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ADVANCING THE FRONTIERS OF SYSTEMS DYNAMICS THROUGH HIGHER ORDERS OF PARADOX

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"All persons are caught in an inescapable network of mutuality, tied to a single garment of destiny."

Martin Luther King, Jr.

Abstract

In systems dynamics, certain archetypes, such as fixes that fail and shifting the burden, contain a combination of balancing and reinforcing loops that exacerbates the original cause. Such a paradox represents a shift from a mechanistic paradigm inherent in a balancing loop to a more holistic paradigm. However, there is a second order paradox that is generally neglected in the analysis of systems dynamics. It is characterized by mutual causality of elements, as observed in new science, chaos theory and mystical traditions. Furthermore, there is a third order paradox that belongs to the spiritual domain. As we advance from the first to the third order paradox, the causal relationships between the opposites become subtler, until the duality disappears. This paper presents a method of unveiling creative solutions—ranging from the material to the spiritual—of puzzles in complex living systems through the exploration of first, second and third order paradoxes.

Key words: Systems Dynamics—Paradoxes—Metaphors—Chaos—Polarities—Mutual Causality—Autopoieses—Spirituality.

Introduction

From the dim ages of the past, humankind has repeatedly searched for a common thread that links all creation. Whether it is in the field of science, metaphysics or mysticism, we encounter perennial human endeavour to connect all elements of reality to a single unified core. According to Aristotle, everything is guided by its nature, structure and intrinsic purpose (*entelechy*). Despite his dualistic theory in which he separated mind from matter, Descartes postulated that there is a homogeneous "substance" underlying all forms of matter, and another underlying all forms of mind (Durant, 1963). An all-encompassing system theory is evident from Laplace's *machinus ex dei*, von Bertalanffy's dream of a general systems theory, Einstein's hope for a unified field theory, Lovelock's Gaia theory (Lovelock, 1979), and Sheldrake's *morphogenic field* in formative causation. (Sheldrake, 1980). At a spiritual level, the mystics have perpetually longed for a transcendent state in which all creation is seamlessly united in a single Truth.

In this perennial search for a common thread that combines all reality through the ages, our so-called *objective* perceptions of reality are unwittingly and unconsciously shaped by super-ordinate philosophy of the time, which Kuhn (1970) called the *paradigm.* Bohm (1987) named it the *tacit infrastructure of knowledge.* Pepper (1942) described it as the *world hypothesis,* and Habermas termed it *Lebenswelt*—the life-world (Habermas, 1987). In a very broad context, we view our reality through two meta-theoretical paradigms—the mechanistic and the holistic.

It is not an accident that paradigms are often symbolized by metaphors. Close examination of the evolution of paradigms shows that the emergence of a new paradigm is often spawned by a new metaphor that offers a creative link between hitherto unrelated elements. In the seventeenth century, Isaac Newton viewed the Universe as clockwork with predictable planetary movements in space and time. This view came to be popularly known as the machine metaphor or the mechanistic paradigm. It is characterized by linear and sequential relationship of cause-and-effect. The holistic paradigm, on the other hand, corresponds to organic metaphors depicting complex, non-linear and self-organizing systems.

In our facile efforts to construct simple causal links among the diverse elements of our reality, we more commonly resort to the machine metaphor than the organic and the humanistic ones. This trend leads to over-simplification of our complex systems—to the point that it has blinded us to the possibilities of uncovering holistic paradigms, and has impeded our discovery of new frontiers. In the analytic exploration of our world, we fragment our reality into increasingly smaller *parts* in order to study their properties at the micro level, and predict the behavior of the *whole* at the macro level. We have rigidly and steadfastly adhered to this reductionism, because it has served us well in the material development of our societies, as exemplified by significant advances in our knowledge in microbiology, genetics, quantum mechanics, and so on. However, in such studies, we have not only lost a sense of the *whole,* but have also overlooked the *purpose* or the existential *values* of human life. Similarly, when we study the universe at the macro level, we observe and predict the astral and galactic movements, and analyze the chemical and physical composition of planets, stars and supernova, without instilling in them any meaning, purpose or mythology.

However, it is significant that every event has the capacity to inspire a metaphor that can offer diverse interpretations of reality and creative options. While a falling apple offered Isaac Newton a metaphor for planetary movements, it gives a mystic a metaphor of a *union* between the lover and the Beloved. What the scientist sees as gravity, the poet sees as love. Thus a

metaphor can stimulate myriad perceptions—ranging from the material to the spiritual—making it a powerful tool in systems thinking.

In a stable state, human beings tend to be quite content sustaining and reinforcing the dominant paradigm. This activity constitutes an organized system of order and structure with which the masses collude. Stacey (1996) describes it as a legitimate system. Accompanying it, there is a shadow system of disorder and chaos that can jump-start a new metaphor and a paradigm with an inherent capacity to renew the legitimate system. Curiously, such a shift is often facilitated by paradoxes, which challenge the prevailing metaphor. Poetry, scriptures, literature, philosophy and various sciences have facilitated a paradigm shift through the magic of paradox. Thus the intricate and chaotic relationship between legitimate and shadow systems, followed by the interplay of metaphors and paradoxes, has played a fundamental role in the history of human evolution. Given the power of the paradox to unveil new metaphors and paradigms, this paper focuses on the exploration of various orders of paradox in systems dynamics to bring about systemic changes and transformation.

Most of our current conventional problem-solving processes lie in the mechanistic paradigm. A new metaphor can be triggered by a paradox that confronts the prevailing machine metaphor, and consequently mobilizes a broader arena of systems dynamics. Moving from the mechanistic to the holistic paradigm, our field of exploration in *space and time* expands until we transcend the temporal framework and enter into an acausal field. This transition depicts a move from a linear problem-solving mode to explorations of greater complexities that correspond to higher orders of paradox.

This paper examines causal networks that start with a simple problem-solving mode of the machine metaphor to correct or "balance" a given deficiency, but which inadvertently generate a number of unintended consequences. Such dynamics lead to what is described in this paper as the first order paradox in which the original cause of a problem is unexpectedly exacerbated. Most problem-solving processes involve the interplay of interdependent opposites, such as profits and loss, giving and taking, thirsting and quenching, etc. This paper demonstrates how myriad scenarios can be systematically uncovered in a wide field of space and time through permutation and combination of these opposing elements. The analysis of the first order paradox is followed by the examination of the second and third order paradoxes, which unveil even a wider field of space and time, and ultimately lift us to higher realms of human consciousness and spiritual awareness.

Dynamics of Similarities and Differences

Paradoxes and metaphors create a fascinating interplay of similarities and differences in various aspects of our world. Bohm and Peat (1987) believed that this interplay forms a crucial ingredient in the creation of new ideas or theories superseding the old ones. They said:

> Through creative play and fresh perception there is a constant movement of similarities and differences, with each new theory differing in some subtle and significant fashion from what came before. (p. 28)

In India, philosophical thoughts on similarities and differences date back to over two millennia, when the Vedic school of thought known as *Vaisheshika* was exclusively devoted to classification of all objects of our experience *(padarthas)* according to similarities and

differences (Radhakrishnan and Moore, 1957). It draws a distinction between objects of direct perception and those of intellectual discrimination. The former have a real objective existence; the latter discriminate between what connects similar objects and what separates different objects, and seeks their combination or inherence. Similarities have known links; differences have undiscovered links.

Metaphors and paradoxes embody the intricate dynamics of similarities and differences. They can therefore be creative tools for exploring the undiscovered links. In metaphors, we identify potential links or similarities between elements that are seemingly different. A metaphor creates a relationship between unrelated elements, helping us to unveil possible links or scenarios. Newton's observation of the falling apple led to his gravitational theory (Bohm and Peat, 1987), which inadvertently launched a mechanistic paradigm that we have continued to use as our lens to view and operate our world to this day. When we are rigidly anchored in a metaphor, the force (or the absurdity) of the paradox can shift us to a different metaphor or another worldview.

Metaphors and Paradoxes

Paradox enables us to uncover possible diversions from the conventional pattern of the dominant metaphor. For example, Tao Te Ching teaches us: "Act without action." (Wing, 1986) Conventional logic of the machine metaphor would associate *act* with *action* and *reaction.* The apparent absurdity in the paradox provokes us to transcend our dominant metaphor (the legitimate system or the paradigm in which we reside), and explore wisdom in a wider framework of space and time. It helps us to weave scenarios that have the potential for validating the paradox.

While a metaphor identifies possible similarities between unlike elements—for example, *an organization and an anthill*—paradox rationalizes thoughts that contradict conventional thinking—for example: *food donations can increase starvation*. Hunger and food constitute the two interdependent opposites involved in the paradox. In systems dynamics, such a paradox is commonly encountered in various systems archetypes that facilitate reinforcement of the original problem or cause. Metaphors point us to possibilities of undiscovered links, which when discovered through the force of a paradox, can lift us to a higher level of systems awareness and a new metaphor.

Clearly, the metaphors and the paradoxes involve the interplay of two interdependent opposites such as hunger and food, thirst and water, profits and loss, etc. They could be viewed from the Hegelian dialectics as *thesis* and *antithesis.* Taking *man* and *slave* as an example, let us explore similarities and differences between them. As explained earlier, similarities identify the links that can offer us metaphors; and differences can stimulate discovery of unknown links through the influence of paradox. We acknowledge the *difference* between a man and a slave, when we declare an understanding of their conventional roles: *the master dominates the servant, and the servant serves the master*. The "*slave serving the master*" represents the balanced loop.

We acknowledge *similarities,* when we attest that a man and a slave are both human, with physical, psychological and spiritual needs. It triggers possible metaphors such as *the man was a slave to his cravings, or the slave was a master of his destiny.* Clearly, the man and the slave each take on the *metaphorical* attribute of the other for dealing with ones individual circumstance—master's cravings and the slave's destiny.

For a transcendent *synthesis*, we can rise to even a higher level of metaphor through the power of a paradox, in which the master acquires the actual attributes of the slave and the slave of the master. One possible scenario would be that *the master develops the servitude of the slave, and the slave develops a personal mastery*. It is worthwhile noting that in this example, the extrinsic behaviors of the master and the slave transform to intrinsic qualities that can influence their relationship in a positive way.

We could explore still a higher order of paradox by actually *reversing* partially or fully the roles of the master and the slave to lift us to loftier metaphors. In other words we can say:

1. *The master serves the servant, and the servant serves the master.* This case depicts a mutual service.
2. *The master commands the servant and the servant commands the master.* This case depicts a mutual command.
3. *Master serves the servant; and the servant commands the master.* This depicts a total reversal of roles.

Such paradoxes resonate with copious spiritual reflections we encounter in mysticism. A deeper examination of their inherent wisdom could unveil many possible scenarios that would make sense of them. The higher we rise in the paradoxical synthesis, the more evident become the rudimentary human qualities, such as humility, charity and sincerity. It is apparent from the above examples that if we can construct various permutation and combination of two interdependent opposites, we can list a gamut of axioms that have corresponding spectra of possible scenarios.

Paradox in Chaos

Our thoughts, by their very nature, fragment our reality into multiple categories. Each thought, in turn, is divided into interdependent opposites—a thesis and an antithesis. Paradox confronts and challenges our mental propensity for partitioning the world into dualities and multiple conceptual systems, and provokes a more holistic view of our reality in space and time. When faced with chaos, we find ourselves in an environment of what appears to be a random confusion. Paradox entices us to explore the underlying interconnectedness. Conversely, every time we are presented with a paradox, it produces a mental chaos, an environment necessary for jump-starting creative insights and possibilities.

In Zen Buddhism, paradoxes known as *koans* consist of statements that appear at first glance to be absurd, but are designed to provoke mental confusion. One such popular *koan* is: "What is the sound of one hand clapping?" Briggs and Peat (1999) explain:

> "Paradoxes and koans take us to the edge of logical, rational, ordered thought. They cause our minds to run in loops and perform iterations of logic as we try to find a way out of the problem. Yet there can be no resolution from within the context in which they are framed. Koans tell us something is missing, something is incomplete about our concept of reality. Yet the very fact we think up such paradoxes in the first place means we are bigger than the conceptual systems we create." (p. 169)

Huston Smith (1994), equally succinctly, describes the effect and profundity of a koan and a paradox.

> "By forcing reason to wrestle with what (from the rational perspective) is absurd, the *koan* rouses the mind to a state of agitation wherein it hurls itself against its logical cage with the desperation of a cornered rat. By paradox and non sequitur it provokes, excites, exasperates and eventually exhausts the rational mind until it sees that thinking is never more than thinking *about.*" (p. 89).

There are unlimited possible meanings and interpretations that one can draw from a paradox, like the infinite growth one can see in our complex and fractal universe. Yet, paradoxically, the complex universe evolves by simple rules observed in the growth of fractal geometry. The complexity of a beehive or a termite nest results from a repetition of simple actions. Like the chaotic systems, paradoxes have the property of sustaining simplicity and complexity simultaneously. Taoist Chuang Tzu was faced with an intriguing paradox in which he dreamt he was a butterfly; but when he woke up he wondered if he was in truth a butterfly dreaming he was a man. This paradox unveils for us wondrous and complex intricacies of our diverse states of consciousness. Yet this complexity and profundity is articulated in a very simple story with a simple question. Paradox appears simple yet generates complex and diverse perceptions in our minds.

Orders of Paradox

This paper delineates three orders of paradox that can facilitate systems thinking at increasing levels of consciousness. The consideration of the first order paradox draws in a large constellation of interdependent variables over a wide field of space and time. But the higher orders of paradox, though common in new science and mysticism, are neglected in our current mapping of systems dynamics. As we move from the first to higher orders, there is an expansion of our panoramic view of the *whole*, presenting us with numerous possibilities. At the same time, there is a contraction and a unification of their parts leading ultimately to a single undivided w*hole*. This scenario can itself be viewed as an ancillary paradox in that the paradigmatic evolution entails expansion and contraction, divergence and convergence, multiplicity and unity.

In the second order paradox of systems dynamics, cause and effect become bi-directional and simultaneous—common occurrence in ecosystems, wherein the needs of one form of life simultaneously serve the needs of another form. In Sufism, such paradoxes are very common. *The lover seeks the Beloved, and the Beloved seeks the lover*. It was epitomized by the spiritual relationship inspired between Rumi and Shams Tabriz (Schimmel, 1992).

In the third order paradox, all the elements get united. The observer and the observed become one; the lover and the beloved become one. Such *Love* transcends the field of space and time, and consumes all realities to form a seamless union. Longing, search, and craving for a higher level of wholeness become the catalysts for this ultimate experience that the Navaho tradition articulates: "I am in the Universe and the Universe is in me."

Systems Dynamics

Systems dynamics, as understood today, refers to causal networks of interdependent variables in complex systems with negative and positive feedback, as represented by *balancing*

and *reinforcing* loops respectively. We view all our realities in terms of intricate assembly of these two circular loops. The causal relationship between the interdependent elements is quintessentially unidirectional and has a cause-and-effect sequence characteristic of a machine metaphor.

In a balancing loop, the reaction *(effect)* balances the action *(cause)*. The effect becomes the cause to negate the original cause. This is a problem-solving modality in which the solution (*effect*) corrects the deviation inherent in the original problem (*cause*). Thus in a balancing loop, one element is balanced by its opposite through an intervening element (the balancing link). For example, losses turn into profits by downsizing. *Downsizing* is the intervening element that enables the polarity between loss and profit to balance. In a balancing loop, the causal flow is unidirectional, sequential, linear and mechanistic with negating, predictable but generally short-term consequences.

While a polarity is neutralized by an intervention in a balancing loop, it gets accentuated in a reinforcing loop. The effect becomes the cause that exacerbates the original cause. For example, a bank deposit swells with a compound interest; or warfare is escalated by a cycle of retributions. A reinforcing loop signifies a causal flow that is positive, unidirectional and sequential.

Systems Search

When faced with a systemic problem, we first need to engage in a systemic questioning to uncover the full landscape that will need to be explored before constructing causal loop network, and in preparation for subsequent analyses of first, second and third order paradoxes. Such questioning should be able to lift us to a higher level of thinking. For example, if a company is considering downsizing in order to increase its profits, we first need to explore *options* in solving the company's problem. In other words, what are the alternative ways in which we can eliminate or reduce the losses? Downsizing may be one such alternative. This intervention gives us a balancing loop, in that the losses are balanced. In preparation for exploring paradoxes, a wider field of systems dynamics needs to be searched through systemic questions, such as:

1. Which stakeholders will gain or lose by downsizing?
2. Are the consequent profits only monitory?
3. What social, cultural, political, global and ethical benefits can be accrued from the profits?

The above questions will provoke answers that define the detailed contours of the landscape to be explored.

First Order Paradox

In certain archetypal situations (such as *fixes that fail* and *shifting the burden*), a balancing loop can set off unpredicted events that reinforce the original cause. Using the above example, downsizing can jump-start events—such as low morale and absenteeism—that increase company losses. This signifies a *paradox* in that the corrective action increases or reinforces the original deviation. The balancing polarity turns into a reinforcing polarity by the emergence of unintended consequences. It contradicts the conventional logic that says: "If we cut down the

wages, we increase our profits." The original intent is reversed to "If we cut down the wages, we compound our losses."

As discussed earlier, paradoxes defy conventional logic, in which an intended effect is contradicted or reversed, by the emergence of unexpected influences. While conventional logic would expect cost-cutting measures to reduce losses, they actually increase the losses. The polarity of losses and profits does not balance. However, there generally is a lapse of time before the unexpected situations contradict the intended consequences. This suggests that if we can have a broader vision of space and time during the analysis, we can construct meaningful scenarios to predict and manage the unintended consequences.

Thus when seeking solutions to a given problem, the exploration of unintended consequences through the forces of paradox can become an effective tool for uncovering possible future scenarios. Such an approach presents us with a conscious strategy of seeking a first-order paradox—a creative process—that lifts us out of our conventional problem-solving mindset and moves us into a systems thinking mode. The balancing polarity turns into unbalanced opposites in the exploratory process. For example, the balancing polarity between *losses* and *profits* turns into increased *losses.* The following examples of "Fixes that Fail" archetype (Senge, 1990) illustrate the first order paradox.

Example 1: Paradox of Charity

Consider an example of a country that has serious starvation problem. In order to carry out a systems dynamics exercise, we first start with a *systems search* by asking the following question:

- What are the alternative ways in which hunger could be eliminated or reduced?

Possible solutions: *Donate food, support local agriculture, send money to neighboring countries for support, etc.*

Each of these alternatives needs to be investigated. Let us take "food donation" as the first alternative intervention. It immediately provides us with a balancing loop, in which food donations reduce hunger. The two interdependent polarities involved are clearly hunger and food. Before launching the first order paradox, we need to ask systemic questions such as:

1. Who will be the short and the long-term beneficiaries of food donations?
2. What ecological, social, economic, and political consequences will it generate?

Answers to the above questions will prepare us for exploring paradoxical situations in which *food donations increase hunger.* At first glance it defies logic, but following the systemic reflections described above, a number of possible scenarios spring to mind to validate it. They include long-term scenarios such as population increase, collapse of existing agricultural businesses, corrupt governments, invading neighbors, etc., which all constitute the unintended consequences.

This example points to the importance of an incubation period for provoking paradoxical situations that lead to the formation of reinforcing loops. The multiplicity of possible scenarios introduces additional links in the causal network. One such reinforcing loop is shown in the causal loop diagram below, consisting of the balancing loop, and the reinforcing loop. As hunger increases, food donations increase, resulting in alleviation of hunger. This sequence of events

constitutes the *balancing* (B) loop. However, after some delay, unintended consequences come into play. The population increases, and hunger is amplified giving us a reinforcing (R) loop.

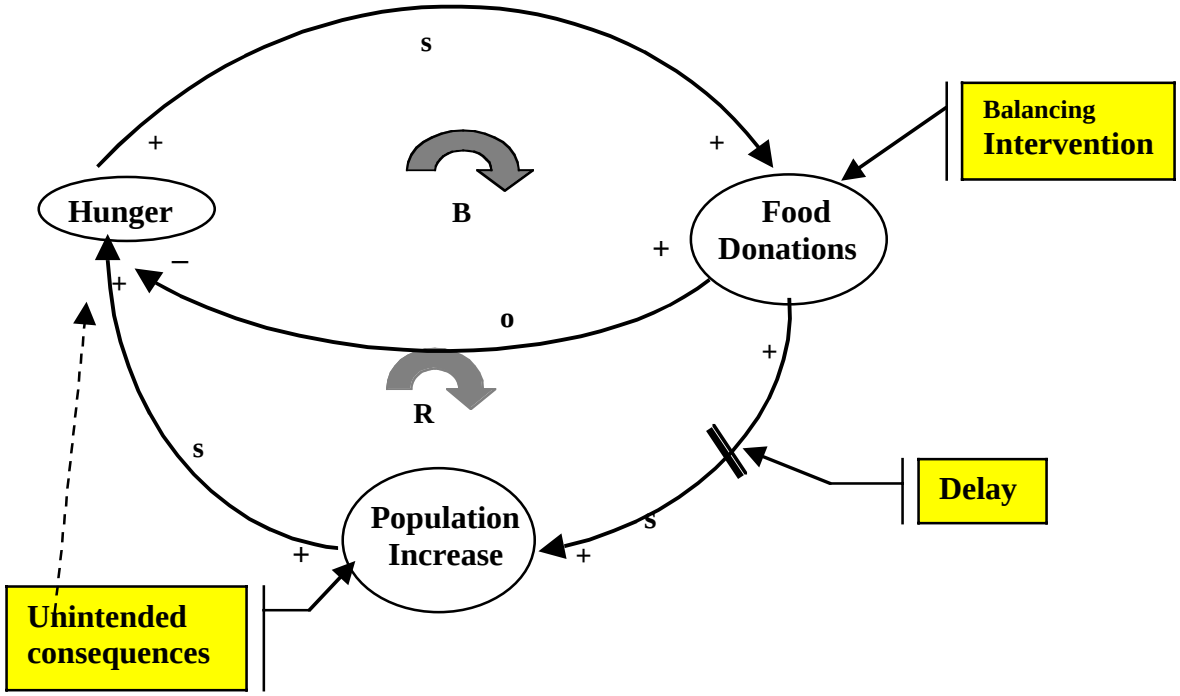


Figure1: Paradox of Charity

The teachings of the sages and mystics abound in such first order paradoxes. The above procedure could be applied equally effectively to any mystical paradox as illustrated in the following example.

Example 2: Paradox of Justice

Foregoing the "systems search," consider the polarity between thieves and law. Lao Tzu's teaches: *"More laws we make, more thieves we create."* Logic suggests that *laws reduce the number of thieves*, resulting in a balancing loop. Lao Tzu's teaching forms a reinforcing loop that reverses the logic of the balancing loop. The "fixes that fail" archetype shown below presents one possible scenario to validate the wise saying. As the number of thieves increase, more laws are instituted. As we institute more laws, we create more lawyers, who in time may circumnavigate the laws via some loopholes, and potentially enhance the original problem. Further exploration can unravel other possible scenarios.

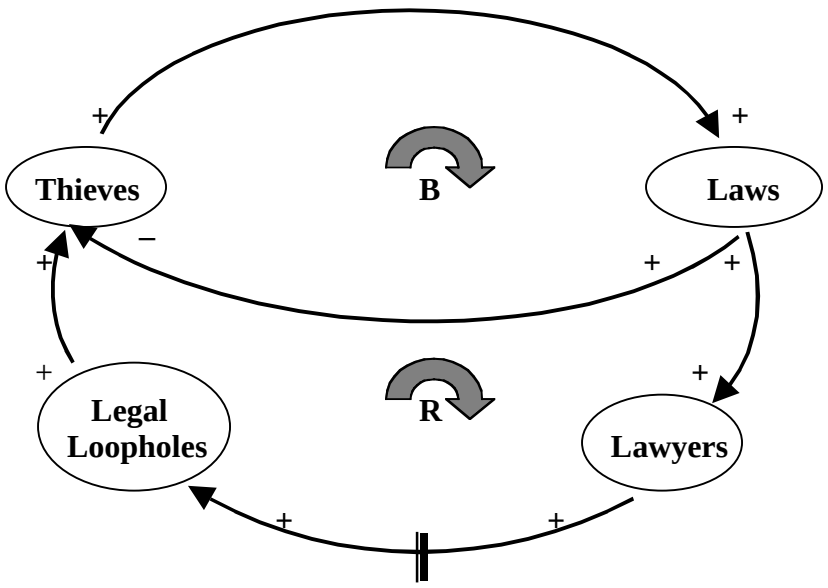


Figure 2: Paradox of Justice.

Second Order Paradox

In the second-order paradox, the mutual causality of interdependent elements is simultaneous, non-linear, reversible, autopoietic and spontaneous. It is not contrived, orchestrated or pretentious. It has neutral consequences: it is neither positive nor negative, neither balancing nor reinforcing. It is exemplified by Rumi's words: "Not only the thirsty seeks the water, but the water also seeks the thirsty." (Schimmel, 1992). Examining this statement as a Hegelian dialectic, it has *thirsting* and *quenching* as thesis and antithesis. It opens up the possibility of a *synthesis* that transcends but includes both. In Buddhism, the polarity represents the coevolution of opposites that the Buddhists call *pratitya samutpada* (dependent co-arising). It views "reality as a dynamic interaction of mutually conditioning events... [It] posits no prime cause or unconditioned absolute to which occurrences can be traced in a linear fashion." (Macy, 1991 p.18) In the early 1970s, the Norwegian philosopher, Arne Naess, described it as *deep ecology*. Much of the universe lies in this holistic paradigm of self-organization and mutual interdependence.

A second-order paradox carries simultaneous reciprocity of events that cannot be represented simply by causal loop diagrams. To cite an example, there exists a mutual causation between intrinsic motivation and creativity. "Creativity may not only require motivation, but also generate it," says Sternberg (p.9, 1999). Not only does intrinsic motivation engender creativity, but creativity also engenders intrinsic motivation, thereby creating a circular compounding effect in both directions. In the second-order paradox, the two opposing thoughts or actions become simultaneously reciprocal, as exemplified in the *Prophet* (Gibran, 1959), "For even as love crowns you so shall he crucify you. Even as he is for your growth so is he for your pruning"

Such paradoxes transcend the cause-and-effect modality, and the dimension of time. Time between the two elements disappears, but the separation between them persists. They compel us to rise to a higher level of awareness and to probe for creative options that explain the

perceived inconsistency. Such inconsistency is not unique to just poetry and philosophy. In quantum mechanics, a single subatomic particle can take a *quantum leap* between two points, and yet appear simultaneously in both locations. Bohm explained this phenomenon as an *implicate order* in which the two particles enfold themselves in a field beyond space and time, and unfold in an *explicate order* within the dimension of space and time. In the field of psychology, Jung described the synchronicity of events that are acausal and carry special meaning for those involved. Peat (1987) says: "synchronicities are characterized by a unity of the universal with the particular that lies within a coincidence of events."

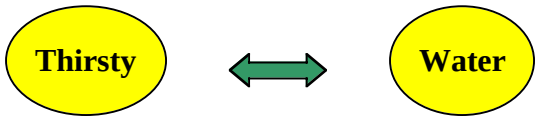
All these events suggest that in some complex systems, the elements move either in a preset field, or evolve in some self-organizing manner. Moving in a predetermined choreography within some field of influence is sometimes referred to as the field paradigm. The collective unconscious (Jung, 1959), the Gaia theory (Lovelock 1979), and the theory of formative causation (Sheldrake, 1980) are a few examples of the field paradigm (McWhinney, 1992) in which the movements of elements seem to follow a set pattern. The elements can also operate in an evolutionary paradigm in which there is a spontaneous unfolding of events through self-regulating, self-renewing and self-creative *(autopoietic)* processes of evolution.

The paradox of the mystics often transcends time; and two apparently opposing elements become concurrent. As characteristic of all paradoxes, second order paradox defies logic and conventional wisdom, but on reflection can lift us to a higher level of awareness, and exploration into far-reaching possibilities. The following example illustrates the point.

Example 3: Mutual Thirst

"Not only the thirsty seeks the water, but the water also seeks the thirsty." --Rumi

The reversal is simultaneous, and the opposing elements of the paradox become concurrent. It is a bi-directional event. The thirsty seeks the water at the same time as the water seeks the thirsty, without forming the familiar circular causal loop that entails a time-dependent sequence of events.



However, upon actualization of their union, each direction of *seeking* is followed by mutual gratification (*quenching*), giving us two balancing loops.

Loop 1: *The thirsty seeks the water; the water quenches his thirst.*
Loop 2: *The water seeks the thirsty; the thirsty quenches water's thirst.*

Seeking and quenching are each bi-directional and simultaneous as depicted in the diagram below. The dimension of time appears only in the causal relationship between seeking and quenching.

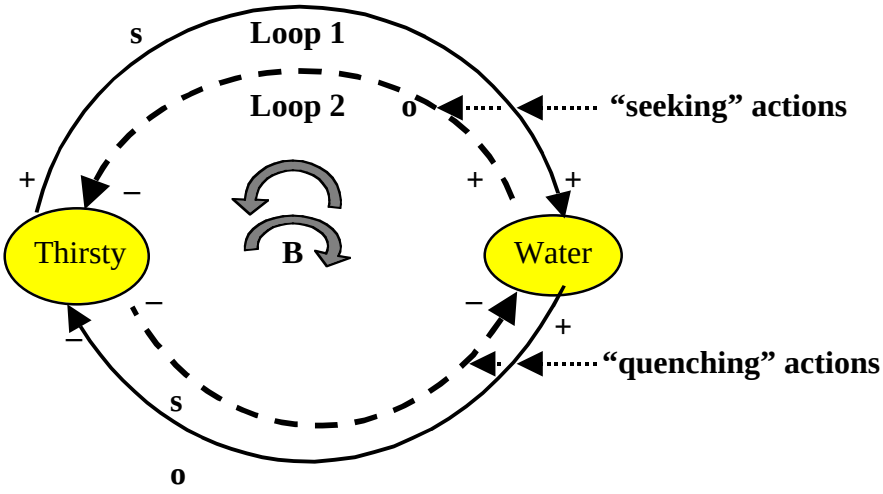


Figure 3: Balancing Mutual Causality

The above diagram superimposes two balancing loops to delineate the simultaneous and the sequential actions involved. Each balancing loop is clearly causal. But for Rumi's wisdom to make sense, the parallel links flowing in the opposite direction, shown in the above loops, have to occur simultaneously, and are acausal. In other words, the top set of parallel links attests that *as the thirsty seeks the water, the water concurrently seeks the thirsty*. The second set of parallel links suggests that *as the water satisfies the thirsty, the thirsty concurrently satisfies the water*—another second-order paradox stimulated by the analysis. Actions of *seeking* and *satisfying* are sequential in terms of cause-and-effect as seen in each circular balancing loop; but the *seeking* actions of the *thirsty* and *the water* are simultaneous. Similarly, the satisfying actions of the thirsty and the water are simultaneous.

In the above example, each second-order paradox contains the principle of autopoiesis. This self-organizing principle of the second-order paradox seems to transcend but include the first order paradox, suggesting a holarchy (Wilber, 1996). All parts of creation are engaged in the cyclic process of *thirsting* and *quenching* or *longing* and *fulfillment*. Indeed, we can explore wider consequences of this single theme, unveiling a rich and intricate ecological and a spiritual map. As an expression of deep ecology, the above example illustrates a self-organizing principle of nature. In mystical context, it represents mutual craving and longing.

For the union to occur, Sufis explain, the elements in the lower sphere of wholeness have to transcend to the higher levels, bringing about a holarchy. Each transition is propelled by the mutual *need* or *longing* of the elements to unite with one another. The atoms long to unite with the molecules and vice versa. The lover longs to unite with the Beloved and vice versa. The longing is bi-directional, and *is* the energy of love. The mutual longing affirms the separation in the world of space and time, but the alchemy of love enables the transcendence to a higher level of wholeness, frequently expressed in the second and third order of paradox by poets and mystics.

Third Order Paradox

In the third-order paradox, the mutual causality converges to a single unified point, as the interdependent elements merge and become indistinguishable from one another. Luis Borges conveys this consummation in the following words (Jantsch, 1980):

It is the tiger that destroys me,
But I am the tiger.
It is a fire that consumes me,
But I am the fire.

In the fifteenth century, the German philosopher, Nicholas of Cusa described it as *coincidentia oppositorum* or the "coincidence of opposites." He argued that as one approaches infinity in the analysis of the world as a whole, or with respect to God, the coincidence of opposites becomes operative. ((Reese, 1980). The duality of space and time disappear, and none of the elements gets diminished or augmented by the separation or the union. The following words of a great Sufi mystic, Abu Yazid al-Bistami, describes such a domain. (Hughes, 1974)

Be in a domain where neither good nor evil exists,
Both of them belong to the world of created things.
In the presence of Unity,
There is neither command nor prohibition.

All this talk and turmoil and noise,
And movement is outside of the veil.
Within the veil is silence, and calm and rest.

Dost thou hear how there comes a voice
From the brooks of running water?
But when they reach the sea, they are quiet;
And the sea is neither augmented by their incoming
Nor diminished by their outgoing.

This ultimate unity is embodied in most mystical traditions. They include the Buddhist concept of *dharmakâyâ* (Capra, 1975), Vedantic philosophy of *adwaita,* non-duality (Wood, 1964), Lao Tzu's idea of the *Tao* (Wing, 1986)), Sufi (22) belief in *Fanâ-fî-Allah,* annihilation in God (Schimmel, 1975), and the Khusraw's notion of *aql-i Kûl,* the Universal Intellect (Schimmel, 1975).

In the third order paradox, the power of *longing* or *thirst* dissolves the dualism inherent in the space-time field; and the two converge to the highest truth of Love and Compassion, as is manifest in the following quotations:

1. It is in the act of giving that you shall receive. *St Francis of Assisi*
2. Act without action. *Lao Tzu* (Wing, 1986)
3. He is I, and I is He (So ham, ahamsa). *Vedic Prayer of a Sanyasi.* (Wood, 1964)

Application of Paradoxes

It is clear that the paradoxes are made up of interdependent opposites, such as *giving and receiving, coronation and crucifixion, thirsting and quenching, feeding and starving, action and nonaction, profits and loss, motivation and creativity etc.* By exploring different permutation and combination of direct and inverse relationships of two interdependent opposites in first, second and third orders of paradox, we can construct diverse relationships that can lead to exploration of myriad scenarios validating each potential link. It charts a heuristic map for systems thinking. Various permutations of fluctuating trends can be explored in "balancing," "reinforcing," and higher orders of paradox. Let us consider an example of water shortage in a given region. Water *demand* and water *supply* constitute the polarity to be explored. The table below demonstrates the dynamism of such an exploration and formalizes a systematic process to aid analysis.

Table 1: Systems Exploration of the problem of inadequate water supply.

#	Fluctuating Trends	Possible Scenarios
1	As water demand increases, water supply decreases.	Problem: Inadequate water supply.
	Balancing Loop:	
2	As water demand increases, water supply increases.	Possible Intervention: Increase size of reservoir.
3	As water supply increases, water demand decreases.	Balancing link: Problem "*solved*."
	First-order paradox:	**Unintended Consequences:**
4	As water supply increases, water demand increases.	Increase in population, irrigation projects, prosperity, etc.
5	As water supply increases, water supply decreases.	Water losses through the permeable bed of the reservoir.
6.	As water demand increases, water demand decreases.	Population reduction due to dehydration, and accompanying diseases.

Other permutations and combinations of the two elements of the polarity can initiate additional first-order paradoxes.

Second-order Paradox:

This paradox embodies the simultaneity of occurrence of the polar opposites. An earlier example of polarity between thirsting and quenching entailed Rumi's profound paradox:

Not only the thirsty seeks the water, but the water also seeks the thirsty.

This paradox can trigger in us a similar second order paradox for the given problem. For example, we can state: "Not only the public demands more water, but water also demands greater consumptions." What scenarios can make sense of such a paradox? The question can provoke an exciting dialogue. It clearly invites organic and ecological type of solutions. For instance, we can develop long-term strategies for changing the ecosystem to attract rain and forestation in the region, and construct infrastructures to contain floods, etc.

Third-order Paradox:

This paradox ushers us into the spiritual realm beyond space and time. Most mystical traditions have pointed us to a path of ethics between the material and the spiritual domain. The ethical values should transcend the borders of nations, territories, classes, races, religions, gender and other pluralistic identities that have divided humanity. In the above example, attempts to solve shortage of water in any part of the world should be based on a social conscience that focuses on improvement of all creatures and indeed creation. Such action focuses on transcending self-interest, and traversing the ethical corridor that balances the material with the spiritual.

Conclusion

In studying systems dynamics, we frequently encounter interdependent opposites that lead to unintended consequences influencing our lives at local and global levels. This paper presents a methodology—illustrated with examples—for engaging in the exploration of systems dynamics of complex systems by analyzing the polarities involved in current or anticipated problems or puzzles. The opposing elements are lifted through first, second and third order paradoxes to uncover emergent scenarios and develop systemic strategies and solutions. Every order of paradox carries specific systems characteristics, ranging from linear-causal to spontaneous-acausal, as summarized in Table 2.

The first-order paradox can be triggered by permutation and combination of opposing elements of the polarity, leading to the examination of direct and inverse relationships in each causal link of the balancing and reinforcing loops. This process can be conveniently tabulated for analysis, as demonstrated in Table 1. The paper also introduces the idea of second-order paradox, which examines acausal phenomena of simultaneity of events. It provides a platform for stimulating global awareness, and understanding the global implications of organizational interventions.

A third order paradox falls into the spiritual domain. As we move from the first to the higher paradoxes, loftier values of humanity enter in the systems landscape. As human beings and societies are becoming increasingly interdependent, a vision for the common good, become imperative. This paper will hopefully open up new frontiers for systems dynamics, desperately needed to resolve myriad problems on our planet today.

Table 2: Causal characteristics of Diverse Orders of Paradox

Systems Characteristics	Problem-solving	Orders of Paradox		
		First	Second	Third
Negative, balancing	✓			
Positive, reinforcing	✓	✓		
Linear Sequential	✓	✓		
Unidirectional	✓	✓		
Causal	✓	✓		
Chaotic		✓		
Reversible			✓	
Autopoietic			✓	
Mutual causation			✓	
Acausal			✓	✓
Spontaneous			✓	✓
Coincidence of opposites				✓

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