Chapter 15. Creativity[1]

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Research on organizational creativity has increased rapidly in the last decade. Not only is creativity of interest to scientific researchers, it has become a compelling topic in the popular media, with recent articles in *Psychology Today* (Gryskiewicz 2000), *Fast Company* (Dahl 2000), and in business-oriented publications such as the *Harvard Business Review* (Hargadon and Sutton 2000). Why this intense interest, and why now? Part of the answer comes from the nature of science and business today, especially in competitive fields where the pressure for innovation and maintaining a competitive edge has become more intense. Creativity provides the raw intellectual materials – ideas, concepts, insights, and discovery – that eventually become new theories, approaches, tools, products, and services that underlie innovation. Innovation is the adoption and social transmission of creative discovery.

What is Creativity?

Although creativity and innovation are closely intertwined in the public eye, they have often been studied in isolation by researchers using different methodologies and models. Creativity has been the province of psychology, with its emphasis on individuals and small groups, while innovation has been the focus of sociologists, economists, and others who take a larger, systems perspective. This separation is unfortunate, because creativity (producing something for the first time) represents "a dramatic aspect of organizational change that may provide a key to understanding change phenomena and, ultimately, organizational effectiveness and survival" (Woodman et al. 1993). Recent attempts to integrate the psychological and sociological perspectives include work by Ford (1996, 2000), Cummings and Oldham (1997), and Drazin, Glynn and Kazanjian (1999).

Creativity is generally defined as useful novelty – not novelty for its own sake, but novelty that can be applied and add value to an organization's products and services (Oldham and Cummings 1996). Creativity includes the generation of ideas, alternatives, and possibilities (Smith 1998). Creativity research has a long history in psychology, focusing on individual differences in personality, cognitive abilities, and problem-solving styles. However, recent theoretical and empirical work looks at creativity as something the brain does naturally. That is, creativity is an adaptive feature of normal cognitive functioning that evolved to aid problem solving under conditions of uncertainty. Under such circumstances, novel approaches and invention are highly advantageous (Simonton 2000; Findlay and Lumsden 1988). This perspective asserts that all human beings have the potential for creativity because we share common neural processes; however, whether the creativity is expressed or suppressed depends on the socio-cultural context, personality differences, and specific personal experiences (such as knowledge and skills). Within work settings, it is also apparent that organizational policies and practices as well as managerial behaviors influence creativity among workers.

By defining creativity as useful novelty, psychologists have clearly placed the emphasis on *creativity as an outcome*. Others, however, are beginning to look at creativity as a *process* that

[1] Related chapters include: Change Management, Knowledge Management; Competencies; Organizational Culture; Innovation.

ebbs and flows over time in response to problems that arise unpredictably (Drazin et al. 1999). In this view, creativity is intricately connected to sense-making, problem finding, and interpretation of events and situations. Although traditional approaches recognize the importance of social processes in creativity, they view social interactions as important for the generation and discussion of ideas, not for sense-making and interpretation. However, as Drazin and colleagues argue, organizational problems that require creativity are often complex, fluid, ambiguous, and occur over long time periods and thus require significant sense-making activity. In contrast, creativity research has tended to focus on bounded problems solved by small groups.

Traditional perspectives also look at creativity as something that can be manipulated once the factors that promote or inhibit creativity are known. These models presume that creativity at lower levels (individual, group) aggregate to produce organizational level creativity. In contrast, Drazin et al. (1999) argue that creativity at the organizational level emerges from the process of negotiating multiple meanings and potentially competing interests between different groups within an organization. In order to understand one another, people engage in the development of joint meanings, which, in turn, motivate engagement and this generates creativity. Creativity is associated with crisis resolution that leads to renewed sense-making and a shift in belief structures.

Regardless of whether creativity is considered a process or an outcome, it is ultimately linked to social processes and contexts and can be considered from a systems perspective (Csikszentmihalyi 1988). The systems perspective views the individual as the source of variation and change (new ideas) that are presented to others who then select and retain creative ideas that are used to elaborate the larger domain. The results of the elaboration are fed back to the individual and the process continues. A key question for organizational leaders is: What sparks the variation in the first place? How do creative ideas happen? What inhibits or suppresses creative ideation?

To understand creativity in the workplace, it is useful to review briefly the cognitive, social, motivational, and emotional processes that influence creative problem solving. After a brief review of these factors, the situational and organizational influences on creativity are discussed.

Cognitive Aspects of Creativity: Ways of Thinking, Mental Models, and Metaphors

The cognitive processes that generate creative outcomes do not differ from everyday thinking (Buchanan 2001). What differs is the context in which the creative ideas arise: The context both motivates and determines the value and usefulness of the ideas. Two key cognitive processes are involved in creative problem solving:

- Combinatorial – producing novel combinations out of familiar ideas/things through generating and testing.
- Transformational – using analogical reasoning and metaphors to transfer concepts from one domain to another.

Creativity also relies heavily on a sound knowledge base. As noted by Buchanan (2000), background knowledge is an essential element that distinguishes deliberate acts of creation from "accidental creativity." Background knowledge not only aids idea generation, it also supports the valuation component of creativity; it places the idea in a context and suggests why it is important (Kuhn 1970).

A number of researchers argue that creative problem solving also involves two different thinking processes. One is convergent or analytical thinking and the other is lateral or associative thinking (Guilford 1967). Edward deBono describes the differences between these two processes in this way: "Vertical (analytical) thinking digs the same hole deeper. Lateral thinking digs the hole in a different place" (deBono 1970:15). While convergent thinking is the process of critiquing and turning the ideas into useful products, lateral thinking is the source of ideas and insights. Both processes are essential for creative work outcomes. According to Cummings and Oldham (1997) analytic thinking is associated with an adaptive problem-solving style, while divergent thinking is associated with an innovative problem-solving style. Kirton (1976) has developed an instrument to assess differences in individual problem-solving styles that has been found to be a reasonably good predictor of employee creativity at work.

Neurological studies show that the brain functions differently under these two kinds of thinking, with a higher degree of neural complexity, and thus a greater degree of neural connections, under divergent thinking tasks than under analytical tasks (Dacey and Lennon 1998). Researchers interpret the results to mean that the brain is accessing a wide array of memories and fantasies that are the raw materials for creative ideation. Interestingly, the studies cited by Dacey and Lennon also show that brain activity during divergent thinking tasks is very similar to activity during mental relaxation. This lends support to the long-held belief that a relaxed incubation period is important for non-conscious processing that precedes the conscious production of novel ideas and insights – the illumination or "aha!" phase of creativity (Claxton 2000). Although the importance of incubation is widely recognized, there is little understanding of how it works because it occurs non-consciously and can't be verbalized.

Another important cognitive component of creativity is the ability to use different mental models. Shifting mental models means being able to shift from one understanding of a concept to a new and different perspective (Chi 1997, described in Dacey and Lennon 1998). This is especially important in multidisciplinary research and development where scientists and engineers must be able to understand one another's perspectives well enough to develop shared approaches to problems and thus shared discovery. Chi suggests that metaphors aid the shift of perspective and are thus an important form of creativity. Numerous other researchers have discussed the role of metaphor in creative problem solving (Kogan 1983, described in Dacey and Lennon 1998; Gardner 1982). Metaphors are useful because they call attention to two seemingly unrelated things.

Smith (1998) provides an analysis of 172 idea generation techniques that are used in organizations and by creativity consultants. He suggests that this wide array of techniques is derived from a much smaller set of "active ingredients" that can be used to determine the best technique to use for different kinds of tasks. He writes: "To understand how a technique works, its active ingredients and their connections to cognitive processes must be identified" (Smith 1998: 110). Active ingredients fall into two primary categories: strategies and enablers. Strategies are active means for generating ideas, while enablers work by fostering conditions within which creative ideas are more likely to occur. The strategies category includes habit-breaking strategies (challenging assumptions), imagination-based strategies (what if?), search strategies (past experience and analogies), analytical strategies (decomposition), and development strategies (compare and contrast, integration). Idea generation strategies aid retrieval of information from memory. In contrast to these kinds of strategies that actively aid memory and information retrieval, enablers act in a more passive way. They facilitate, rather than directly provoke, creative ideation. Enablers include intrinsic motivation, incubation (setting the problem aside), and deferred evaluation.

An important implication of the research on the creativity and mental functioning is that no one kind of cognitive process is responsible for creative thought: it draws on many kinds of processes. As noted by Dunbar in a study of scientific creativity, novel concepts and ideas often arise through a series of small changes produced by numerous cognitive mechanisms, including analogy, distributed reasoning, and deduction (Dunbar 1997). Dunbar's work is especially interesting because it captures "in vivo cognition" – the discussions of scientists during laboratory meetings. Dunbar was interested in identifying when and how innovative scientific thinking occurs. He found that insights and new ideas occurred as a result of the interactions generated by lab presentations. Listeners presented alternative interpretations and hypotheses and suggested additional experiments to test new concepts and ideas. He found that different members of the group focused on different aspects of the problem – some focused on data, others on methods and reasoning about hypotheses. Dunbar's research underscores the importance of social processes in the generation, manipulation, and critique of new ideas.

In applying chaos theory to creativity in organizations, Stacey (1996) also recognizes the important role of social and cognitive processes. He argues that creativity begins when some members engage in exploratory dialogue using analogies, metaphors, and self- reflection to develop new ideas that, under the right circumstances, are amplified and applied throughout the system to become dominant schemas.

Personal Variation in Creativity

Although the cognitive processes involved in creativity are the same for everyone, it is still evident that some people are consistently more creative than others and that people differ in their creative outputs over time (Dacey and Lennon 1998). Thus, there are individual differences as well as situational factors that influence creativity of individuals. These differences are related to many factors, including personality, experience, interests, and knowledge.

Creative individuals have several features that distinguish them from their less creative peers: They have a rich body of domain-relevant knowledge and well-developed skills, and they find their work intrinsically motivating (Simonton 2000; Amabile 1988). They tend to be independent, unconventional, and more risk-taking, and to have wide interests and a greater openness to new experiences (Simonton 2000). Research by Sternberg (1988) found several additional characteristics: skill in recognizing differences and similarities and making connections; appreciation of and ability to write, draw or compose music; flexibility to change directions; and willingness to question norms and assumptions. Creative individuals also tend to have a "discovery" orientation, which leads them to view situations from multiple perspectives, to find problems, and to ask novel questions (Csikszentmihalyi and Getzels 1988).

In work contexts, creative people also tend to take the initiative, to work effectively in teams, and to have extensive networks, including "networks in waiting" of individuals who can be called upon when needed (Kelly and Caplan 1997). Kelly and Caplan, in a study of "star performers" at Bell Labs, also found that these individuals shifted gears easily between a narrow focus on specific aspects of their work, to a broader focus on how their work fit into the larger organizational picture. Work by Roberts (1997) identifies important differences between "idea-havers" and "idea-exploiters." Ideas were most likely to be exploited by internal entrepreneurs who advocate and push for change. They take ideas and attempt to get them supported and adopted. Entrepreneurs are especially sensitive to company politics and the latest corporate buzzwords.

Organizational Factors that Inhibit or Facilitate Creativity

The organizational context – including the management practices, job design, and human resource policies – plays an important role in creativity. Amabile's model of organizational creativity (Amabile 1988; Amabile et al. 1996) is one of the most widely cited in psychological studies of organizations. Although not explicitly stated, the assumption behind the model is that creativity and innovation are important for all organizations and jobs. In contrast, other researchers (Mumford et al. 1997; Shapero 1997; Shalley et al. 2000) begin with the assumption that some situations and some jobs are more likely to benefit from creativity than others. Stacey (1996) also argues that creativity is more likely to be important when it helps an individual or organization survive better in its environment. In his perspective, the "fitness landscape" for creativity and innovation is related to other people and organizations in any given environment. Ford (1996) makes a similar argument, noting that creative actions are more likely to occur when they are more "attractive" than habitual actions. He sees an inherent tension between creative and habitual behaviors. The organizational context and personal characteristics determine the movement between these two types of behaviors.

Key organizational factors related to creativity include "proximate factors" that are close to daily experience (job design, managerial behaviors, training, work group diversity) and "distal factors" that are more remote, such as organizational structure and climate (Shalley et al. 2000).

Proximal Factors

According to Amabile (1988), *complex and challenging jobs* that enable workers to decide how to carry out tasks are more likely to encourage intrinsic motivation that, in turn, increases creativity. Motivation is also aided by a sense of urgency that increases the perception that the project or task is valuable and worth pursuing. In contrast to complex, challenging jobs, routine work can readily be accomplished by adhering to well-known processes and information. In such circumstances creativity may actually incur a cost if it reduces efficiency by introducing unnecessary change.

Although there is widespread belief in Amabile's perspective, there has been relatively little study of how creativity actually occurs in work settings. An exception is a recent analysis of a Japanese firm that uses a deliberate, structural approach to motivating creative problem finding and problem solving throughout the organization (Basadur 1997). The Japanese program includes three key components: monetary incentives, training/coaching, and careful alignment with organizational strategy. In order to encourage suggestions, monetary rewards were given for all implementable ideas, no matter how large or small. Small rewards were given to individuals, and large rewards were primarily given to teams. Teams were free to use the funds as desired. The program also included significant training and mentoring. Managers coached new workers in the cycle of problem finding, problem solving, and solution implementation. Their performance was evaluated in part on their ability to get workers to perform well in the idea generation program. And finally, the program itself was closely tied to strategic organizational goals. Quality circles were used to align ideas with "theme problems" identified by top management. The program had very wide participation throughout the firm and resulted in as many as 140 suggestions per person/per year. Basadur argues that the program is successful because it is highly motivating. However, the motivation comes largely from extrinsic sources, including rewards, recognition, and deliberate coaching. It is not clear from Basadur's account whether intrinsic motivation

played a significant role. As pointed out by Smith (1998), intrinsic motivation is difficult to identify because it is an internal, non-conscious process.

Actual measures of creativity in field studies are relatively rare. In addition to the research by Basadur (1997), Amabile and Conti (1999) used patent disclosures as an indicator of creativity. They found that patent disclosures decreased during and after a major downsizing at a large high technology firm. In this same study, the KEYS instrument showed that subjective ratings of the factors that stimulate creativity decreased significantly and ratings of organizational impediments increased. Oldham and Cummings (1996) also found evidence for the relationship between creativity stimulators (especially proximal, job related factors) and patent disclosures. Employees produced more patent disclosures when their jobs were complex and challenging and when they were supervised in a supportive, non-controlling manner.

Another proximal factor influencing creativity is *managerial behavior*. Managers can influence creativity in workers by instilling strong values, beliefs and assumptions that encourage creativity (Meyers 1982) and by their response to critical incidents, particularly when they perceive conditions as opportunistic rather than threatening and when they are proactive rather than reactive (Tesluk, Farr and Klein 1997). Managers can also encourage behaviors associated with creativity, such as free exchange of information, diversity of opinions, open questioning, and challenging of assumptions (Nonoka 1991). As noted in the study of the Japanese firm described above, coaching and mentoring are also valuable managerial tools for promoting creativity (Basadur 1997). Managers can also influence creativity by guiding careers, maintaining group diversity and providing challenging tasks (Roberts 1997). Roberts sees these factors as far more important than creativity training, which he views with considerable skepticism. Cummings and Oldham (1997) identify supportive and non-controlling supervision as one of the most important factors influencing individual creativity.

Diversity is considered by many researchers to enhance creativity (Stacey 1996; Schuler and Jackson 1987). Diversity is a broad concept and includes different disciplines, personality types, and different ways of thinking about problems, all of which are believed to lead to increased number and variety of ideas. However, diversity also has the potential to increase tension that, if not resolved successfully, can lead to organizational conflict and chaos (Stacey 1996). When working successfully, diversity creates new dialogue that counteracts existing ideas and strategies of the "legitimate system." In fact, in Stacey's view, creativity occurs outside of the legitimate, status quo system and is often in direct conflict with that system. Creative changes work their way into the dominant system through persuasion, political maneuvering, and ultimately, through re-education.

Having *stimulating co-workers* also promotes creativity by adding excitement and energy and the potential for synergy (Cummings and Oldham 1997). Research on team dynamics emphasizes the potential of interactions with others to motivate, stimulate interest, add complexity, and introduce competitive pressure – all of which can lead to enhanced individual and group creativity. Hargadon (1999:137) argues that groups play a central role in organizational creativity by "creating novel and unexpected combinations of an organization's past knowledge in ways that individuals or more formal organizational structures do not" and that group analogic reasoning plays a central role in organizational creativity.

There is growing evidence that the *affective context* also influences creative problem solving. Creative people have been described as open to emotional experience and to exhibit high levels of positive energy (Simonton 1977). In numerous laboratory and field studies, Isen has consistently found that creative problem solving is more likely to occur when people experience positively

toned moods than when they are in neutral or negative moods (Isen 1990; Isen and Baron 1991; Isen et al. 1987). The studies show that positive moods also have numerous beneficial impacts on cognitive and social functioning, including more efficient decisional processes on complex tasks and more innovative approaches to negotiations. Creative problem solving is less likely when people are depressed, unhappy, or stressed. This is because negative moods or stress tend to restrict attention and lead to stereotypic responses (Gazzaniga 1988). The relationship between emotional functioning and creativity raises questions about how work relationships, events, and other factors in the work environment influence positive and negative mood states and what the consequences are for creative efforts (Ford 1996). At the present time, little is known. Isen's own research has used traditional experimental paradigms in which mood is manipulated, often through the presentation of a small gift (such as candy).

Distal Factors

Distal factors, which set the overall context in which creative behaviors occur, include resources, organizational adaptability, organizational culture, and levels of internal strife. .

Resources are important not only for functional support, but also because having an adequate level of resources for the task/project influences workers' perceptions that the project is valuable and worthy of organizational support. Resources include financial support as well as time, physical space, and information (Mumford et al. 1997).

Another distal factor influencing creativity is organizational adaptability. Highly adaptive organizations tend to be more supportive of creativity (Basadur 1997). Adaptability means continually and intentionally changing routines to find better ways of doing business. Adaptable organizations engage in "opportunistic surveillance" – which means scanning the environment to anticipate new opportunities and problems and responding with new methods and approaches. Organizations that show low adaptability exhibit high levels of control through centralized decision making. Rigid adherence to rules and regulation tends to have negative impacts on creativity. This may occur through numerous mechanisms. For instance, Amabile ((1998) argues that centralized decision making and adherence to rules and regulations reduces intrinsic motivation, with corresponding decreases in creativity and the ability to cope with problems and demands, both of which detract from well-being. Centralized decision-making and control also reduces information flow through an organization. To the extent that creativity requires free access to information and knowledge, this will dampen the generation of new ideas.

The degree and nature of internal strife in an organizational also influences creativity. Strife and conflict increase stress that, in turn, generates use of familiar strategies and behaviors rather than novel approaches (Gazzaniga 1988). Stress also generates negative moods and anxiety, which, as noted above, inhibit creative functioning.

Stacey (1996) also looks at conflict as a potential inhibitor of creativity. Ironically, however, conflict is also a generator of creativity. Drawing on chaos theory, Stacey argues that creativity arises from the conflict between an organization's existing system and an emerging "shadow" system. The existing "legitimate" system in an organization tends to be conforming and hierarchical. Creativity originates in the organization's shadow system that is characterized by diversity, ambiguity, contention, and speculations brought about by new ideas that threaten the current norms and values. Stacey argues that an organization at the edge of chaos doesn't display chaos itself. Instead it shows stability and then sudden change to a new form that has been slowly evolving in the shadow system. Bureaucratic organizations with high levels of centralization are difficult to move in a creative direction because they have restricted information flow and few

connections between individuals. The dominant system in a bureaucracy consists of routines, habits, and highly defined procedures. Rich information flow, many interconnections, and diversity of behaviors and perspectives provide the raw materials for new ideas. Whether or not these are actualized as creativity depends on how well the organization, groups, and individuals can deal with the anxiety produced by challenges to the existing system.

Although stress is usually an inhibitor of creativity, especially if it is chronic or if stressful events are perceived as threatening, researchers also suggest that a modest degree of stress is beneficial and motivating (Antonovsky 1987). Antonovsky argues that good stress (which he calls "eustress") is associated with positive challenge.

The Role of the Physical Environment

The physical environment or setting can influence the degree to which divergent thought processes are used. Divergent thinking has a broad, relaxed focus of attention that requires a sense of psychological safety and peacefulness (Isaksen 1983). Distractions and time pressures can inhibit this process. In addition, creative problem solving takes time. A person or group may stop short of achieving a creative solution if there are strong external time pressures; under these circumstances, the first solution that appears to be good enough is likely to be selected (Guilford 1967). Also, problem solving tools, equipment, and technology available to workers can aid the ability to switch perspectives by providing display space, visual aids, analogies, and metaphors (Schrage 1995).

Research on creativity has focused almost exclusively on the social environment and organizational context. Very little attention has been paid to the physical work environment, even though spatial factors are known to influence communications and the nature of interactions (Allen 1977; Penn et al. 1999). Creativity thrives on the free flow of communications and interactions among diverse members of an organization. For instance, the overall pattern of space in building interiors affects patterns of "useful" interactions between research groups (Hillier and Penn 1991). Spatial patterns affect movement patterns, and movement patterns influence how frequently people come in contact with one another. Furthermore, the permeability of boundaries and the degree of openness in a space affect the potential for eye contact that precedes many interactions (Allen 1973). Enclosure, on the other hand, aids privacy, mutual disclosure, and development of trust, which in turn all aid the free sharing of information and creativity (Allen 1977).

The Costs of Creativity

Throughout this chapter, creativity has been viewed as a positive outcome or process, one to be encouraged and supported. The costs of creativity have been given much less attention. However, some researchers are beginning to look at this issue. Shapero (1997) describes creative people as non-conformist and jokers, who have little reverence for authority or procedures, little loyalty to organizations they work for, little patience for consensus building, and who are unmotivated by incentives that are important to others – such as status. Not surprisingly, such people are often difficult to manage and they can create unrest in the organization. This, as Shapero (1997) notes, is the "cost" of creativity that is often overlooked by organizations. He asks whether managers really need more creativity and whether they are prepared to live with it. He suggests that having a few creative people may be sufficient: "Many can benefit from the

creativity of a few, and there are industries, companies, and fields where creativity is far less needed than in others" (1997:44). Shapero also cites examples where creative organizations – "pioneers" – lose out competitively. New methods, processes, products, and concepts can be readily copied by others once they are on the market. The innovator pays all the costs of development, while the companies that copy or modify their products can put their investments into marketing and production. Thus, it doesn't always pay to be first to market with a new idea or product. Many benefit from the creativity of a few – including other organizations. Stacey (1996) also argues that creativity can lead to high costs in terms of internal tension and strife, if it is not controlled through bonds of trust and mutual support.

The Application of Creativity to Public Science Management

Although many of the ideas presented in this paper come from studies of organizations in the private sector, especially high tech or research and development (R&D) firms, they are relevant to the Federal sector as well. Many of the factors that inhibit creativity are characteristic of bureaucratic organizations – such as hierarchical structure, centralized decision making, inadequate resources and budget cutbacks, a tendency to do things the way they have been done in the past, and a high level of rules and regulations. Furthermore, the physical settings and spaces are allocated on the basis of seniority and are frequently not designed in ways that encourage openness, sharing, and a sense of equity.

Public science funding organizations could implement policies and procedures that facilitate, rather than impede, creativity. In addition to implementing these policies and procedures in its own organization, the science funding organizations could identify ways to encourage science implementing organizations to understand and adopt them as well. As noted in the above sections, this could include factors ranging from job design to communication – for example supporting an open flow of information and ideas from both the outside and within the organization. It should be noted, however, that an increasing challenge for managers is to strike the right balance between creativity and control, particularly in organizations dealing with materials and equipment that require careful management to assure worker and public safety and national security.

Relevant questions include:

1. When is creativity most important (for what kinds of projects and when in a project cycle)? Where is it most important to locate highly creative people?
2. How can creativity be encouraged within a bureaucratic and hierarchical culture? Should bureaucratic cultures be modified to encourage creativity? How can this be done without abandoning the controls necessary to protect our national security and interests? How could the physical environment be changed to promote creativity?
3. Given the specialization of scientific staff and in some cases the physical isolation, what mechanisms could be effective in creating interactions that spark creativity?
4. What can managers do to increase the ability of their organizations and groups to "capture" creative ideas and to leverage them effectively?
5. Would it make sense to do more to foster knowledge communities and creative partnerships (see Chapter 5) across disciplines and across organizational boundaries to promote scientific creativity?

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