

# Involving mind, body, and friends: Management that engenders creativity<sup>☆</sup>

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Received 1 February 2007; received in revised form 1 April 2007; accepted 1 June 2007

## Abstract

Based on the careful observation and interviews of employees at three companies, and supplemented by cases from the popular business press, a discovery approach is used to derive four management principles that engender creativity and innovation in organizations: (1) manage organizations so that their knowledge base is more diverse than what would occur naturally; (2) encourage employees to embrace a collaborative and non-complacent attitude towards work and the organization; (3) make it possible for organization members to engage in the quick testing of ideas and solutions as they emerge; (4) reward employee and supervisor behaviors that support these principles and punish resistance to their implementation. The principles work in companies even if creativity and innovation are not stated organizational objectives, and do not require large investments or disruptions to work processes to yield valuable results.

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**Keywords:** Creativity; Innovation; Knowledge management; Idea testing

Creativity and innovation are generally recognized as vital to commercial success in the 21st century, and also as critically important to the effective solution of tough organizational and social problems. Creativity is typically defined as the recombination of existing knowledge into novel configurations, and innovation as the value generating application of such novel configurations (Amabile, 1996; Davila et al., 2006). Calls for creativity and innovation have multiplied in recent years, giving rise to management practices such as chief innovation officers (CIOs) and the hiring of innovation consultants, to a proliferation of self-help books on the topic, and to multiple articles and Internet sites that highlight innovative practices at different companies (e.g., [www.businessweek.com/innovate](http://www.businessweek.com/innovate)).

Levels of news coverage and investments on creativity and innovation management can lead managers to believe that

engendering innovation and creativity in organizations is costly and hard to achieve. The present research suggests that this is not the case. Based on direct in-depth observation of three companies, and supplemented by the publicized accounts of other organizations, it is argued that the consistent application of four management principles can engender creativity and innovation in organizations regardless of size, industry, and access to financial resources. The four principles are:

- Manage organizations so that their knowledge base is more diverse than what would occur naturally.
- Encourage employees to embrace a collaborative and non-complacent attitude towards work and the organization.
- Make it possible for organization members to engage in the quick testing of ideas and solutions as they emerge.
- Reward employee and supervisor behaviors that support these principles and punish resistance to their implementation.

The present research suggests that the implementation of these principles does not need to involve large investments or high levels of organizational disruption, although wise investments and management may enhance the expected outcomes. Moreover, it suggests that creativity and innovation arise when

<sup>☆</sup> This research is made possible by the Fulbright Chile/USA Bi-National Commission, the University of Illinois at Chicago, USA and Universidad Gabriela Mistral in Santiago, Chile.

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the principles are applied consistently even if not consciously, and that the principles need not be applied across the full breadth of the organization, but can unleash creativity and innovation in teams as long as they can function autonomously. The exposition begins by describing the companies involved in the research, the circumstances that gave rise to the application of the listed principles, and the outcomes they achieved as a result. Because of company concerns with confidentiality, the names of the focal companies are disguised. Published examples of companies that have engaged in similar behaviors and realized equally beneficial outcomes are also included. Actual company names are used for examples drawn from the business press. The company descriptions also point out how the companies' actions embody the suggested principles, and are followed by a short exposition of the theoretically-substantiated mechanisms that give rise to these principles and the observed results. The exposition concludes with a short discussion of management lessons from the research.

The objective is to contribute in two ways to contemporary managerial thought and behavior about creativity and innovation. First, illustrate that creativity and innovation can be harnessed by organizations across all size and resource support levels, provided they are willing to apply these principles consistently. Second, argue that creativity and innovation are not mysterious outcomes invoked through cabalistic practices, but are instead natural outgrowths of human nature that can be unleashed through straightforward management practices. It is not argued that engendering creativity and innovation is effortless or cost-free, but the companies studied herein illustrate that both are achievable by organizations in pursuit of everyday business objectives without a need for disruptive change and significant investments.

## 1. Diverse companies and innovative outcomes

The management principles suggested derived from observation and documentation of company practices by two of the authors within the context of an international scholar exchange program. The three companies welcomed the research team with the expressed purpose of helping to improve organizational learning practices. The research process involved careful observation of management practices (e.g., suggestion programs, employee competitions, team management, etc.) and in-depth interviews with managers and workers at the different locations. Not surprisingly, creativity and innovation were found in companies that are striving for a learning environment, given the close relationship between the two phenomena. What was not expected was the finding that the same combination of factors would engender higher creativity and innovation across companies in industries as diverse as mining, aquaculture, and cement production. The principles presented here, and their potential to unleash creativity and innovation, were not directly recognized by the companies in advance of their implementation through diverse management initiatives. Noting similar outcomes across the companies, however, led the research team to a grounded discovery approach to the data — one in which the noted evidence guided the search for, and in some cases

development of, explanatory theory. These are the situations from which the insights developed.

### 1.1. Mountaintop Mines and the Bright Ideas program

Mountaintop Mines (MM) is among the world's largest copper mining enterprises. The operation produces over 350,000 tons of payable copper-in-concentrate from over 50 million tons of ore annually. MM is also recognized as a world leader because of its safe use of technology, good labor relations and employee safety, and environmentally responsible operations. The company employs over 2000 persons, distributed between the mine site (approximately 900), the ore processing complex (approximately 500), the concentrate shipping port (approximately 200), and support personnel. Copper mining involves the extraction of ore from an open pit or closed mine, crushing the ore to pebble sized fragments, and extracting the copper mineral from the crushed ore through a leaching process. Ore concentrate is transported as slurry to shipping facilities, drained and loaded for transport to smelting facilities. MM is an open pit operation. Although MM has three operational components, the observations stem from the processing plant and the mine, the two facilities available for study during the research period.

As with most large enterprises, MM continually manages hundreds of environmental, technology, and human variables across thousands of interactions, and faces a steady stream of novel problems that must be solved without compromising its production output objectives. Rising copper prices and increased demand in recent years have resulted in higher production quotas being issued by senior management, leading the company to seek higher levels of employee learning, autonomy, and creativity. To that end, MM instituted the Bright Ideas program, which encourages employees to propose solutions to existing problems and production hurdles, from which a small number of ideas are chosen and publicly recognized at the annual employee appreciation banquet. By the company's initial standards, the Bright Ideas program has been successful, generating over 1,200 ideas in its first 18 months of operation. The management principles and outcomes noted in this research came about through the implementation and management of the Bright Ideas system.

Because of its relatively short life span (MM started operations in 1999) and hiring practices that draw professional and trades personnel from across its country of operation, MM has a recognizably diverse knowledge base in its employees. There are no dominant ethnic groups, and its management team is characterized by a broad distribution of universities and educational backgrounds. The same can be said for its widely-recruited trades and production personnel, all of whom have at least a recently acquired technical high school education, with many having one to two years of additional training. Average employee age is 35. Resulting from these practices are two contributing factors — knowledge diversity and a social environment that is tolerant of diverse perspectives.

The Bright Ideas program is designed for equal access by all employees through internet-enabled suggestion input stations,

and participation is encouraged by team leaders and supervisors. Although the program was initially set up for individual employee submissions, managers are flexible on how employee teams develop and submit ideas. In the ore processing plant, which is organized around employee teams because of dangerous work conditions, the most natural place for ideas to develop is group meetings, a collaborative setting where non-complacency and friendly competition has grown as calls for higher production have led to increased team autonomy. Workers at the mine site are also organized in teams, but they do not work in close proximity because of the equipment (oversized trucks, front loaders, and shovels) and tasks involved. Employees work twelve hour shifts in both settings, and the complex operates continuously. At the mine site, communication between team members takes place through team leaders and supervisors. At the processing plant, knowledge tends to disseminate between team members because safety rules seldom allow employees to work in isolation and the noisy conditions preclude mass verbal communication.

An additional difference between the ore processing plant and the mine is the ease with which employees can perform quick and dirty prototyping of new ideas. In the mine environment the equipment involved is costly, and detailed rules for its use are strictly enforced. Variations from work processes to test new ideas must be cleared with managers before being implemented. In contrast, plant personnel are able to perform quick experiments on new ideas in a large subset of the ore processing operations without management approval. Case in point is an improved system for loading metal crush balls for truck transport between a storage facility and the crushing mill. Crush balls are mixed with ore in large tumblers to accelerate the breakdown process. They were originally transported in 1-ton containers that had to be unloaded, filled, and reloaded by a two-person team. The process had caused several injuries and spills, and workers devised a system for filling the containers while still in the truck. The system was developed iteratively, as first a loading chute was designed and tested, followed by iterative alterations to the truck loading ramp until an adequate angle of descent was achieved. The team developed the design working independently and received minimal funding, performing some of the concept testing on personal time. This level of team autonomy is not allowed at the mine site.

Compelling evidence that differences in managerial practices led to increased creativity and innovation first arose from the different submission-to-employee ratios between the mine and plant sites in a 12-month period (based on Bright Ideas program statistics made available by MM). In the twelve month period ending December 2005, the processing plant's 500 employees generated 450 ideas, in contrast to the 120 ideas submitted by the 900 mine site workers in the same time period. In addition, the percentage of blue-sky ideas (e.g., building a swimming pool for employees) emanating from the plant was 12%, in contrast to 30% from the mine site. Moreover, the managerially actionable ideas coming from the plant generated 4–5 times more in savings to the company than what came from the mine site. In general, plant employees produced a greater number of

actionable ideas with higher dollar value. Observation and interviews further revealed differences in the level of enthusiasm with the Bright Ideas program and overall job satisfaction. Plant workers are overwhelmingly engaged and enthusiastic about the program, whereas mine site workers tend to see it as a chore. Moreover, although more skilled and better compensated than plant workers, the mine site workers interviewed tend to see themselves as less appreciated by management. None of the interviewees suggested, however, that differences in work environments or management practices may account for this variance.

The search for other companies that employ diverse knowledge-sharing teams and quick idea testing in search of innovation led to the documented practices of companies such as Google and Procter & Gamble, where these team approaches have been either newly adopted or escalated (Conlin, 2006). Even more to the point is the example of Whirlpool, which abandoned high-priced consultant-dependent approaches to innovation for a home-grown process where employees from diverse areas of the company are allowed to work together (using web-based collaborative tools) and test ideas autonomously, while management performance metrics are linked to these efforts (Arndt, 2006). The company attributes part of its increase in revenue from innovative products (from \$10 million to \$750 million in four years) to this initiative. In contrast to MM, however, these companies are in the business of developing new products and services, and seek creativity and innovation as an end. Mountaintop Mines and the other companies seek learning organizations as a way of improving output, elevating efficiency, and reducing or eliminating environmental degradation, and have unleashed creativity and innovation as a side benefit. Moreover, they achieved it with minimal investments and disruptions.

## 1.2. Quality Salmon Limited and the Innovation Fair

Quality Salmon Limited (QSL) is an important player in global salmon production. The salmon industry has seen accelerated growth in the past two decades, as major Asian markets have been added to the traditional European and North American markets. This has in turn led to high volume production facilities such as QSL, which are impressive and controversial; impressive because of high quality and low operating costs, and controversial because of a poor record in dealing with safety and environmental concerns. The last major round of complaints against QSL came in 2003, when European importers reported product tainted with a known carcinogenic at the same time that Japanese importers complained of shipments showing antibiotic residue in excess of international standards. Prior to 2003, QSL's typical response to such criticisms was to quickly adopt whatever technologies industry leaders had developed to deal with the noted problems. As the company has grown into a market leadership role, however, opportunities for the quick acquisition of problem solutions has disappeared, given that industry leading organizations seldom have the luxury of adopting product ideas and problem solutions from competitors, and must either develop solutions

internally or stagnate. QSL has undertaken several initiatives towards improving its learning capabilities, with the Innovation Fair as an example.

The primary motivator for the fair was to build social capital among a subset of employees as a way of increasing learning capabilities. QSL has fresh water salmon spawning farms (where salmon eggs hatch and begin maturation), salt-water maturation farms (where salmon grow from river spawn to harvestable adult size) and processing plants (where salmon are cleaned, filleted, and packaged for export). Spawning and maturation farms are highly mechanized operations requiring only 2–3 employees working separate shifts, while the plant consists of conveyor belt operations where employees work in close proximity. The innovation fair targeted spawn and maturation farm workers who work in isolated conditions and have limited opportunities for group interaction and learning. Not surprisingly, these workers also tend to see themselves as somewhat disconnected from the company. The main objective of the fair was for employees to work together and become better acquainted as a way of building social capital, camaraderie, and a sense of belonging. QSL invited the research team to review and make sense of the results of the fair.

The Innovation Fair was developed as an annual event where self-directed employee teams submit project ideas, from which some are selected for development funding and showcasing at the fair. Projects selected for presentation are given resources to flesh out ideas (i.e., working models and/or mockups), and employee teams are expected to further develop projects on personal time. Prizes are awarded for the best idea and the best presentation, based on votes by fair attendees. Because of its social capital building objective, high levels of team autonomy are allowed, embodied in the fair's golden rule — permitted are all things not expressly prohibited. The company does not dictate operational domains for employee ideas or rules for how resources must be spent, and teams were allowed to self-manage structure and processes. Anecdotal reports abound of teams working long hours, arguing, and testing ideas and designs the night before the fair opened. Knowledge diversity, collaboration and non-complacency within the teams were naturally emerging characteristics of the process, aspects of the process from which the company expected problems, not benefits.

One unexpected outcome from the fair was that the number of entries far exceeded company expectations, while social interaction and relationship building did not materialize to anticipated levels because of inter-team competitiveness. Initial expectations were for 30–35 submissions and 15 projects being presented at the fair. Instead, over 80 projects were submitted, of which 30 were presented at the fair, for many of which the testing and working models were partially funded by the employees because the initial budget was depleted. Project entries ranged from designs for improved farming processes and facilities to designs for a company sports recreation complex. Another unexpected outcome was that hundreds of QSL employees, key suppliers, and competitors attended the event. The company will not release figures on the number or monetary value of ideas emerging from the fair that were implemented, but unofficially suggested that one winning idea was

a netting system that curtails sea lion attacks on maturation farms without damaging the predators. Stock losses to sea lion attacks are a problem for the industry, and few of the protection methods implemented to date have passed muster with environmentalists. The netting system that arose from the innovation fair is seen as promising by environmentalists and the company.

Small diverse teams working autonomously on projects and having opportunities to show off ideas to a tough audience are practices for creativity and innovation also used by Electrolux, the multinational producer of home appliances (Sains and Reed, 2006). Motivated by declining market share and rising import pressure, Electrolux adopted autonomous idea development teams as an important tool in its quest for fresh new products. In this case, giving groups the ability to quickly assemble prototypes, and present them for evaluation by other teams and experienced product developers, is as important as the teams being cross-functional. The company reports that one positive outcome has been a more holistic confluence of design and engineering inputs while products are still being developed, resulting in products that achieve high market acceptance because of looks *and* strong performance. The QSL case also illustrates that companies not necessarily seeking such levels of creativity and innovation can nevertheless achieve and benefit from them.

### 1.3. Rocky River Cement and self-directed teams

Rocky River Cement (RRC) is a medium-size producer of cement products. Established in the late 1940s to produce cement from steel smelting by-products, RCC has grown through acquisitions and self-funded investments into a company of national scope. The company competes with large multinationals such as CEMEX in its home market, causing RRC to be cautious and methodical in its management. Standard management practice at RRC is to follow the lead of larger competitors in the adoption of new technologies and operational initiatives.

One such adoption is the use of self-directed teams, which the company did not consider until the design stage for a new cement plant to supplement its 50-year-old facilities. For its new plant, RRC copied the well-documented organizational structure and procedures of a CEMEX subsidiary of similar size and scope. The new plant uses state-of-the-art manufacturing technologies and enjoys a young and well educated (high school diploma minimum) workforce that accepts self-directed practices (i.e., group evaluation of proposed problem solutions) as the norm, having never worked under different management practices. The old facility, in contrast, functioned under a hierarchical chain of command since its inception. It had a culture where decisions were made by supervisors and enforced by team leaders down the chain of command.

As the new cement plant went online, RRC sought to integrate its management practices across the facilities by using experienced managers and workers from the old plant to solve production startup problems at a new facility, while concurrently instituting self-directed teams to the old plant. It was in this transfer process that the aforementioned principles yielded



unanticipated outcomes. The research team was invited to visit both plants and help management make sense of outcomes from the personnel exchange initiative. The research effort included interviews of team members and analysis of team decision histories.

The personnel exchange created diversity in perspectives that both plants recognized as valuable. The adoption of team decision-making practices by the old plant, and the insertion of old plant personalities into new plant teams, however, caused tension. On the one hand, new plant personnel brought a strong penchant for consensus decision making, which had been unimpeded at the new plant in part because the organization had yet to encounter real world output demands with tight time and resource constraints. New plant personnel were accustomed to postponing decisions until all concerns were addressed and negotiated solutions had been identified. This was a far cry from the old plant environment where decisions were made on the fly to sustain production, and union–management conflict was the *de facto* mechanism through which differences were resolved. When faced with the contentious environment of the old plant, transferees from the new plant were uncomfortable and did not know how to respond to what often came across as harsh attacks and unilateral decisions.

On the other hand, old plant supervisors for whom decisions by fiat and the always-present non-complacency of union representatives were normal were taken back when directives became topics of discussion at team meetings, and might be altered through a consensus-building process to which the supervisors were unaccustomed. Old plant transferees to the new plant were also uncomfortable, both with being asked for personal opinions at team meetings, and with being expected to cooperate with managers in the development of problem solutions. The personnel exchange created two cauldrons for creativity and innovation. In one they placed employees (i.e., transferees from the new plant) who embraced collaboration but were uncomfortable with non-complacency, and in the second employees (i.e., transferees from the old plant) who were uncomfortable with collaboration but had well-developed scripts for surfacing non-complacency.

Two types of problems emerged. On the one hand, collaboration without non-complacency more than once led to consensus around easy-to-agree-on solutions that were not optimal. On the other hand, non-complacency without collaboration caused unenthusiastic pursuit of objectives that lacked team buy-in, and the potential for botched implementation because of oversights that experienced team members would have caught if they had been more involved. To alleviate both types of problems RRC management allowed plant managers to 1) proceed at a different pace in implementing the self-directed team approach, and 2) reward the hardest-to-achieve behaviors at each plant. At the old plant, one of the most difficult tasks to achieve has been the training and certification of all employees on at least one task, made difficult by resistance to the required documentation of job practices that had been carefully guarded secrets of workers and department supervisors before the move towards self-directed teams. By rewarding (primarily through public recognition) documentation achievements, the rate at

which training goals are achieved almost doubled in the 6 months after implementation. At the new plant, the most difficult behavior to implement has been instilling the ownership of decisions in team members even if not all were in agreement at the team meeting that the decision was announced. Decisions having to be made even when not all concerns have been addressed are a fact of life in companies where production schedules must be met. In this case, the rewards have been administered at an individual level and details were not disclosed to the research team. The company reports improved cooperation from employees, however. Needless to say, rewarding employee contributions has required that managers be better informed of the decisions and behaviors of employees across different areas of the company, and that employees trust managers to be impartial and consistent in the administration of rewards.

One final step taken at both plants is implementation of a process improvement program where all suggestions are expected to be formally submitted by teams, and where teams are required to flesh out ideas, test their viability, and perform cost-benefit analyses for submissions approved for further consideration. The quick testing of ideas is an integral of this process, and has proven most valuable at the old plant. There, a divergent array of equipment and technologies accumulated over time has created hundreds of opportunities for process improvements that can be quick tested without compromising the plant's productive output. Coupled with an increase in team collaboration and non-complacency, the company reports that the process improvement initiative has led to a high number of beneficial changes. In the more integrated new plant, idea testing tends to be scheduled for maintenance downtime periods, and performed as close in time to the emergence of the idea as possible. In 18 months of operation under self-directed team structure focused on process improvement, the old plant produced over 230 proposals of which 65% were implemented. Moreover, the dollar value and enthusiasm generated by the initiatives has been encouraging to plant management and labor alike, which until recently have worried over the plant's long term viability. At the new plant self-directed teams have been operating for 2 years, and generated 80 process improvement suggestions in the first year, and over 160 the second year. The implementation record for the new plant was not available.

A corollary example of self-directed teams as a way of engendering creativity and innovation, this time in product development, is that of Electronic Arts Inc. (EA), the video game producer (Helm, 2006). Responding to rising costs in its more traditional venues for video games — professional sports and blockbuster movies — EA has moved away from large programming departments that work on narrow elements of software across dozens of game applications (e.g., buildings, trucks, trees) to six-to-eight person teams that work autonomously on more broadly defined task areas, such as making character faces look as realistic as possible. Important to the self-directed nature of the teams is making deadlines more flexible without eliminating them altogether, trying to engender collaborative and non-complacent work groups that still make

progress toward timely decisions. In addition, teams are urged to present their most remarkable breakthroughs on a large flat screen TV in the studio on a weekly basis, which raises accountability and competition between teams while also disseminating knowledge. The company claims these practices will help it regain market share through internally developed products and lower its reliance of high-priced sports and Hollywood themes.

## 2. Management principles for engendering creativity and innovation

As discussed earlier, these companies were not seeking creativity and innovation per se when they embarked on the initiatives discussed above. Moreover, insights arose from recurring cause-and-effect patterns in the observations and interviews gathered as the research team helped the companies. Four principles were identified that worked together to engender creativity and innovation as modeled in Fig. 1. Moreover, having identified the principles and how they interrelate, a theoretically-grounded explanation that would also deliver managerially relevant knowledge was developed.

### 2.1. Diverse and accessible knowledge

Given that creativity emerges from the recombination of existing knowledge, it stands to reason that a diverse base of knowledge increases the chances that creative and innovative outcomes will be attained (e.g., Kanter, 1988; Amabile, 1996). Some companies pursue diverse knowledge through training programs that expose employees to best practices, both within and across industries that may be facing similar problems. This approach to knowledge building, for example, is part of lead user methods (von Hippel et al., 1999), variations of which have been applied by companies such as 3M and General Electric. An alternative approach is to hire personnel trained in a wide range of disciplines, and with diverse training back-

grounds even within the same discipline. Companies hiring engineers, for example, can engender diversity of perspective by commingling engineers from various sub-disciplines (e.g., mechanical, electrical, civil, biomedical) in the same work groups or task teams. Such companies can also engender diversity by hiring engineers from different schools and with different orientations towards theory and practice, bringing together highly abstract and highly applied viewpoints of the same problems. Hiring across disciplines and university backgrounds is one of the strategies used by IDEO and other product innovation consultants to encourage creativity and innovation (Hargadon and Sutton, 1997; Kelley, 2001). An important aspect to keep in mind is that as knowledge diversity increases, the number of concepts that can be used to arrive at novel recombinations rises, and thus engenders a creativity-munificent environment. Moreover, as the focal companies exemplify, knowledge diversity can be achieved in pursuit of other organizational objectives and without large resource outlays.

Also evident in the companies is that knowledge diversity should be accompanied by knowledge being accessible to others beyond those who are instrumental to its initial acquisition (Tobin, 1996). Because of how creativity arises, knowledge that resides only in the minds of a few has less opportunity to be applied towards novel recombination. The examples of technology-focused companies such as Electronic Arts and Electrolux suggest there is value in knowledge being documented and made accessible to others through the internet and other media. The results achieved by the focal companies suggest, however, that the most effective dissemination channel may well be conversation between the knowledge bearers, which points toward the need for collaborative and non-complacent environments.

### 2.2. Collaborative and non-complacent work environments

Research into the practices of innovative organizations (e.g., Kanter, 1988; Nonaka and Takeuchi, 1995) points out that an organization's procedural or problem solving knowledge normally exists in a tacit state and is activated only in response to externalities, a process that is conducive to the efficient handling of recurring challenges but not to the effective and innovative handling of novel problems. Moreover, researchers further argue that to counter this tendency when business environments become unstable, organizations should self-create opportunities for making knowledge explicit in pursuit of novel recombination and greater numbers of innovations, instead of waiting for externalities to trigger the process. This is precisely the mechanism found in companies such as Electronic Arts, Whirlpool, Google, and others. It is also the mechanism that was accidentally set in motion by MM's Bright Ideas program, and by QSL's Innovation Fair.

An important factor in making knowledge explicit is conversation, given that through it knowledge already existing in individuals is supplemented and enhanced by the insights of others, making emerging recombinations of knowledge more complex and rich in detail. Moreover, conversation helps

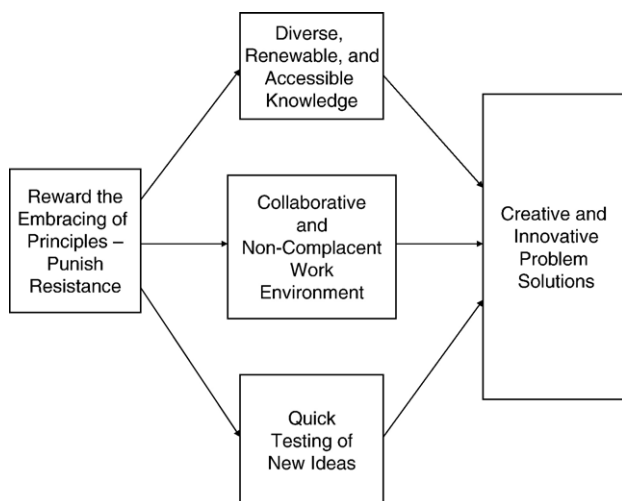


Fig. 1. Four principles that help engender creativity and innovation in organizations.

organization members to make more coherent the novel configurations they envision, transforming novel configurations from loosely coupled associative networks into representations with emotional and cognitive content that can be handled as mental entities and integrated into other arrays of knowledge that are similarly assembled. This sensemaking transformation is an inherently social process, and encapsulated in Weick's (1979) basic sense making recipe — how can I know what I think until I see what I say. It is important that organizations encourage members to share unique perspectives on phenomena and processes, and to flesh out and enhance the outputs from novel recombination by talking about them. It is also important that conflict over goals and problem solutions are allowed and possibly encouraged to surface (e.g., Kanter, 1988; Nonaka and Takeuchi, 1995). Research shows that divergent thinking can result in problem solutions that are more creative (James, 1995; van Dyne and Saavedra, 1996), and is thus a process worth encouraging. In some of the focal companies, such as RRC, the conflict was at first seen as detrimental, but ultimately came to be appreciated. Organizations that trigger internal cycles of divergent thinking are here labeled as *non-complacent organizations*, because they do not allow the sense of contentment that often arises from successfully re-applying problem solutions to take hold. As in the case of RRC, many organizations have strong tendencies to neutralize conflict and shield successful routines from environmental disturbances (Dougherty, 1992). In contrast, non-complacent organizations devote resources to periodically articulating and evaluating tacit knowledge and to submitting currently applied routines to critical evaluation (Hargadon and Sutton, 1997). The conversations where existing routines are re-examined are often heated and emotional, as found at all of the focal companies and most likely happens in other organizations, but the updating of knowledge and behaviors that the process engenders can be valuable. As seen in the focal companies, it can be further enhanced by allowing for the quick testing of new ideas.

### 2.3. Quick testing of new ideas

In many organizations the problems are tangible, and the solutions need to be also. Problems can range from production bottlenecks to shifting customer needs to environmental degradation, and in most cases the solutions involve existing and proposed new systems and technologies being altered to yield improved outcomes. Moreover, in many cases it is also possible to test if new combinations will produce desired outcomes without a full implementation of the proposed solution. This type of quick testing, sometimes called rapid prototyping, is an important contributor to creativity and innovation in organizations for more reasons than the obvious benefits that accrue from the early detection and resolution of implementation hurdles.

One additional and not-always-obvious benefit is the release and application of body-related knowledge that takes place when working prototypes of emerging solutions are tested. Research across sub-fields of neuroscience (e.g., Damasio, 1994; Barsalou, 1999) has affirmed the idea that the human

mind extends beyond the confines of the cranial cavity to involve knowledge that is generated and maintained by different parts of the body in addition to the knowledge in memory. Research has further argued that a person's grasp of what exists and is possible is enriched by bodily involvement because of the additional knowledge that such bodily involvement generates (e.g., Rosa and Malter, 2002; van der Lugt, 2002). This raises the possibility that a problem solver's grasp of alternative solutions is enriched by physically handling at least some of the solutions' components and possible combinations. Bodily involvement with novel arrays of components can contribute knowledge that is otherwise not available, and it is thus not surprising that organizations that allow for the quick testing of novel combinations tend to produce more complete and easier to implement problem solutions (Hargadon and Sutton, 1997; Kelley, 2001). This enrichment was also sensed by members of the focal organizations, MM and QSL in particular, who on more than one occasion commented on how team problem solving efforts rose to greater possibilities when they embarked on the quick testing of idea prototypes.

A second benefit from quick testing new ideas stems from the often unanticipated outcomes of such testing (new knowledge), which although not directly applicable to the problems at hand may have value in solving yet-to-be-encountered problems. Physical renderings often bring to light relations and interactions between components that had not been considered, and generate outcomes different from what was envisioned. That is a firmly-entrenched belief in the Whirlpool organization, where managers report that ideas are never killed, but are instead shelved for other employees to look at later, and where 717 shelved ideas have been accumulated to date (Arndt, 2006). It is also the case at IDEO, where unanticipated outcomes from the prototyping are documented and archived into a store of creative combinations that may be accessed in the future (Hargadon and Sutton, 1997; Kelley, 2001).

### 2.4. Reward behavior that supports these principles and punish resistance

It stands to reason that behind management actions that seek creativity and innovation, reward systems that encourage these outcomes must exist. At stake is more than motivating creativity and innovation, which research has shown to be primarily brought about by intrinsic factors such as challenge, autonomy, and shared goals (Amabile et al., 1996), and which the focal companies amply embodied. The more important outcome to bring about through rewards is sustaining an environment where diverse knowledge can be applied, where collaboration and non-complacency are integral to the culture, and where the quick testing of ideas proceeds without direct supervision — an environment that by definition is more risky and challenging for managers.

Having a diverse (and up-to-date) knowledge base demands that employees be allowed to develop expertise in diverse domains not always directly applicable to the problems at hand, and that those employees be allowed to bring such knowledge to bear in the pursuit of problem solutions. It is inevitable that

as the knowledge base expands a manager's ability to exercise control by knowing more than his people will be curtailed, forcing him or her to delegate expertise and trust the judgments of his employees. Having employees who know more than them is unnerving to many managers. The interviews revealed that it was the managers who believe they are rewarded for delegating and trusting who fared best when creativity and innovation arose, while those who perceived rewards as coming from anticipating what employees would uncover became nervous.

Cultivating a collaborative and non-complacent environment and allowing for the quick testing of ideas are also risky for managers. When the focus is on sharing knowledge, for example, conversations among co-workers are likely to be disjointed and not always on task, resulting in a process that may be perceived as inefficient and wasteful. Moreover, the manager is not always aware of what is being exchanged. The same holds true when companies allow employees to quick test ideas, since it becomes almost impossible for managers to track what is discovered, adopted, and discarded through multiple testing iterations. As it pertains to encouraging non-complacency, it demands that managers be comfortable with conflict within the team, stand above the fray, and channel contention and disagreement productively. They must allow emotions to surface without letting the team become dysfunctional. It also demands that managers move away from providing feedback in the traditional good/bad format, and adopt instead an appreciative approach that focuses on providing feedback that is informative and constructive, looking for value in whatever ideas emerge from the recombination process while at the same time being comfortable with adopting some ideas and laying aside others (e.g., Chisholm, 1987; Kanter, 1988; Collins and Amabile, 1999). It is not surprising that some suggest this is the most challenging aspect of managing an innovation focused organization (Kelley, 2001). The natural tendency of managers is to want to reduce or eliminate distractions and conflict in organizations, particularly when they see themselves as being rewarded for efficient control of the teams they oversee.

The suggested principles are risky. This was clear in the three companies studied, where some managers expressed concern and even fear over the new knowledge being expressed, the collaborative and non-complacent team process, and the intrinsic motivation that drove those employees to uncharacteristic behaviors, such as working on ideas on personal time and spending personal funds on working models and prototypes. Had these managers acted on such fears and concerns they would have curtailed employee activities, and possibly stymied processes that have ultimately proved valuable to their companies. In some cases it took the observant wisdom of other managers to restrain the natural tendency to discredit and flee the unexpected, but in every case a key factor at play was a reward system that encouraged the managers to accept the risks inherent in employees knowing more and acting on that knowledge. The approaches that seem most amenable to continuous creativity and innovation are those that reward managers for delegating responsibility for knowledge management, dissemination, and testing to employees, and who instead manage

through the exercise of leadership, team building, and careful human resource deployment. These managers do not seek to control employees, and live with higher risk levels than controlling managers.

The managers at MM, QSL, and RRC that saw themselves as being rewarded for taking risks and making things happen were comfortable with the processes and outcomes being generated, and were eager to pursue more opportunities for the organizations to be creative. Moreover, similar reward systems were found at companies touted for innovative track records (Byrnes and Arndt, 2006; McGregor, 2006), such as IBM and Nucor, even though the mechanics of the systems vary by industry and company. At MM, QSL, and RRC the regular reward systems were not expressly designed to encourage the types of risk taking described above, and it is far from clear that the companies are prepared to embrace such reward systems openly. It has been argued all along that the principles observed at work emerged by accident in these three companies, and the most compelling evidence is that, when faced with the principles they had uncovered and the changes to reward systems necessary to systematize achieved outcomes, all three decided that they needed to consider the matter further. Admittedly, managing such compensation systems is complex and challenging, and may pose serious implications for management and reward practices at higher management levels. Based on the companies' experience, however, the contribution of such reward systems towards having organizations where creativity and innovation abound seems hard to refute.

### 3. Limitations and discussion

There are admittedly other factors in each of the focal companies that contributed to creativity and innovation. The companies, for example, are leaders in their home markets. Moreover, all three are pursuing stronger learning environments as a way of improving responsiveness to internal and external forces. Given the sharing of antecedents between organizational learning and creativity (e.g., diverse knowledge, knowledge sharing, documenting unexpected outcomes), it seems safe to argue that the principles uncovered may not have come together had the companies not been trying to elevate internal learning capabilities. It can be argued that creativity and innovation are subsumed by organizational learning. Not all learning organizations are creative and innovative, however, with many becoming more efficient and cost-effective operators through the learning process. Learning organizations that are also creative and innovative are ones where the renewal and recombination of knowledge happen spontaneously and continually regardless of whether the company is doing well or poorly — a disruptive state-of-affairs that can only be sustained when reward systems are focused on its sustenance.

Another limitation is that the focal companies differed in how they implemented diversity of knowledge, collaborative and non-complacent work environments, the quick testing of ideas, and the rewarding of compliance with these principles. The operational examples of these companies are highly constrained by industry and nation of origin factors, and not as



valuable as the more abstract management principles articulate herein. Not even within the mining, salmon, and cement industries would it be possible to adopt these companies' practices entirely, given factors such as labor/management relationships, trade constraints, and corporate governance (e.g., private equity ownership) that also factor into how the companies are managed.

Nevertheless, at a more general level it appears that the psychological and sociological mechanisms that make people creative and innovative in one setting can be transferred to other setting. Diversity in the knowledge base of groups or teams charged with solving problems and developing ideas is valuable, be the group in a factory, a product development lab, a medical center, or a university. Moreover, the value of such knowledge rises when it is shared by group or team members, and the sharing of knowledge cannot be tightly controlled, but must be allowed to follow the sometimes indirect pathways by which humans and organizations seem to learn and develop. This freedom is particularly important when the desired outcome is novel recombination of existing knowledge.

In addition, it is clear that creativity and innovation can benefit from knowledge that is unleashed by the quick testing of new combinations alongside knowledge made accessible by thoughtful conversation. This is an area where management research is in its infancy, and where future scientific advances are likely to reveal an intricate and fascinating array of interacting sub-mechanisms that can be further explored for managerial implications. There is enough evidence in the examples of globally recognized innovators and the companies in this study to argue that the quick physical testing of ideas is fruitful, and complementary to knowledge diversity and conversation. One specific contribution of this research is to show that it can happen in organizations other than those focused on new product development.

Another contribution of this research is showing that these principles can engender creativity and innovation even when companies do not set out to achieve such outcomes. In the case of the companies here studied, the objective was quicker responses to internal and externally induced problems. In the pursuit of these goals the companies created environments where the identified principles generated valuable results. Now that the companies are aware of the principles, they are seeking ways to systematize their application and generate even better outcomes, but also struggling with how to reward support for the first three even if it means reduced managerial control. It seems clear that some control must be sacrificed. Managers must transition from the idea that they are good managers because they know more than employees to being good because they can oversee employees who knows more. Moreover, it is an approach that demands being comfortable with spending resources in the pursuit of knowledge that will not always be directly applicable to the problems at hand. Building creative organizations seems to be at odds with management focused

on control and efficiency, both popular metrics in modern organizations. Finally, the focal companies illustrate that having creative and innovative problem solving environments is possible for companies of various sizes and working in diverse industries, and not solely the purview of large organizations in high technology industries.

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