creative ideas contained in the fringe are potentially very useful (circles), others not so useful (dots). Both kinds of ideas are distributed around the periphery. Many of the ideas may be just plain dumb, but it is just as likely that an idea is too early to be useful, or too late, or that it will cost too much money to explore or implement. There is no value to labeling these ideas good or bad.

All ideas in the fringe involve risk. There is risk to the careers of the people who initiate such ideas and likewise for the colleagues and managers who champion them. For the organization there is financial risk first in terms of research investment and ultimately in the costs associated with bringing new products into the marketplace.

The ideas an organization chooses to develop may lie in any quadrant. Since the results are unpredictable, the organization must make a judgment call about which ideas merit exploration based on it's goals and future expectations. In a typical high-tech firm development tends to occur in isolation from other functions. As activities in the center proceed as usual, the idea attracts resources and manpower and that portion of the fringe grows (Figure 3).

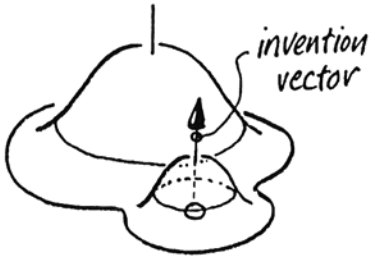


**Figure 3. The Idea Profile Modified by Invention**

When feasibility has been proven, the organization makes the decision whether or not to implement the idea. If the idea is accepted, the bulge on the periphery will be absorbed into the center. A better image is achieved if the firm is visualized as existing on a playing field. With this field as a reference system, the center is seen to shift in the direction of the idea (Figure 4).

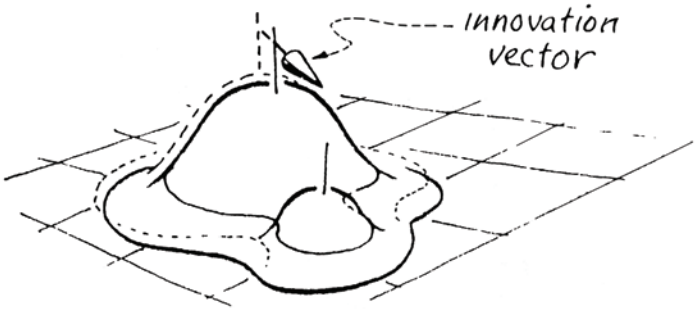


**Figure 4. The Idea Profile Modified by Innovation**

New ideas create vectors for the movement of conventional thinking. Such a shift is rarely a painless occurrence. Both the organization as a whole and the majority of individuals have a major investment in the way things are. Creativity always involves a tension between security and growth.

When resistance to change is too great, the idea will die. However, should the individuals involved feel too invested in their work, they may create a spin-off firm centered on these ideas.

In both cases where the idea survives and grows, the new idea moves from being experimental to being more central. Over time such ideas eventually become the conventional ideas that new creative ideas must challenge. Ideas become conventional precisely because they are useful, and can be made to work in a predictable fashion.

The fundamental difference between invention and innovation is made clear in this model. Invention involves the conception and vertical growth of a new idea in the fringe of the idea distribution. Innovation is associated with the horizontal movement that occurs as these new ideas are incorporated into products, organizations, or systems on a broad scale. Both involve taking risks, and both are properly associated with creativity. At the same time they require different skills and abilities. Invention has more to do with personal courage while innovation has more to do with organizational courage.

**Discouraging Creativity**

When the creative fringe is either intentionally cut off or culturally discouraged, the creativity profile takes on a new shape. The resulting distribution of ideas available inside the organization then resembles a slightly melted marshmallow rather than a poached egg (Figure 5).

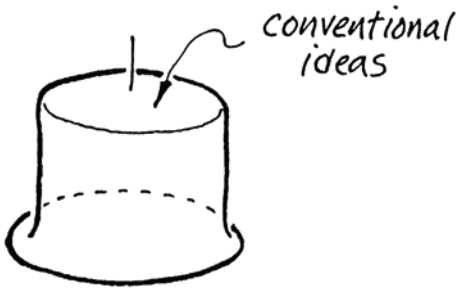


**Figure 5. An Idea Profile with Creativity Discouraged**

An excellent example of intentional elimination of creative and independent thinking occurs in the military. Statements like, "Who asked you to think?", "Just do as you are told", and "Don't make waves" characterize the building of a fighting force that will follow orders instantly.

The same form applies to the culture of Japan. For over 1400 years a relatively large Japanese population has had to live on a small amount of arable land. As may be expected, the result has been great social restraint which stresses harmony. Expressions like "the nail that sticks up gets pounded down" and "the tall tree catches the most wind" characterize the social pressures that argue against behaving in ways we think of as being creative.

It would be a mistake to assume that organizations or cultures that have the same creativity profile behave in similar ways. Performance depends more on the actual nature of conventional thinking contained within the organization. Historically, military organizations have always been rigid, conservative and tradition-bound. The military's top-down hierarchy discourages decision making input from the bottom. Ironically, they are also organizations which have the greatest need to respond to change. When the historian Elting E. Morison at MIT studied innovation he looked at the military for this very reason. His book, *Men, Machines, and Modern Times*, is a delightful and instructive book for engineers to read.

The situation in a Japanese corporation is different. Here harmony and consensus building is stressed. Everyone's input and involvement is required. Not being noted for internal invention, Japanese firms eagerly collect, share and evaluate ideas from both inside and outside the organization. There is much less evidence of the Not Invented Here Syndrome that is so prevalent in the United States. Group consensus takes time to build, but once a change is agreed to it is implemented with vigor by everyone in the organization. From the outside the result looks like quick frictionless movement as compared to the lava lamp like flow of a large American corporation.

**Summary**

Rather than view idea quality as following a bell curve that goes from bad ideas to average to good creative ideas, it is more constructive to talk about idea availability and to visualize it as a three-dimensional distribution that contains safe conventional ideas in the center and risky creative ones around the fringe.

As the Tufts experiment demonstrated, the bell curve model is misleading because creative ideas lie in both tails of the distribution. As a result, well-meaning attempts to increase idea quality by chopping off the lower tail have the paradoxical effect of eliminating the desired upper tail.

Viewing idea availability in this form also clarifies the difference between invention and innovation. Invention involves creating new ideas in the creative fringe while innovation involves moving the center of conventional thinking in the direction of the invention.

This model raises interesting and challenging questions for engineering professors who wish to offer courses and programs that truly encourage creativity. In many ways engineering has become a fundamentally conservative profession, not improperly concerned with applying sound conventional thinking to the design of objects such as bridges, cars and computers so that they are safe to operate and be around. This involves the elimination of risk and associated life threatening danger. At the same time we live in an age where it is perhaps more risky for a manufacturing firm to stand still, than it is to "take a risk" and move into the unknown. Engineers are reasonably expected to be among the major contributors of creative ideas.

In an accompanying article entitled "Integrating Creativity into the Mechanical Engineering Curriculum," Bernie Roth, Doug Wilde and I share some of our thoughts on how to encourage creativity in both our engineering students and ourselves.