Coyotes, Jazz, and Creative Teams: Facing and Seeking Variance

Russ Derickson
Innovation Affinity Group, LLC
2020 W. 10th Ave. D-205
Broomfield CO 80020 USA
Russ@InnovationAffinity.com

Kathleen S. Long
Optima Research Group, Inc.
P.O. Box 391401
Mountain View CA 94039 USA
Kathy@OptimaConsulting.com

V. Scott Gordon
Computer Science Department
Sacramento State University
Sacramento CA 95819 USA
gordonvs@ecs.csus.edu

Akira Tana
Acannatuna Music
2040 Mezes Ave.
Belmont CA 94002 USA
Akira@AkiraTana.com

William Tremblay
Department of English
Colorado State University
Fort Collins CO 80523 USA
William.Tremblay@colostate.edu

Abstract

A conceptual framework is presented to explore the dynamics of variance in innovative teams within various domains. Recent reports of over reduction of variance through misuse of Six Sigma quality practices in otherwise creative enterprises suggest that effective innovation in teams requires another operational model. Inspired by behaviors observed in coyote packs and jazz combos, a three-facet systems model is presented that includes production of variance and adaptation to variance to balance what we call the *Guardian* role in variance reduction. These new roles are called the *Innovator-Creator* and *Adaptor*, respectively. All three roles are crucial and serve as agents in a complex adaptive system comprising a creative, innovative team. Each agent also represents a state within a system and it is shown that interactive dynamics entail changes of state. The notion of system metabolism to ingest and assimilate various magnitudes of variance is also explored. The model applies equally to organizations and individuals through an inherent structural recursion.

1 Introduction

Creativity and innovation are of premium value in business, scientific research, professional sports, the arts, and much else in life. *The Economist* in a headline article [Jarboe, 2006] informs us of their critical value yet emerging dearth and uneven distribution on a global level. In a 2007 issue in *Business Week*, we learn that many companies widely known for their innovation entered into misapplication of Six-Sigma quality practices that severely diminished idea generation among otherwise creative employees [Hindo, 2007]. Both underfeeding and strangulation of creativity and innovation are occurring. What's going wrong here and what can be done about it?

To address the apparent overuse of Six Sigma variance reduction in various enterprises, we present a systems model to illuminate the dynamics of team-based creativity and innovation that was inspired by rather strange bedfellows: *coyotes* and *jazz musicians*. We argue that a creative team should be part coyote pack and part jazz combo to balance out what we call the *Guardian* role that strives to reduce variance in a system. While essential for system stability, an unchecked *Guardian* response can stifle, if not kill, creativity and innovation. The key to effective innovation lies in understanding and embracing the relationships between system agents with respect to variance, and achieving a balance between them. Coyote packs and successful jazz combos achieve such balance, and therefore provide the basis for our model.

Coyotes have a remarkable ability to survive by adapting to environmental change, whereas jazz musicians have a profound facility to intentionally invoke change in an otherwise unchanging environment for purposes of creative expression. Stated in another way, the environment drives the coyote, which *reacts and adapts* to the environmental variance it faces to survive and flourish, while the jazz musician drives the environment by acting to *produce and embrace environmental variance* for artistic invention.

A balanced system can lead to highly creative, robust, and resilient teams. Thus, in addition to the *Guardian* mentioned above, our model also includes the *Innovator-Creator* to produce variance in an environment and the

Adaptor to adapt to variance introduced to the environment. The model thus associates and correlates creativity and innovation with variance, while recognizing that it is sometimes difficult to discern whether variance introduced to a system at any given time represents "signal" or "noise."

Our systems model is conceptual and comprises the three-facets, *Innovator-Creator*, *Adaptor*, and *Guardian*, for mapping the operational elements, roles, and interactions deemed necessary for successful creativity and innovation in various types of functioning teams. We describe the model facets as both "agents" (roles) and "states" within a complex adaptive system, and explore changes of state, static states, and system metabolism relative to the introduction and assimilation of innovation in a given environmental domain. The model applies equally to whole organizations and individuals through an inherent structural recursion.

2 Definition and Nature of Variance

The common definition of variance is that it is the quality or state of being different, variable, divergent, or anomalous. Variance speaks to the degree of difference between several ideas or opinions, deviation from a given procedure, or the degree of change in an environment over time. In statistics, it represents the quantified deviation (i.e. mean square deviation) of a population of numbers from the mean value.

There are times when it is desirable to limit variance for efficiency, safety, or quality, such as during manufacturing, performing surgery, or flying a commercial airplane. Conversely, there are times we want to increase it, as when designing innovative products, doing research or creating art, or introducing unexpected offensive or defensive maneuvers in competitive sports. However, even in creative settings there shouldn't be too little or too much variance; *constraints* play a crucial role, and as we shall see, effective use of the *Guardian* is an integral part of a creative team.

Indeed, constraints seem ubiquitous in creative teams. The coyote pack reacts and adapts to the variance in its environment, but has only a constrained ability to modify it within limited tactical scenarios (described later). The jazz musician is able to increase or decrease the variance in his/her environment at will, but is also constrained by the conventions and forms of the idiom. So too the *Guardian* role that seeks to preserve the environment must also be constrained to avoid strangling innovation.

3 Coyotes and Jazz Musicians

A deeper look at coyotes and jazz provides useful insights into variance in various domains. In the case of the coyote, its environment is the natural one with its rich, ecological systems. In jazz, the environment consists of a performance setting: an audience, a small combo (typically 3-5 players), and its own "ecology" – the structure and conventions for the interactions of musicians in the jazz idiom.

Coyotes and jazz musicians possess both similar and dissimilar traits and are an integral part of their respective environments. Coyotes are clever, flexible, and able to conform to and modify social dynamics, and possess a bag of tricks to flourish in a naturally varying environment where other species die off [Beckoff, 1995]. These adaptive traits also characterize the best jazz musicians. However, unlike coyotes, jazz musicians seek and are able to invent change within a group dynamic to purposely modify their environment. Also, "survival" in the world of jazz is more metaphorical and speaks to a musical combo's success in creative expression for a receptive audience, often based on artful risks. The common links between jazz players and coyotes include versatility and the ability to improvise, two earmarks of creativity and innovation.

Coyotes, in comparison to many other species of mammal, "improvise" with greater ingenuity when facing a changing or varying environment that threatens survival. For example, they hunt alone if there is plenty of small game and rodents, but team in pairs or larger groups to hunt larger game, such as deer, if small game populations within their habitat diminish. Coyotes also team symbiotically with badgers to hunt and share prey, lending their keen senses of hearing and smell to the badger's ability to burrow into the dens of evasive underground prey. Their diets, among the most varied compared to others that share their habitat, include both vegetation and prey, making them far less vulnerable to depletions of certain food items. Indeed, they are among the most versatile, inventive animal species, and have even been observed to scale 14 foot vertical chain link fences much like a spry primate if motivated to reach the other side. Not least, the coyote is viewed as "magician," "trickster," or "cultural hero" in the creation myths of various Native American cultures [Beckoff, 1995].

In the preceding examples, the coyote is primarily *adapting* to environmentally generated variance with an instinctual skill set. However, they also possess tactical skills in which they *create* variance in restricted amounts. For example, if their habitat is also occupied by wolves, they prefer to live on steeply sloped terrain. That way, when chased, they will run down slope, then suddenly stop and run back uphill as the pursuing wolf, with its greater inertia, struggles to stop and reengage the clever coyote, now some safer distance away. This exemplifies a tactical, defensive maneuver in which the coyote creates a surprising variance to throw off the predatory wolf. Analogous surprise tactics are standard fare in competitive sports in which the production of variance operates for offensive or defensive advantage against an opponent [Bar-Yam, 2000].

In contrast to coyotes, jazz musicians improvise to create intentional change for the sake of artistic performance within a fundamentally stable and structured environment. Thus, in playing a known musical composition, a jazz combo will ad-lib various melodic, harmonic, and rhythmic

embellishments and novel combinations, based on the composition's structure. This adds interest and surprise for an audience, and, tellingly, often for the combo players themselves. The jazz setting requires mutually supportive interplay between combo members in musical dialog, bantering and exchanging solos. Also, a new player, "sitting in," can add rich elements of uncertainty, novelty, and creative tension to an established jazz group, catalyzing exciting new responses and musical journeys.

4 Three-Facet Model of Innovative Teams

Our framework for understanding and dealing with variance in creative, innovative teams embodies the coyote pack and the jazz combo, in a three-facet systems model. The model focuses on dynamics of variance in a given environmental milieu, namely, the relationships between:

1) production of variance
2) reduction of variance
3) adaptation to variance

The jazz idiom is our primary source for insight into variance production, whereas coyote behavior primarily illuminates the role of adaptation, although the boundaries are fuzzy. Quality programs such as Six Sigma elucidated the need for variance reduction in a system (the *Guardian* role), but recent experiences in creative enterprises signal both the upside and downside of variance reduction. We will also explore how the framework can elucidate and help engender embedded structural recursion in a system.

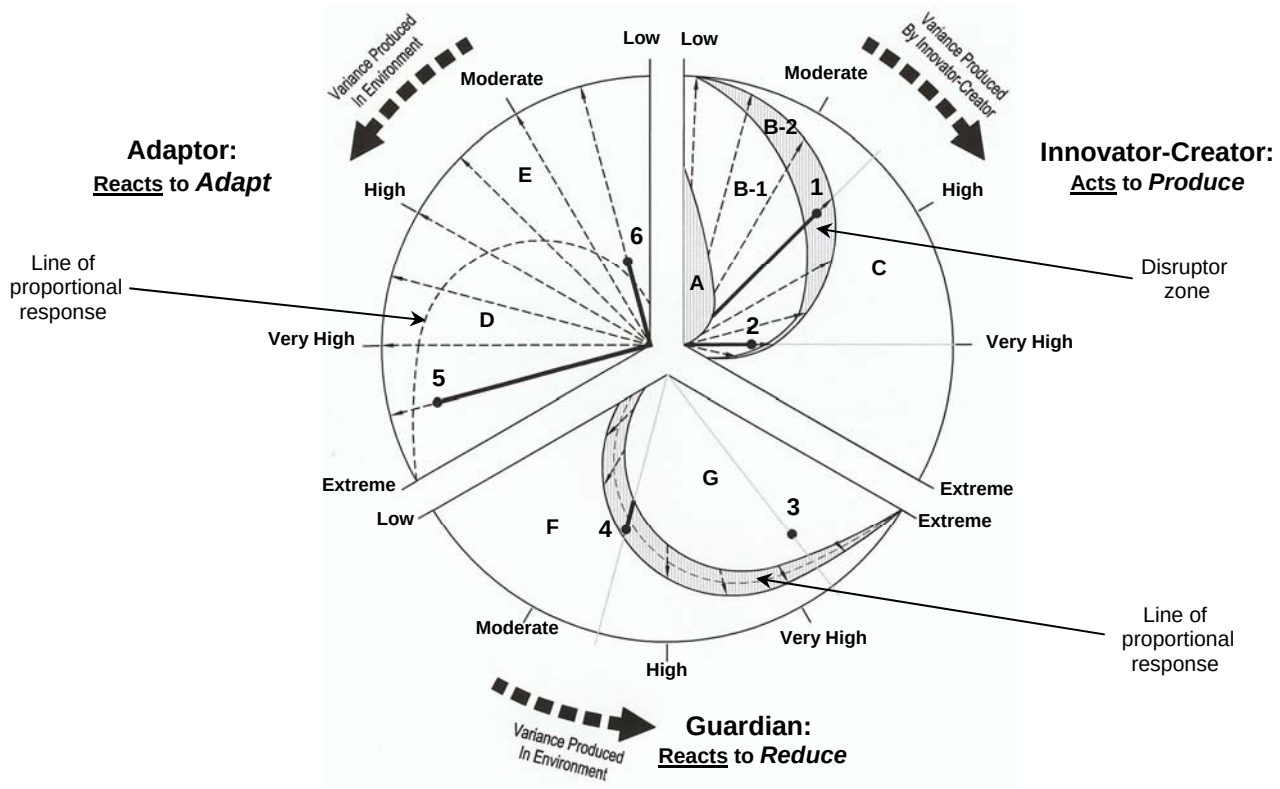

Figure 1. Conceptual three-facet model explores the dynamics of variance in a team or organization within a given environmental domain. Each of the three pie segments represents a separate state and also corresponds to a specific role (agent) around variance in a team or organizational system: 1) *Innovator-Creator*, 2) *Adaptor*, and 3) *Guardian*. Interdependent dynamics between agents yields a complex adaptive system. Note: radial length denotes rate of action for Innovator-Creator and magnitude of reaction for Adaptor & Guardian.

Figure 1 displays the graphically-based, three-facet systems model of the dynamics of variance in a given environmental domain. The figure should be viewed as a quasi-quantitative schematic in its depiction of the dynamics of variance, with no claim of exactness or precision. The *Innovator-Creator* **acts** to produce variance in a given environment. The *Guardian* **reacts** to environmental variance by attempting to reduce it. The *Adaptor* **reacts** by adapting to it. In a system, such as in a team or larger organization, all three facets interact dynamically as agents (roles) in a complex adaptive

system [Miller and Page, 2007]. Importantly, although the *Innovator-Creator* in the model is generally a human agent or agents, it may also be an embodiment of forces and interactions in nature or society of sufficient scale to effect environmental change. Note also that variance can have positive, neutral, or negative consequences.

4.1 Innovator-Creator

In the *Innovator-Creator* pie segment of Figure 1, the magnitude of variance produced by the agent increases clockwise, and the rate of variance produced is proportional to the length of a radial line emanating from the center of the circle at a given clockwise position (several arbitrary example radial lines with arrows are shown). Radial length is measured from origin to arrow tip. Thus at point **1**, the amplitude of variance is moderately high, and its rate of production is within the "disruptor zone" (marked **B-2**, described later), and is high relative to variance magnitude.

The zone labeled **C** represents a rate of variance production that is too high relative to its magnitude for the environmental system to metabolize (i.e. ingest and utilize) and too high for the *Innovator-Creator* to achieve. System metabolism will later be discussed further. In region **A**, the rate of variance production is too low relative to its magnitude and insignificant as a creative-innovative act.

Point **2** represents high amplitude of variance produced, but at a low rate, so that the existing body of knowledge (and the agent's skills) are not overly extended. The system can effectively metabolize it over an appropriate time frame. Moving the radial line clockwise from point **2** to a higher magnitude position requires an even shorter radial length to enable systemic metabolism. We argue that the deepest levels of creativity reside between very high and extreme amplitude of variance production, in which rates are exceedingly low. Major innovators such as Albert Einstein and William Blake reside in this zone of the figure.

In an improvised jazz performance, the magnitude of variance produced typically ranges from moderately low to moderately high, with corresponding rates ranging from moderately high to moderately low. The greater the magnitude, the lesser the production rate must be so that an audience can comprehend (metabolize) and enjoy the music, recognizing that a more sophisticated audience may appreciate greater variance at a higher rate.

Continuing the jazz setting, the *disruptor zone* represents one (or more) of the musicians pushing the envelope compared to the other players, to enhance the performance and spur on the level of creativity. Because jazz is based on conventions and forms, improvisation therefore is not unstructured or characterized by large magnitudes of variance at high rates, contrary to some common misconceptions. Rather, jazz performance more typically resides in regions **B-1** and **B-2** in Figure 1 and usually does not exceed a moderate rate of variance production.

By contrast, musical *composition* (jazz or otherwise) entails larger amplitudes and lower rates of variance production. The more innovative the composition or the greater the introduction of new forms and conventions, the more we find ourselves at high to very high magnitudes of variance within regions **B-1** and **B-2** in the figure

Within the deepest realms of advancements in jazz by an innovator-creator (e.g. at point **2** on the figure), we observe a process of necessary acceptance by other musicians and an evolutionary assimilation over time in performance settings. Players and audience must grow together symbiotically, so that today's innovation becomes tomorrow's mainstream.

The same process of innovation occurs in product design, including the existence of the disruptor zone. Depending on whether design is based on current conventions and patterns or is more deeply innovative, it is comparable to either jazz performance or composition. Innovation can run shallow or deep, depending on the number of variables and driving forces within an environment [Hargadon, 2003].

Looking to other spheres of endeavor, we would not frequently expect to encounter an Albert Einstein or William Blake. In Einstein's case, it was more than a decade before his innovations were metabolized, and even then only within his discipline, and after an analogous process of evolution as described above for advancements in jazz. For Blake it was more than a century, during which a far more complex process of assimilation within society occurred.

An important point needs to be made about the disruptor zone. Figure 1 shows a narrowing disruptor zone as we move clockwise toward increasing magnitudes of variance production. The reason for this is that at higher magnitudes the process is already highly "disruptive" and difficult to "metabolize." Further disruption is counterproductive.

4.2 Guardian

In the *Guardian* segment of Figure 1, variance produced in the environment increases counter-clockwise. In contrast to the *Innovator-Creator* segment, the length of the radial lines emanating from the origin of the *Guardian* pie segment denotes the magnitude, not the rate, of *Guardian* response. Radial length is measured from origin to arrow tip.

The *Guardian*, as preservationist, always reacts to reduce variance as it emerges. A proportional *Guardian* response is depicted by a narrowing band that spirals concave upward from left to right in the pie segment (several arbitrary radial lines within the band are shown for illustration). Thus, while a proportional response increases with added environmental variance, it does so with decreasing "slack" at high, more critical, variance levels.

Region **G** on the figure corresponds to a less than proportional response to reduce variance, and may lead to a

system spiraling out of control (hypo-vigilance). Similarly, region **F** represents greater than proportional response and may result in wasted energy in reducing variance (hyper-vigilance). We acknowledge that a response can also become unstable or oscillatory, so an effective *Guardian* should be informed and guided by system control theory [e.g. Levine, 1996] that includes proportional, differential, and integral sensing of dynamic environment variance.

Point **3** shows a case with very high environmental variance with less than proportional response. Point **4** shows moderately high variance with response in the proportional range. In general, note that the *Guardian* performs over a narrower range than the *Innovator-Creator* and the *Adaptor*.

As stated in the introduction, a *Guardian* role gone afoul can limit the variance essential to creativity and innovation. From information theory we know that new information is best garnered in experimentation that incorporates enough variance to achieve low probability successes and failures in roughly equal proportion [Reinertsen, 1997]. However, creativity also requires constraints such that variance is neither too small nor too great [Stokes, 2006; Hargadon, 2003]. Thus, the *Guardian* role is crucial for system stability and success, but must be balanced by the *Innovator-Creator*, and as we shall see, the *Adaptor* as well.

4.3 Adaptor

For the *Adaptor*, variance introduced into the environment increases counter-clockwise, and magnitude of adaptive response increases with radial length. Although a line of proportional response is shown in the figure, an *Adaptor* response may be appropriate anywhere in the pie segment, granting the *Adaptor* a wider behavioral range than the *Innovator-Creator* or *Guardian* (as noted by the family of radial lines that extend to the circumference of the pie segment for all levels of variance). This suggests a broad, versatile role for the *Adaptor*, analogous to the coyote.

Point **5** displays slightly less than proportional response to extreme environmental variance (region **D**), and point **6** shows somewhat greater than proportional response to moderately low variance (region **E**). Both cases may be valid for a given instance of environmental variance. For example, a small variance introduced into the environment may end up of no consequence, or may instead foreshadow something big. So either a small or large response could be valid. Similarly, a large environmental intrusion may be inconsequential, or lead to catastrophe. Thus, the knowledge and wisdom of the *Adaptor* is crucial for correct response.

5 Using the Model for Analysis and Guidance

The following discussions explore aspects of the three-facet model in diverse settings and suggest management tactics and strategies for guiding creativity and innovation in teams and whole organizations.

5.1 Discrete States and Changes of State

Each of the model's three agents (*Innovator-Creator*, *Adapter*, and *Guardian*) represents a discrete "state" in a team or whole organization. A single actor (or reactor) can remain in one state or shift between states, but not be in more than one state at a time. State changes can be quick or slow, as circumstances or environmental domain may dictate. For example, in a jazz combo, a soloist can be in *Innovator-Creator* mode, suddenly switch to *Adaptor* mode in momentary reaction to another player's feedback, then return to *Innovator-Creator* mode, modifying his/her solo based on that interaction. Likewise, an ensemble player (or even a soloist) may suddenly switch to *Guardian* mode if the tempo becomes unstable or some player steps too far out of the structure of the piece being played/improvised upon.

One observes analogous state changes (good and bad) in teams and organizations in other domains, too. Management strategies can serve to maximize benefits associated with effective shifts in state in specific endeavors.

5.2 High-Variance Teams

Product design teams, like jazz combos, are "high-variance" teams. If properly managed within a whole organizational structure, design teams will operate largely in *Innovator-Creator* mode, with frequent shifts to *Adaptor* mode to accommodate constraints imposed by manufacturability, markets, budgets, etc. However, such state changes typically occur at a slower rate than in a jazz combo.

Good management seeks to maintain innovative function in its high-variance teams by buffering them from *Guardian* influences that undermine creativity. It is not unusual that management also needs to attend to a design team's change of state to *Guardian* mode when required periodically to transition to new design tools and processes. Resistance to change is apparent and persistent, even with the innovative.

5.3 Low-Variance Teams

By contrast, manufacturing teams typically operate at "low-variance", dwelling primarily in *Guardian* mode for quality assurance. Complications can arise when an organization periodically seeks to evolve by incorporating innovations in manufacturing equipment and/or new operational processes. Guardians may vehemently resist such innovations.

An effective, well-known organizational strategy in the field of product development is to form teams that include stakeholders in design, manufacturing, and marketing. This reduces the "us versus them" mentality, allowing the *Innovator-Creator*, *Adaptor*, and *Guardian* to co-exist with a healthy blend of recursion and acceptance of state change.

Other low-variance teams include airline cockpit crews, and surgical teams that operate with fixed procedures for safety and quality. These teams are not doing research or

prospecting for novelty and surprise. Thus, they also function primarily in a *Guardian* mode, but train for emergency contingencies that are addressed with set, well-rehearsed procedures. However, there are occasions when rare events arise for which a "low-variance" team is not trained, requiring a change of state to *Innovator-Creator* and *Adaptor* roles. As with manufacturing teams, evolution in the airlines and medicine require management intervention that includes training and other proactive steps.

An example of a team that resides operationally between low-variance and high variance is a symphonic orchestra. Although a composition is usually scripted in precise form, interpretations by the conductor and orchestra members add variance through artful choices in phrasing, inflection, and dynamics. This interpretive license, with careful execution, adds interest for the listener without violating compositional integrity, and features the virtuosity of the musicians.

5.4 Recursion in Teams and Organizations

Individuals, teams, and divisions are all embedded within a larger organizational environment. When a team pursues an innovation out of sync with the parent organization, the parent system itself (as *Guardian*) may reflexively quell its output. For creativity and innovation to flourish, they must emerge within a recursive, self-similar structure [Long, 2006] that extends, like Chinese nested boxes, from individuals to the entire organization. Interestingly, we sometimes see high levels of creativity in sub-cultures existing clandestinely "below the radar" within heavily constrained organizations. Most of us know such examples.

Organizational structure goes beyond ostensible configuration to include relationships within a social and emotional context. Emotion is not often discussed as part of organizational structure, but it is manifested in levels of fear, trust, frustration and other emotional elements of the culture. Cultures that support creativity and innovation tend to value trust and "intelligent" risk-taking. The *Guardian* role would act to preserve this culture. The *Innovator-Creator* role is fueled by emotions of surprise, joy, and wonder and is often "raw," while the *Adaptor* role tends to be more "cooked," yet alert to challenges, and able to adapt while remaining sensitive to the common goal. The *Adaptor* role can provide a gliding "fill" when innovators first grasp a gestalt. This can be an initial step in metabolizing the change. An effective system structure is recursive with each team member able to manifest and balance all three roles. Likewise, all three roles must be present and aligned within individuals, teams, and the organization-at-large.

6 Summary and Conclusions

We presented a three-facet model of the dynamics of environmental variance in order to explore creativity and innovation in teams and larger organizations, characterizing them as complex adaptive systems. The model is inspired by and incorporates behavior that is found in successful creative/adaptive groups in nature and the arts, namely, coyote packs and jazz combos. We identified essential agent roles common to such organizations, dubbing them *Innovator-Creator*, *Adapter*, and *Guardian*, and showed how to structure teams for exploiting the diversity and interactions between the roles with effective management.

Understanding and embracing the importance of all three roles is valuable not only for managers, but also for the team members themselves. By embracing an appropriate balance of contrasting agent roles, teams can apply methods that are ubiquitous among successful and innovative groups.

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