Thinking More Effectively about Deliberate Innovation

Can innovation leaders benefit from thinking about innovation in new ways?

Christopher M. Barlow, PhD

Successful innovation often requires the application of many different areas of expertise by a variety of players. Some innovation proceeds as a variety of ideas and possibilities bouncing through society and the marketplace until someone finds the last piece and an innovation is born. Others are put in place by entrepreneurial heroes working like Ford or Edison. While usually thought of as successful solo inventors they actually did quite a bit to adjust the other parts of the system.

Edison realized that he could not just manage the invention of the light bulb, he had to get generation and transmission equipment designed, had to develop accurate measurement instruments to enable billing, and had to convince investors to capitalize his establish-

ment of electric companies. Ford is known not only for his design of the Model T, but his efforts to improve metallurgy and adapt mass production methods, and his innovation in paying his workers enough to let them buy his product, driving other employers to do the same, further increasing his market. Each spent a lot of time interacting with many different people to fix each of the elements of their innovation.

Many of today's systems are so extensive and complex that opportunities are available beyond the capacity of individuals and organizations working alone. Obviously, there is a great deal of attraction in assembling people who understand all the various aspects of a situation to invent and innovate together, but

this is far easier said than done. Differences in knowledge, perspective, thinking styles, cultures, goals, and values all interfere in effective communication and collaboration. Those who want to drive deliberate innovation need to understand ways to lead this interaction and synergy.

The Benefits of a Different View

Those seeking to deliberately accelerate the innovation process push "out of the box" thinking, seeking opportunities hidden by the assumptions and perspectives of knowledgeable people. Whether through selecting project participants, building special environments, or leading alternate methods of interacting such as brainstorming, these innova-

DIRECTOR'S NOTE

This edition features articles by two of the speakers at last year's HSATM Conference. Dr. Christopher Barlow, of DePaul University and the Co-Creativity Institute, is a researcher, professor and author who has been involved in the management and teaching of team creativity and innovation for more than twenty years. He presents a provocative way of looking at innovation, and the resultant implications for managing the creativity/innovation process. Dr. David Tanner, founding Director of the DuPont Center for Creativity & Innovation and past president of the American Creativity Association, describes the practices employed to enhance the environment for creative thinking at DuPont.

Also included in this issue are the Takeaways from an Alliance Roundtable meeting dealing with overcoming the obstacles to innovation. Held in September 2005, the principles discussed are obviously relevant still, and the experiences of the two Alliance Partners described herein, aimed at spurring innovation in their organizations, offer valuable insights to our readers.

Larry Gastwirt

IN THIS ISSUE......

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tion leaders lead individuals, teams, and organizations to look outside their knowledge for possibilities. In both process and content they push people to explore the less familiar. They consider ways that their knowledge might be limited and try new thinking and interaction processes in a search for hidden possibilities.

I would like to suggest that these innovation leaders may also need to do some "out of the box" thinking about the tools and approaches they use, especially as the target problems become more complex.

To get us started with the impact of our language on our effectiveness in this area, let's begin with the analogy of Roman numerals. If I ask you to multiply XXVI times XIX it is going to be a long time before you come up with CDXCIV. However, if you convert it to Arabic notation, 26 times 19, some readers can do it in their head, most can do it with paper, and all can do it with a calculator. In the same way, as a college professor teaching leadership, it has been very helpful for me to change the language.

I teach that no one "has" leadership, although we all "have" followership, processes that cause us to give someone our trust. When the characteristics or behaviors of one individual trigger the followership of another, we call the process leadership. However, in today's multicultural and cross-functional world, people are so different in their followership triggers that no one person can be said to "have" leadership. This change of language allows teaching of "deliberate leadership," a process of investigation and experimentation with various human and organizational factors until the desired followership-triggering relationship emerges.

I am convinced that in the area of deliberate creativity and innovation many popular concepts can be like trying to multiply Roman numerals, especially as one shifts attention from individual creativity to teams to organizations and to trans–organizational collaborations. Trying to produce "out of the box" ideas from teams of highly creative people who develop a complete understanding of the problem, then spend many hours of "less creative" time judging, documenting, and selling the ideas, might lead us to less than optimum strategies for important innovations. Let us discuss some useful differences in understanding creativity at different innovation levels, starting with a suggestion to stop focusing on ideas.

Creativity: Not out of the box thinking, better box thinking!

Creativity facilitators have talked for years about the idea–generating power of redefining or "reframing" problems; I find it very useful to define creativity as the insight, not the idea. This grew out of analyzing the "AHA!" or "Eureka!" experience, that tremendous feeling we get when a new idea emerges in our minds. Looking scientifically for what changed when creativity happened, in order to research the phenomenon, forced me to a new perspective: creativity is not a change in the problem, it is a change in us, a change in our thinking that makes the already possible solutions obvious. In a very real way, each AHA! moves us into another

reality, another way of seeing the world. Figure 1 is an attempt to describe this process. Take, for example, the classic creative quote: "Don't raise the bridge, lower the water."

"THE REAL PROBLEM"
(Intuitively Perceived)

The "New" Viewpoint

Insight Shift

The "Old" Viewpoint

Newly Available Ideas

Old Ideas

Figure 1

Imagine a "floor" which contains all the things we might do. Each flashlight represents a viewpoint, problem statement, or "framing" which illuminates a certain set of alternatives. We start with the left flashlight, representing our initial problem statements,

such as "raise the bridge," illuminating on the "floor" all the various ways to raise bridges. The lightning bolt of insight leads us to a second perspective such as "get the boats past the bridge" which we intuitively know is closer to the real problem, represented by the cloud above. When some of the alternatives "illuminated" or made obvious by the new viewpoint are better than the best of the old ideas, we call it creativity.
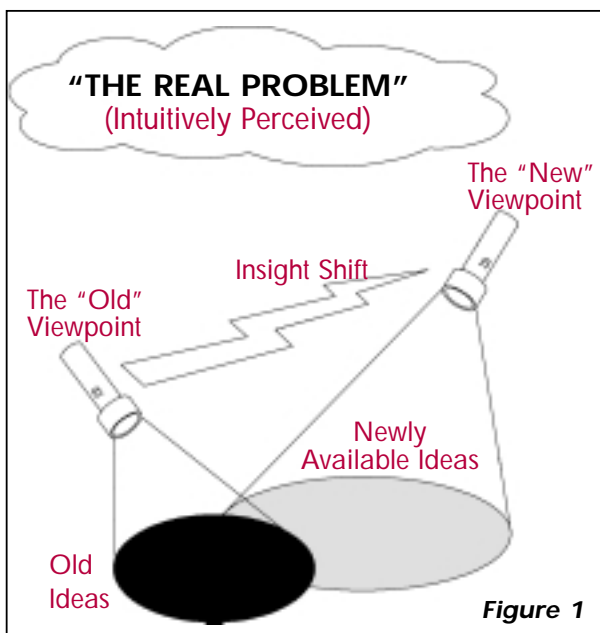
Of course, to a person with the old viewpoint, these ideas make no sense. They are "out of the box." If I ask you to design a lift bridge, and you begin describing the building of a dam and lock to lower the water level, I have to wonder about your sanity or intelligence. An important aspect of this

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model is that what is important is not just that the ideas are out of the original "box," but that they are in a "better box," the focus on getting the boats past.

Another interesting result of labeling the insight as being the creativity is that when we share our learning with a decision maker who then makes the same shift, we can argue that they have been creative with an "appreciative AHA." Certainly their shift of perspective also requires creativity that can be as difficult and just as important as the one getting the idea. Since the full creative event involves not only the generative shift of the "inventor" but also the appreciative shift of the decision makers, those decision makers are your co–creators. Managing that co–creative process as a whole can greatly increase the return on innovation efforts.

The other important aspect of this definition of creativity as finding a "better box" is that expertise and relevant knowledge comes back into the model. If the creativity lies in shifting to a flashlight or viewpoint that better fits our knowledge (the fuzzy cloud), then our

sense of creativity, or the "betterness" of the box, is totally dependent on our understanding, knowledge, and values. The accuracy of that understanding strongly impacts the usefulness of the insights and ideas.

We have all had the experience of sharing a problem with someone whose enthusiastic, creative suggestions demonstrate that there are large areas of the problem that they do not understand. They are certainly having creative "AHA!" experiences based on their

with a brain that contains an unusual combination of knowledge. For example, although the Wright Brothers were derided as "bicycle makers" they were able to solve key problems like steering because that derided knowledge gave them critical insights unavailable to those with backgrounds in areas like automobiles (e.g. both bicycles and airplanes lean into turns). It is a lot of work to generate creative insights within specific domains of knowledge like physics or

described above for deliberate leadership. In a very real sense, the relationship among members of a cross–functional team is one of co–leadership.

The real challenge is in leading the experts to create together. There is a broad array of thinking and leadership tools available, but here again, there is an aspect of multiplying with Roman Numerals. There are many similar plans for deliberate creativity by groups, but many of them are like project management or manufacturing processes. Take the order (get assigned the problem), assemble the needed parts (team members and information), manufacture (brainstorm lists of ideas), inspect for quality (selection processes), pack and ship (document and present proposals). It sounds good, but the research I have done suggests that the best ideas emerge during the proposal writing phase and are more likely when more time is spent in judging the ideas and documenting them to propose to the organization or client.

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"cloud" of understanding, many of which have little or no value. However, when one of their insights triggers an AHA! shift in you to a "better box," your AHA! is more relevant. I have seen a high–tech cross–functional multi–level creative effort in which a production worker with extensive hobby reading came up with an idea he could not even spell correctly, which triggered the PhD head of R&D into the creative realization that he could make this work as a future generation of their product. His "appreciative AHA!" certainly was a creative event, critical in the innovation impact of the effort.

Efforts to deliberately improve creativity must not only increase generation of new ideas and insights, but also must increase the openness of bright people to "appreciative AHA's." Deliberate innovation should be focused on assembling and leading processes that are more likely to produce "relevant AHA's" not only in the "creators," but also in the organization and decision makers who are expected to innovate with the new insights. This is a reason to include decision makers in the process, so they are there to be shifted with everyone else, in ways that reflect their knowledge and understanding. For those who do not participate, it is necessary to identify the creative insights that make the ideas worth considering and triggering those insights before trying to explain the ideas.

Cross-Functional Creativity: Learning Until it Becomes Obvious

There are opportunities for innovation and creativity that require integration of knowledge that transcends the capacity of most single brains. Sometimes we get lucky with a brain that can process more knowledge or

mechanical engineering, but it becomes even more difficult when innovations require multiple areas of knowledge.

The problem is well represented by the classic poem, The Blind Men and the Elephant, by John Godfrey Saxe, in which each of the blind men touches a single part of the elephant and proclaims the elephant to be like an object resembling the part he happens to touch – a wall by the one who touches its side, a spear by the one who touches the tusk, etc. Each expert, engineer, scientist, lawyer, accountant, etc., is like a blind man seeing only one part of the elephant. The solution is not for them to stop being blind so they can see the elephant. The real solution is for them to share their insights and knowledge openly and creatively until, as a group, they can understand the elephant, even though not any one actually understands the whole thing in all details.

This is the essence of a successful cross–functional or multi–disciplinary team. In fact, I prefer to define a cross–functional team as one in which the team members cannot check the detailed work of other team members. Accountants cannot check the calculations of the mechanical engineers, engineers cannot check the allocations of the accountants. This takes away our preferred way to assess the competence of those we depend on. If we put together a basketball game, it does not take long to assess the competence of the other players. In cross–functional teams, we lack that frame of reference, so all that is left is to assess the character of the team members, for social processes to allow us to assign a degree of trust to our coworkers. Notice that this is the same process

This is totally out of the expected sequence, but it reveals another way to think about creativity and design efforts – to think about it as learning. Every task and interaction makes the team more and more knowledgeable and better connected about the problem and its possibilities. Every task also has an impact upon individual and group creativity. The later it gets in the process, the more prepared the team is to have relevant and transformative AHA's. This has led me to insert extra creative efforts as "breaks" in the documentation phase, generating some of the teams' best results.

I now also view each step in the process as a way to increase the knowledge, creativity, and cohesiveness of the group. As a group works together creatively, each becomes aware of the issues of the other areas, at least at a strategic level. Marketers get more aware of production's issues, manufacturing becomes more aware of the needs of salespeople, etc. As each gets a broader understanding, the group is more capable of a "group AHA!" when ideas emerge that benefit multiple areas synergistically. This perspective seems to allow us to create collaborations far better prepared to deliver "relevant AHA's" responding to a fuller spectrum of the real world issues and opportunities. This is an interesting contrast to the usual innovation management plan that sees changes as easier in the early phases of design and most difficult and expensive at

the end, and therefore ignores later creative efforts whose ideas might be too expensive. A learning perspective suggests that a design team should be challenged late in the process, because that is when they are prepared to be most effectively creative.

The Hypertext Team

Even the definition of the team can limit our thinking. Nonaka[2] makes an interesting point that a team includes not only the people in the room, but also all the people and

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knowledge they are connected to. He compares teams to a hypertext web page that not only includes the pictures and words on the page, but all the content and programs and processes that the page links to. A team member makes a direct contribution of inputs, but also has the ability to return to his or her organization and use various available resources. This can give interesting guidance when picking team members. A senior expert in a field might not be as useful as a junior who has better contacts or access to critical resources.

A co-creative impact arises from this insight. As team members work on sub–problems with colleagues in their areas of the organization, that interaction is likely to trigger in those colleagues the shifts in perspective needed to see the true value of the eventual recommendations. This process can greatly improve the accuracy of assessment and speed of adoption.

Words may be too simple

Again, our thinking habits can reduce our effectiveness as problems become more complex. For example, commonly used word-oriented methods such as brainstorming and discussion are capable of generating long lists of short ideas, but complex problems tend to need short lists of long ideas. Moving beyond words can greatly increase creative effectiveness.

Geir Kaufmann[3] investigated the usefulness of visual images in the solution of concrete problems. He took problems and puzzles that had already been assessed for their difficulty and presented then in different ways. He took easy, moderately difficult, and difficult problems and presented them to different peo-

ple as: word problems requiring word answers; picture problems requiring sketched answers; or actually putting the subjects in the physical situation described in the problem.

The toughest problems were solved only by people working in the real situation. The easy problems were solved quite effectively when given as word problems, and presenting them as pictures or real world situations just slowed down the solution. Problems of moderate difficulty were difficult to solve as word problems, but generally well solved as

picture problems, while there was little advantage to putting the subjects in the real world.

This seems to indicate that sitting around chatting (or even brainstorming) is only going to work for the easiest of problems. With more difficult problems, it helps to draw pictures to understand and solve the problem. And for the most difficult problems, it seems that you need to just jump into the situation and muddle around until you get it solved.

Three-dimensional prototypes or scale models may also fit this "reality" category. Designers of buildings and products have known for a long time that some people can make sense of blueprints, but others really need a physical model to begin reacting to ideas or contributing to a design. Therefore, external models may permit people who think more complexly to present and manipulate their structural ideas, while permitting those who operate at lower levels to check its implications against their knowledge.

The Wicked Nature of Trans-Organizational Innovations

In handling complex situations and problems it is helpful to recognize that they are a blend of "complicatedness" and "wickedness." Systems researchers have long measured the complicatedness of a system by the number of different states the system can be in, the number of different "moves" for each of the sub-components. Checkers has more options than tic-tac-toe, chess has more than checkers. As the numbers of elements in a product or service or process to produce and distribute them grows, the complicatedness becomes more challenging. This is the kind of difficulty addressed in Kaufmann's research, an issue

which greatly benefits from imagery and models. But there is more to complexity.

Wicked is a word that emerged in the discussion of levels of problem–solving. There are some problems that we know the answer to, others that can be solved with a known structured process. Others are considered ill-structured because the problem itself is not fully or correctly understood. While ill-structured problems generally have agreement among the players on the values, there are problems whose stakeholders have conflicting goals. These have been labeled "wicked."

Many creative problem–solving methods assume that once all the aspects are clearly understood, a commonly beneficial solution is available. Even though finance, manufacturing, engineering, marketing, etc. all have to make compromises, all are attempting to contribute to a profitable company. But some of the most significant innovations go beyond the boundaries of any one organization.

One of the most frustrating things about many large-scale innovations is that from the time they seem to be obvious, it can be a long time before they actually occur. Bhaskar Chakravorti[4] notes in *The Slow Pace of Fast Change: Bringing Innovations to Market in a Connected World* that, in the language of game theory, many innovations require multiple simultaneous changes by a number of different players, most of whom do not benefit if they act alone. The innovation causes others losses for which they must be compensated before giving needed consent and cooperation.

For example, if a complete electronic medical records technology system was in place, the benefits and savings would be substantial for most participants in the medical system. Yet, if any one person or organization acts alone, they achieve limited benefit, often at substantial cost. Chakravorti argues that real life innovation takes far longer than expected because it takes years for all the players to move together in ways that make the innovation complete. A real challenge to innovation leadership, whether heroic or collaborative, is to accelerate these adjustments.

The "Wicked" Nature of Organizational Politics

It is useful to note that similar clashes of goals and values occur within organizations. While customer satisfaction and organizational profits/performance are important, most players have other goals which conflict with

each other and cannot be easily resolved by "ultimate" goals like "optimum shareholder value." Engineering might be attempting a standardization program to better control quality while marketing is pushing for mass customization. Shifts in course requirements for a degree in a university can shift enrollments, increasing or decreasing the number of faculty positions in the affected departments. If these strategic--evel questions can become part of problem–solving and design efforts, solutions can often be found that better satisfy these conflicting goals, or at least prepare the innovators to deal with the resulting organizational resistance.

Solving the Wickedness of Complex Problems

The wickedness of problems is the disjunction and conflict among the goals of the owners and stakeholders in the situation. This is normally the realm of negotiations, politics, and power, although creative effort can reduce the apparent conflict and enlarge the pool of available alternatives.

Creative effort in this area requires a characteristic that psychologists call "cognitive complexity," the ability to accept conflicting realities and values. This is actually necessary from the earliest phases of organizational creativity, as manufacturing wants large long-term orders, accounting wants payment in advance, and marketing needs small short-term orders with payment after delivery.

Such issues can be managed and resolved by focusing on impacts on profits or other ultimate organizational goals, while wicked problems are defined by the conflicts in these ultimate goals. As difficult as these goal and value conflicts seem, we solve problems like this everyday. Sports leagues set rules that teams comply with while attempting to defeat each other. Professional associations set ethics rules that maintain the existence and trustworthiness of the profession, while allowing members to compete strongly. Industries attempt to set standards that support all players while the players are trying to put each other out of business.

Complex innovation requires understanding and acceptance of the needs, desires, and goals of the various players so that a pattern of activities can be developed which will synergize into a solution in which all are doing well while producing a valuable new innovation. For some innovations, a single entrepreneurial organization can design and negotiate all the pieces, but it seems that if a set of partners can create a collaboration process that create together and allow the firms to creatively explore their own options, a better innovation can result. Of course, this is far easier said than done.

Accelerating the Creativity of Trans-Organizational Collaborations

There is nothing new to suggesting joint ventures and collaborations to attempt large-scale complex innovation. There is a vast array of tools and techniques used in this area. What this article attempts to suggest is that in the planning of these efforts, in the selection and application of the tools of deliberate innovation, the language and concepts described here might provide better returns on the invested resources.

"Co–creating relevant and mutually advantageous AHA!'s" is a great focus phrase. The social aspects of the collaboration process need to be structured to build the kind of trust and cohesiveness among the collaborators that allows them to not only challenge each other and seek new perspectives together, but also to accept and work with profound differences in goals and values. The technical aspects of the collaboration not only apply thoroughly the expertise and resources of the team members, but test insights and create useful shifts in perspectives among decision makers and stakeholders. Collaboration leaders who understand and are able to apply these strategies seem likely to produce successful innovations far more efficiently. ■

To summarize the major recommendations coming out of the above:

- Focus beyond ideas to insights.
- Move from "out of the box" thinking to "better box" thinking.
- Make sure the collaborators include knowledge of the whole "elephant" of knowledge, perspectives, and values so they produce "relevant" AHA!'s.
- Manage the creativity/innovation process as a learning process in which the collaborators learn more and more about the whole "elephant" until the solution is obvious.
- See those who resist our ideas with objections as our co-creators, for whom we must eliminate objections by improving our ideas or giving those resisting the insight necessary to understand the true value of the idea.
- Include stakeholders or design links to stakeholders not only to include their perspective in ideas but also to trigger shifts in their perspectives that will prepare them to understand and accurately judge the new ideas.
- Acquire the leadership tools and skills to enable the resulting complex and diverse teams and meetings to effectively appreciate each other and work with each other effectively.

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The Creativity — Innovation Connection

David Tanner, PhD

"An established company which in an age demanding innovation is not capable of innovation is doomed to decline and extinction. And a management, which in such a period does not know how to manage innovation, is incompetent and unequal to the task."

Peter Drucker, 1973

Drucker's words are as true today as they were in 1973. Likewise, the fundamental principles on how to build a more innovative organization are as applicable today as they have been in past years.

Innovation has been defined in many ways, including:

- "The process by which knowledge is developed and applied in new ways to the needs and material operations of society." (Peter Drucker)

- "Putting into effect something that is new." (Edward de Bono)

- "An innovating organization is one committed to renewing itself." (H. Smith Richardson)

- "The process of bringing any new problem-solving idea into use." (Rosabeth Moss Kanter)

- "To create and bring into profitable commercial use new products, processes and businesses." (Gifford Pinchot)

All definitions of innovation have a vital element in common. They require creative thinking! Therefore, a key challenge in building a more innovative organization is to enhance the environment for creative thinking and educate employees in creativity skills and their practical application.

The Howe School Alliance for Technology Management annual conference in June 2006 was entitled "The Creativity-Innovation Connection." The conference brochure eloquently delineated the connection between creativity and innovation:

"The genesis of innovation is a creative insight, one that excites the enterprise and stimulates it to undertake the process of implementation to obtain economic value. Where, however, does the concept come from, and how can an organization stimulate more and better ideas?"

This article describes how the environment for creative thinking was enhanced in the DuPont Industrial Products Division, a group of seven businesses including *Kevlar*, *Nomex*, *Tyvek*, and nylon. It will also describe some of the most powerful creative thinking tools and how they were applied to achieve bottom-line results. While the program was initiated by the technical organization, all functions including manufacturing, marketing and business teams participated.

Creating an Environment for Creative Thinking & Innovation

In the mid-1980's the DuPont Industrial Products Division was under severe competitive pressure, mainly from overseas companies. We had strong programs on TQM – Total Quality Management, but so did everyone else. To maintain a strong competitive position, we needed to generate entirely new ideas and concepts. To accomplish this, it was necessary to enhance the environment for creative thinking and innovation and to educate employees in creative thinking skills.

Initiating a new program in an organization is usually resisted by employees who are fully occupied with their assigned duties and other urgent chores. This would certainly be the case in an attempt to initiate a creativity program. We decided to proceed, but in a way that would avoid the usual inertia. The approach taken was not to "announce" a creative thinking program, but to just "start doing" certain things. An action-oriented culture-change model was particularly helpful in providing a path to achieve these goals.

Culture Change Model

The challenge to provide a more creative, innovative environment is as difficult as any culture change, requiring ongoing support and patience. Many components contribute to culture change. One way to characterize these is through a culture–change model designed by Charlie Krone, a
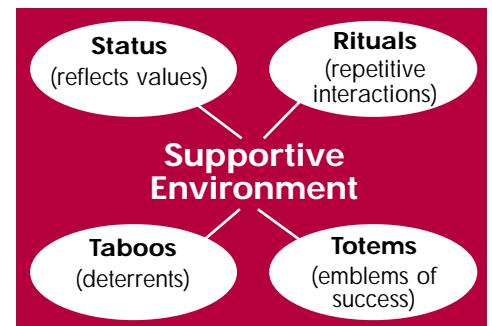

FIGURE 1

DuPont consultant. A culture can be defined by four components (Figure 1) and changed by shifting these components:

Status - This is where we are grounded. Giving status to an effort reflects what management values. Technical unit heads gave status to the effort by occasionally substituting monthly day-long technical program reviews with skill-building creativity seminars and workshops. The substitution emphasized the workshops' significance. In the morning there would be a guest speaker, like Edward de Bono, teaching lateral thinking techniques. In the afternoon, three-four cross functional teams, working on real problems, would apply what they learned in the morning session.

This approach enabled people to experience in a practical way the value of creative thinking tools. It gave tremendous status to the effort. It began the education process. Site libraries stocked books on creativity and innovation. People began requesting attendance at external workshops and seminars. Champions began to emerge and apply creative thinking tools in their jobs. The "unannounced" program was underway.

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Rituals - Repetitive interactions are vital to help foster a desired environment and cascade awareness of leadership values throughout the organization. Several repetitive interactions were initiated. For example, during periodic management visits to the sites, the final hour of the visit was reserved for a Creativity Social Hour. These were coffee and cake sessions with a creativity theme.

In advance of the session, unit heads would invite two – three individuals doing creative work to speak to their peers about their work. Over a period of several years, no one turned down this opportunity. People love to discuss their creative work and credit team members for their contributions.

The highlight of the meetings was the enthusiasm of speakers as they described their creative ideas and how they were implementing them in their programs. This helped colleagues understand the meaning and value of creative thinking. It altered perceptions about who could be creative. For example, process engineers initially felt that creativity was only of value for research people. But when they heard a fellow engineer get up and say "I came up with an idea that led to an increase in throughput of 30 – 40% vs. a goal of 5%," the other engineers began to understand the practical value of creative thinking and became active in the program.

Totems - These are emblems of success which can be honored by reward and recognition.

This is a controversial subject. Some believe that this causes jealousy and reduces communication among employees who feel others may use and get credit for their knowledge. Our experience was that the benefits outweighed the potential negatives. We didn't wait until an idea reached commercial reality, but recognized and rewarded individuals and teams on the run when they generated novel ideas that were being successfully implemented in their programs. For example, in the Creativity Social Hours described above, individuals invited to describe their creative work were all smiles for the recognition. Following their presentations, they were given gift certificates for dinner for two in a local quality restaurant, which was much appreciated.

Taboos - These are behaviors contrary to the values we seek to affirm, i.e., things that need to be eliminated from the culture. For example, a taboo is to punish employees for taking a risk that didn't pan out. It is more productive in a creative environment to learn from mistakes rather than to punish. Another taboo is to act negatively when a colleague suggests an idea, even though it appears to be unrealistic. It is more productive to analyze the idea in a way that might lead to other ideas of value.

Bottom-Line Results

The program to generate a more creative environment paid off with many bottom-line results that ultimately led to the DuPont Center for Creativity & Innovation. For example, a joint team of "Kevlar" Technical and Manufacturing, which had been active in the divisional creativity and innovation program, won a corporate award by a broad--based attack on hazardous waste. This effort reduced process waste in the polymer area by over 80% and saved the business $3 million annually. The manufacturing manager wrote:

"Many of the efforts undertaken by Kevlar team members were considered or attempted in the past without success. One of the reasons they were successful this time is that over the last several years, Kevlar has had a program to change the environment for creativity and innovation and give to the organization the skills necessary to do their jobs more creatively."

The phrase – "…and give to the organization the skills necessary to do their jobs more creatively…" sets the stage for the next section of this article.

Creative Thinking as a Skill

There is a myth that creativity is limited to a few individuals who are naturally creative. In reality, creativity is a skill that can be learned and applied like any other skill such as driving a car, golfing and swimming. There are many creative thinking techniques that can be organized into three categories: idea collection processes; pattern-breaking tools; and focused thinking frameworks.

Idea Collection Processes Idea collection processes include brain storming, mind mapping, and brain writing. These processes help collect and organize ideas generated within normal thinking patterns. In problem-solving sessions, it's best to start collecting ideas applying some of these processes. When teams have exhausted ideas generated within normal thinking patterns, then pattern–breaking techniques such as lateral thinking and metaphoric thinking, discussed below, help trigger a flow of new, more unusual creative ideas.

Pattern-Breaking Tools There are several tools that help us break outside the constraints of our normal thinking patterns which can be learned and applied. Two of the most powerful are lateral thinking and metaphoric thinking.

Lateral Thinking – This tool is based on the development of "provocations" which jolts the mind out of its normal patterns of thought. The provocation (Figure 2) is an idea related to the problem you are tack-
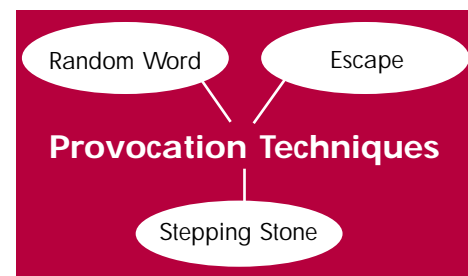
FIGURE 2

ling, but it makes no sense, it's foolish, impractical, ridiculous. Dr. Edward de Bono, the inventor of lateral thinking, teaches several techniques that systematically help generate provocations:

Continued on next page

Random word involves creating a new "entry point" by selecting a word at random, e.g., a word from a dictionary or poster that is not connected to the subject.

Escape involves examining the subject for what we take for granted and then negating or escaping from it.

Stepping stone involves exaggeration, reversal, distortion or wishful thinking about the subject that is a stepping stone to new ideas.

The lateral thinking process involves three steps: 1) selecting the problem area requiring creative new ideas; 2) developing provocations related to the problem using lateral thinking techniques; 3) generating sensible ideas dealing with the problem, stimulated by the provocations.

The bolder the provocation, the better the chance it will lead to unusual new ideas. The challenge is to generate several provocations and ideas until one rings a bell and excites enthusiasm to implement. There are many examples where lateral thinking applied in the Industrial Products Division led to bottom-line results in new products, new processes, cost reduction, and speed of delivery.

Example - An information systems team was dealing with the issue:

How can we reduce costs in the information systems function?

The group manager had attended a lateral thinking workshop and convened a session to apply her learnings to this issue. Using the technique of escape, they listed things they would take for granted about reducing costs. One of these was to reduce costs by spending less money. Escaping from this, they generated the provocation:

Reduce costs by spending more money.

This provocation generated the idea that spending more money on fewer vendors would provide leverage to obtain large discounts. The approach was to reduce the number of vendors and negotiate better prices on high-volume orders. This approach led to an annual savings of over $300,000. Applying this concept to maintenance saved another several hundred thousand dollars annually. This was the result of about a two-hour meeting.

Example - A plant technical group was dealing with this issue:

How can we improve continuity of our complex continuous–flow filter system?

The filter system was based on a reciprocating belt with 70 moving parts that had frequent failures. The group manager was a creativity champion whose group was educated in lateral thinking. A reversal provocation paid off:

The moving belt is stationary.

This provocation shifted thinking in an entirely new direction and led to the design of a system that reduced the number of moving parts by 80 percent. The result was a major breakthrough in process continuity, product quality and substantial cost savings.

Metaphoric Thinking – This technique generates new ideas and concepts by connecting the problem under attack to a problem that occurs in an entirely unrelated system, such as nature. The challenge is to understand how the problem was solved in the other system.

Example - A research chemist who had attended creative thinking workshops applied this technique to find a better way to dye "Nomex" fiber, which was used in flame resistant industrial applications. Because the fiber had a very tight molecular structure, the trade dyeing process required swelling agents, which were costly and caused environmental problems.

The chemist applied metaphoric thinking and pondered:

What in nature can be penetrated despite its tight structure?

His answer: *The Earth!*

He reasoned that coal miners gain access to the interior of earth by digging holes and propping them open with structure props. Inspired by this analogy, he added a large organic molecule during Nomex manufacture to prop open the structure. This enabled dye molecules to squeeze into the fiber during the mill dyeing step. The new technology led to commercialization of a dyeable, flame-resistant Nomex, trademarked "Colorguard," for applications in carpets, upholstery and draperies.

Example - A special task force was addressing the problem of how to reduce dust in their manufacturing plant. The dust was formed by a step in the process and was contaminating the rest of the plant in spite of newly installed exhaust fans.

The group developed a long list of ideas using normal thinking patterns, but none were very good. A facilitator knowledgeable in creative thinking techniques was enlisted to help solve the problem. The technique that paid off was metaphoric thinking. The group considered how nature removes dust from the environment. One way that nature removes dust is through heavy rainfall. This thought shifted their thinking to an entirely new direction that led to an elegant but simple way to reduce dust in their operation.

Focused Thinking Processes

Focused thinking frameworks play a vital role in structuring the approach to problem solving, opportunity searching and creatively organizing one's thoughts around a subject or issue. A highly productive framework for focused thinking is the "Six Thinking Hats" (Figure 3).

The Six Thinking Hats – This framework, designed by Dr. Edward de Bono, is an ingenious approach to thinking through a subject in a focused way that makes time

Six Thinking Hats	
White Hat	(Information)
Yellow Hat	(Benefits)
Red Hat	(Feelings)
Green Hat	(Creativity)
Black Hat	(Caution)
Blue Hat	(Managing the Thinking)

FIGURE 3

and space for creative thinking. The underlying principle is that parallel thinking is more productive than argument.

There are six hats. Each one has a different color and represents a different dimension in thinking about the subject being addressed:

The White Hat deals with information, the Red with feelings, the Yellow with benefits, the Black with caution, the Green with creative ideas, and the Blue with managing the thinking. All participants are required to wear the same hat at the same time, fostering parallel thinking. The hats are alternated depending on the sequence of thinking that makes the most sense. It is similar to golfing where each club in the golf bag has a different purpose and can be taken out and put back depending on the situation.

The Six Thinking Hats has been used extensively in companies such as DuPont, IBM, Prudential Life Insurance, British Airways and Siemens as a way to have efficient, productive meetings. The framework is especially valuable when dealing with complex, controversial issues where emotions run high and people might otherwise engage in argumentative recriminations.

Example - A technical planning team in the Industrial Products Division recommended to divisional management the formation of a new business that would capitalize on the combined strengths of the existing individual businesses of *Kevlar, Nomex, Tyvek, Sontara and Teflon.* The idea was controversial. Business managers felt it would dilute resources from their businesses and were strongly opposed. Technical management was strongly in favor.

A two-hour meeting was scheduled to resolve this controversial issue. Technical people designed the meeting based on the Six Thinking Hats framework. The business managers were agreeable since the division had an ongoing creative thinking program and were familiar with the value of this framework. An experienced divisional facilitator led the session.

The meeting started with a brief White Hat overview and discussion of the proposed

idea. Then, instead of Yellow Hat thinking to elucidate benefits, the facilitator initiated Black Hat thinking. An energetic discussion by business directors resulted in many hang charts listing serious difficulties with the idea. This allowed business managers to air reasons, many justified, why they were opposed. Technical managers also wore the Black Hat, participating in listing potential difficulties.

Next came Yellow Hat thinking, to discuss benefits. There was dead silence. The technical people purposely said nothing. Then, one of the business managers noted a benefit. This started the ball rolling. Soon, all business managers joined in along with technical people. There were as many hang charts listing benefits as those containing difficulties.

Green Hat thinking generated many creative ideas on how to capitalize on benefits while overcoming difficulties. At this point, everyone was energetically engaged in upgrading the idea to make it workable. Finally, everyone donned their Red Hats and took turns expressing their gut feelings on whether there was enough merit in the idea to proceed with next steps. It was decided to charter the planning team to recommend a stepwise implementation plan for further review, embodying inputs from the meeting. The business managers now had strong buy-in to pursue the idea further.

Impact of Creative Environment on Inventiveness

An environment that fosters creative thinking and innovation is bound to inspire inventiveness. This was indeed the situation in the DuPont Industrial Products Division, where statistics related to patents soared.

The number of notices of invention from R&D people surged from 40 in 1987, when

the program started, to 148 in 1989. In the same three year period, patent filings climbed from 16 to 67. Patent allowances nearly tripled from 10 to 28 and were on the rise.

A Tie Between Invention and the Arts.

Art and invention are often thought of as being worlds apart. Art is emotional and expressive and concerned with beauty. Invention is pragmatic and technical and concerned with knowledge. But there is a bridge. Both a work of art and a new invention are results of a creative act. Both are the result of solving a problem in a manner that involves creative thinking. Buckminster Fuller, the famous inventor, was asked about the relationship between these two disciplines. He responded:

When I am working on a technical problem, I don't think about beauty – but when I am finished, if the solution is not beautiful I know it is wrong.

There is indeed a beauty, an elegance, a strong sense of art in every creative solution to a problem, no matter how technical the problem. If an original idea solves a problem it might be the basis of an invention and possibly a patent protecting an important innovation that assures the future health of a business.

Maintaining Momentum

Initiating a program on creative thinking is a good first step in building a more innovative organization. The challenge to a management team is to maintain momentum in the program over a period of years so as to achieve ongoing bottom line successes. The culture-change model described earlier in this article provides an excellent mechanism to achieve this goal. ■

About the Author:

David Tanner (daveeet@aol.com) was founding Director, DuPont Center for Creativity & Innovation. Prior to that he was Research Director, Pioneering Research Laboratory; Strategic Planning Manager, Fibers Department; and R&D Director, Industrial Products Division. Dr. Tanner has a PhD. in polymer science and holds 33 US patents. After retiring from DuPont with over 30 years of service, he became Executive Director, Edward de Bono International Creative Forum. He is past-president of the American Creativity Association, and has authored two books, "Total Creativity in Business & Industry – Roadmap to Building a More Innovative Organization," 1997, and "Igniting Innovation Through the Power of Creative Thinking," 2007.

Roundtable Meeting Take-Aways

TURNING INNOVATION INTO A POWERFUL BUSINESS STRATEGY:
Overcoming the Obstacles to Innovation *(continued)*

This meeting, held at DRS Corporate Headquarters in Parsippany, NJ, continued to explore methods and practices for surmounting the numerous barriers to innovation. Facilitators were Lem Tarshis of Stevens, Ron Eilertson of Teknor Apex, and Jason Brito of ISO. This was the fourth in a series of Roundtable meetings aimed at unlayering the broad subject of innovation.

Lem Tarshis began by summarizing the learnings of the past three meetings. In particular, Lem enumerated some of the common barriers to innovation and some of the so–far identified concepts for overcoming these obstacles, employing some the materials presented at the last session by Larry Gastwirt (see Takeaways for 7/12/05 and the summary table on the next page).

What was clear from the ensuing discussion was that most people present recognized the obstacles from their own organizations and were able to relate to attempted solutions. One of the conclusions of this discussion was the need for organizations to properly define innovation and communicate expectations to all employees.

The next facilitator was Ron Eilertson of Teknor Apex, who continued his presentation from the prior meeting (presentation slides available from the Alliance office). Utilizing the HSATM Innovation model and associated audit, Teknor Apex identified their top obstacles to innovation as:

- Insufficient good ideas in the hopper
- Inadequate focus on marketing
- Overly complex product development process

- Overabundance of projects for available resources
- Too few business goals for new product development

Ron further reviewed what Teknor Apex has been doing to address these shortfalls. To get more ideas, they have begun using Quality Function Deployment (QFD) methods while getting a better view of what customers really desire. Ron was asked whether Teknor Apex was sure they were looking in the right places, and Ron responded with his belief that the answer may be no because of the second obstacle, namely a shortage of marketing talent focused on innovation. They are working on improving this situation by hiring marketing personnel, transferring responsibility for new product development to marketing, and strengthening use of their Stage-Gate Process, including the evaluation and feedback of new product ideas.

Roy Nicolosi next began the discussion of ISO's recently enacted innovation program by describing ISO for the group. ISO is a provider of data, analytical and decision support products, serving customers in and outside the insurance industry. The company became for-profit in 1996. The company is very profitable and growing nicely.

Today there are still many long-term employees and so they still have a culture of doing things the "old way." There are more than 500 employees in the IT function, with an average tenure of over 9 years. They have experimented with Critical Chain and Quality Function Deployment and have introduced a modern Stage-Gate process. They also have commercialized or cleaned out a huge inventory of product and process ideas that had long been in the hopper but had not been pursued vigorously. ISO came to the realization earlier this year that there was far too little organic growth for the future, and put a team in place to analyze the obstacles and come up with recommendations.

With this background, Jason Brito described ISO efforts to date to improve the quantity and quality of innovation (PowerPoint presentation available from the Alliance office). ISO uses the same definition of innovation that came out of the first 2005 Roundtable, namely the creation of value through the implementation of new ideas. They break innovation into two broad areas, the front–end conception and refinement of new value–adding ideas, and the advancement of these ideas from concept to utilization – i.e. implementation. They consider themselves pretty good in the implementation area, although incremental improvements can be made to their processes. On the other hand, the team found potential for huge improvement in the front end.

The team identified several general barriers at ISO:
- Already have strong financial performance (so why change?)
- Historical drag from formerly being a not-for-profit

- Different Strategic Business Units traditionally not inclined to work with one another
- No dedicated resources for innovation – ideas have no home
- Inadequate freedom to do innovation-related work

In addition, they identified a number of specific actionable obstacles to innovation at ISO:
- Not enough individuals purposefully searching for and defining opportunities
- The idea-capturing process at ISO has fallen into disuse and needs renovation
- Job rotation is not being purposefully used as a means of fostering innovation
- Insufficient training in support of innovation
- The reward system could be used more effectively to support innovation

To help overcome these obstacles the team developed the following recommendations to management:
- Dedicate individuals to innovation
- Renovate and re–introduce process for idea capture
- Train in innovative methodologies
- Screen new hires for innovation potential
- Formally rotate jobs
- Enhance and leverage their new product development process
- Create incentive programs

ISO is now taking the following steps to refine/advance the recommendations:
- Better determine ISO's current innovative status by conducting Alliance Innovation Audit and researching origins of recent new products
- Refine recommendations based on findings and begin implementation
- Publicize initiative among employees (and update status periodically)
- Develop and deliver grassroots education for all employees on the basics of innovation.
- Align with other initiatives to create a stronger drive toward an innovative culture

Many of the Roundtable attendees suggested looking at the rewards and recognition system to convince employees of the seriousness of the initiative. ISO also was encouraged to use cross–business innovation teams (DRS reported they are doing that at their corporate headquarters). ∎

Common Barriers to Innovation	Mechanisms to Overcome Barriers
Organizational history/legacy	Be cognizant of the impact that the legacy is having, and adopt practices to reinforce those aspects that work to stimulate innovation and counter the aspects that work against it
Innovation strategy unclear (or absent)	Adopt and effectively communicate a clear innovation strategy • Establish innovation guidelines and goals: business areas, quantitative screening criteria, etc. • Establish resource guidelines

Poor culture for innovation
- Deficiency in "Inquisitive," "Advocative," "Collaborative" and "Goal–Directed" behaviors (HSATM Innovation Model)
	• Instill innovation "norms," e.g.:
	  - Innovation is lifeblood of business and everyone's job
	  - Ideas can come from anywhere
	  - There are no "bad" ideas
	• Apply practices associated with highly innovative organizations by HSATM Innovation Study

Unclear idea collection process - Where do new ideas "go"? - Who assesses? - What are assessment criteria? - What is nature of feedback to originators?	Install or renovate formal idea collection process - and use it!
Slow/arbitrary feedback to idea generators	Incorporate feedback norms into formal idea process
Insufficient knowledge of technology and market trends	Maintain market/technical knowledge function

Fragmented/Inadequate resources – Especially for large opportunities	• Commit resources
	• Especially resources aimed at enhancing market/trend knowledge and developing preliminary business cases
	  - Applies especially to lower risk activities
	  - "Opportunity Attack Teams" (after Koen) to rapidly develop actionable plans for large opportunities
	  - Preponderance of resources full time

Too slow to stop support of less–promising opportunities	Develop specific screening criteria and apply prioritization process to kill poorer projects
Over–tweaking before customer testing - Especially for radically new products and platforms	Quick trials, refinements, and re-iterations ("Lickety-split" improvisation, per Lynn and Reilly)
General	• Employ systematic, quality, product development process • Define more detailed business cases, reflecting risk appropriately

HSATM

HOWE SCHOOL ALLIANCE FOR TECHNOLOGY MANAGEMENT

UPCOMING EVENTS

2007 Annual Conference
Commercializing New Ideas: Crossing the Bridge from Idea to Innovation
June 12, 2007, 9:00-5:00
Babbio Center, Stevens, Hoboken, NJ

Our Sixteenth Annual Conference examines the process of securing organizational alignment and support to develop and commercialize new concepts – in other words, to cross the bridge from idea to innovation. The Conference will share knowledge of how organizations have overcome the barriers and challenges associated with advocating, nurturing, and developing new ideas, on the road to innovation.

This conference will appeal to technology managers, product managers, marketing managers, new business development personnel, project managers, corporate and business unit managers – in short, to everyone interested in energizing and achieving innovation.

Four distinguished speakers will share their views and experiences in successfully bringing new products to commercial reality:

Peter W. Schutz, former CEO of Porsche A.G. and international authority on leadership and business management techniques. Mr. Schutz' topic is *The Driving Force: Extraordinary Results with Ordinary People*; he will describe lessons learned to achieve successful innovations at Porsche and Cummins.

Dr. Jack Emert, Chief Scientist for Infineum Ltd., a joint venture between ExxonMobil and Shell Chemical, will present *Anatomy of a Technical Innovation*. He will describe the strategies, processes, and critical enabling factors used to design and implement a successfully commercialized product.

Dr. Christopher Barlow, of DePaul University and the Co-Creativity Institute, will present *Innovation Leadership: Heroic or Collaborative?* He will look at the changes in actions and processes needed to solve the innovation problem from the beginning of the creative efforts.

Dr. Richard Tait, former executive with DuPont and a founding member and innovation manager for their Center for Creativity and Innovation, will present *Building Innovation Execution Competency*. He will describe an integrated framework for effectively structuring and implementing the critical elements to achieve innovation excellence in a complex business organization.

Please contact Sharen Glennon to reserve your space, 201-216-5381 or Sharen.Glennon@stevens.edu

Roundtable Meeting, May 2, 2007

The next HSATM Roundtable meeting will take place on Wednesday, May 2, 2007 from 1:30-4:30 PM at ARDEC, Picatinny Arsenal, on the topic **Mindsets for Innovation**.

Innovators need to know how and when to influence mindsets. Focused mindsets provide great leverage for creativity, decision-making, and action, but they often need to be shifted before people and organizations can see the full potential of ideas and innovations. Those attempting deliberate innovation need to apply leadership skills to shift those mindsets that they see as "resistance to change." Roundtable participants will discuss the variety of conflicting mindsets and values they have experienced and consider more effective approaches in their own organizations. The meeting facilitator will be Chris Barlow. See the HSATM website for more information.

INFORMATION

For further information on HSATM activities or to submit an article, contact Dr. Lawrence Gastwirt at **212-794-3637 • Lawrence.Gastwirt@stevens.edu**

Visit the HSATM website: **http://howe.stevens.edu/HSATM**

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