Delivering Health Care in Complex Adaptive Systems I:

The Nature of Dynamic Systems

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We face a major challenge in seeking to lead complex mid-21st Century organizations—and this is particularly a challenge regarding health care organizations and systems. It seems that many leaders convert complex dilemmas into simple puzzles. When they do so, they find that no matter how they solve the puzzle, a new puzzle pops up and undermines their progress. These befuddle leaders are replicating the old Sufi story of the wise people and the Elephant. The "wise" people are blind—and they are relying on their touch when seeking to determine the identify of what they are touching. "It's a rope", "It's a horn", "it's a tree". The label given depends on where they happen to be standing with regard to the elephant and as a result which part of the elephant they are touching.

Some of the "wise" leaders of American health care (and most other health care systems in the world) declare that the problem is burdensome governmental regulations. Others declare that the elephant of disfunction is actually protective diagnoses (based on fear of lawsuits). Among those who are particularly fearful of or distaining of the elephant's presence in their life, the problem is uncontrolled costs or the transformation of human-service oriented health care into a for-profit enterprise. However, the elephant is seen and defined, it seems to be very much out of control and given its large size there is widespread fear that it will trample everything.

Another wise narrative is centered in an African creator story. This story concerns polarities The God of the realm decides to wear a hat, Red on the right side and Blue on the left. He gracefully glides between two tribes, one on the right, one on the left. "Our God wears a Red hat" the ones on the right declare. "Our God wears a blue hat!" shouts the other tribe. The tribes begin wearing the hats of the appropriate color and soon there are skirmishes, eventually raids, and then full-on warfare to prove which God is superior. This God, of course, has a humorous streak. So, just before the war starts, he walks the other direction, thus reversing the colors. Confused and baffled, both sides decide to cease their warfare and create a co-council of wise men to study the Gods together.

The elephant is clearly present in mid-21st Century health care. Furthermore, there is warfare (sometime clearly present) among the various constituencies who view the elephant in diverging ways. The divergent perspectives have widened—and polarities exist regarding the color of the health care hat. There are even green, yellow, brown, purple, and occasionally white hats to complement the red and blue hats and to further confuse the situation. The Gods have indeed been mischievous and those who dwell in or are served by the health care community have not found a way to cease their warfare and create a co-council.

In this essay—and in the essay we have already written (Fish and Bergquist, 2022) as well as other we will soon be writing—our task is to make sense of the multiple ways in which to view the health care elephant and in which to bring people together to help tether the elephant and make it more caring and effective in addressing contemporary health care needs. We will seek to make sense of the differences between puzzles and problems. Our attention will be directed to the nature and dynamics of polarities in health care.

Of greatest importance will be our attempt to unweave the gordian knot that is to be found in what has recently been described as complex, adaptive systems (Miller and Page, 2007). It is this type of system that is predominant in and often dominate of mid-21st Century health care organizations. We believe that the concept of "emergence" helps to explain the nature and dynamics of these systems, and that these systems can only be effectively lead and managed when this leadership and management is being engaged in a team setting.

What Are Complex Adaptive Systems?

We begin to answer this fundamental question by turning to the writing of John Miller and Scott Page who directly address this question in their book appropriately titled *Complex Adaptive Systems*. (Miller and Page, 2007). In offering their answer, we should first note that they are primarily interested in social (human) systems. We are fine with this focus given that health care systems are decidedly social—there are very few systems more dependent on the social interaction between people than those systems that deliver health care.

The key point to be made by Miller and Page (2007, p. 9) regarding complex adaptive systems is that they are complex--and not just complicated.

> We are surrounded by complicated social worlds. These worlds are composed of multitudes of incommensurate elements, which often make them hard to navigate and, ultimately, difficult to understand. We would, however, like to make a distinction between complicated worlds and complex ones. In a complicated world, the various elements that make up the system maintain a degree of independence from one another. Thus, removing one such element (which reduces the level of complication) does not fundamentally alter the system's behavior apart from that which directly resulted from the piece that was removed. Complexity arises when the dependencies among the elements become important. In such a system, removing one such element destroys system behavior to an extent that goes well beyond what is embodied by the particular element that is removed.

Based on this distinction, we can state that a complex adaptive system (at least as found in a social setting) is composed of numerous elements that are tightly interwoven. They are interdependent and operate in close proximity to one another. It should be noted, that this close proximately allows a complex adaptive system to operate without heavy oversight or control. Each part looks to the one next to it for direction, thus eliminating the need for traditionally valued hierarchical control. The system is adaptive precisely because each part of the system can sense the need for change and can help to direct this change—as is the case among flocking birds.

Flocking

For many years those who observe the behavior of birds were trying to discover how birds so beautifully flock. The tight coordination of rapid movement among many birds must mean that a very clever and powerful bird is “in charge” and is choreographing the complex flocking. This remarkable leader was never discovered. It seems that birds flock without any one bird being in charge. Rather, each bird moves in coordination with the bird(s) right next to them.

A bird at the outskirts of the flock notices a hawk swoping in and engages in diversionary action. The neighboring birds follow suite and quickly the entire flock is taking this diversionary action. If the birds were operating through a hierarchy, then information about the incoming hawk would be relayed through a set of channels to the lead bird who would then send out a message to all birds in the flock about the diversionary action to take so that the hawk can be avoided. By this time, the hawk would have already hit the birds at the edge of the flock. Delay caused by multi-step communication in the hierarchical structure would reduce the agility of the flock and lead to its vulnerability.

This startling finding regarding the absence of hierarchy among flocking birds soon expanded to the study of many other animals that operate in herds (e.g. Bison), schools (e.g. fish) and other forms of clustering and swarming. Apparently, hierarchical control is rarely found among these animals. In fact, hierarchical control is rarely adaptive in social systems. Furthermore, those who study complex systems find that they are LEAST amenable to hierarchical control is they are large and complex—such as human corporations and most health care systems. We must study and appreciate complex adaptive systems precisely because they point us in directions that lead us away from hierarchy.

Feedback and Delay

The first, fundamental building block in any description of complex adaptive systems concerns the feedback that occurs among components of this system. We refer to each component as an “agent.” An agent, in turn, can be a person, an organization or a specific event. Feedback specifically concerns the influence which one agent in a system has over other agents in the system. This influence typically is engaged through the flow of information (though it can take place through the physical impact of one agent on another agent – the “billiard ball” metaphor is appropriate in this regard).

Feedback can be either positive or negative. These terms don’t refer to the “goodness” of the feedback. Rather, they refer to the nature of influence that the feedback has on the second agent. Positive feedback means that the second agent is more likely to perform in a particular manner as a result of the influence. Negative feedback means that the second agent is less likely to perform in a particular manner as a result of the influence.

The critical factor to note is that a complex adaptive system will only endure if it contains both positive and negative feedback relationships between agents operating within this system. A system with only positive feedback relationships between its agents will soon explode from the exponential growth and pace of action within the system – or this system will collapse as all of its resources are exhausted as a result of its unbridled growth. Some negative feedback is needed to apply breaks and corrections.

Conversely, a system with only negative feedback relationships will die quickly. It is smothered in negativity and a lack of sustained energy. Some positive feedback relationships are needed in order to provide both direction and energy. It usually takes only a bit of negative feedback to keep a system operating in a reasonable, sustainable manner; however, quite a bit of positive feedback is usually needed to launch and sustain a system—especially if it is large and complex (think of the energy needed to launch a rocket heading into space).

There is one other feedback-related features that is critical to any full appreciation for the dynamic operation of complex adaptive systems. This feature is the Delay that occurs between the provision of the feedback and its receipt. Wars have been started and lost as a result of delay (in the transmission of information (as well as supplies).

At a more mundane level, we find that delays in the receipt of information regarding customer needs or even inventory can damage the operations of a retail store. Similarly, delays in feedback regarding rates of tax revenues can incapacitate a government's capacity to plan for the initiation of specific human service programs. Even more important is the pattern or response to delays that can occur in a system. If there are major delays, then there are likely to be major swings (oscillations) in the size of a retail store's inventory or a government's quantity (and quality) of human services.

Some of those who study complex systems—adaptive and otherwise—believe that delays in a system account for more of its unique features than either the size or type (positive or negative) of feedback operating in this system. As an architect of system dynamics concepts, Donella Meadows, 2008, pp. 151-152) concluded that:

> Delays in feedback loops are critical determinants of system behavior. . . Delays that are too short cause overreaction, "chasing your tail" oscillations amplified by the jumpiness of the response. Delays that are too long cause damped, sustained, or exploding oscillations, depending on how much too long. Overlong delays in a system with a threshold, a danger point, a range past which irreversible damage can occur, cause overshoot and collapse.

As Meadows has noted, there are systems in which delays are very short. The feedback is proximal (neighborly) with agents working closely together. Elements of the system are tightly coupled. Each element reacts immediately to the actions taken by a neighboring element. Such is the case with the flocking of birds. Tightly coupled agents (such as birds) work with minimal delays. They can be quite agile in their response to outside challenges—but can also be quite jumpy ("trigger-happy") as Meadows observes. Other systems can operate with major delays in the flow of information and either positive or negative feedback. The agents operating in these systems are loosely coupled. The feedback is distal (foreign) and this system runs the risk of responding too late, with too little effort, and in the wrong direction to an impeding challenge.

It is important, in conclusion, to suggest that failure to recognize and appreciate the delay function operating in virtually all complex systems typically results in actions that yield results which are quite different from what was desired and anticipated. Often a set of "counter-intuitive" steps must be taken to produce the desired results. As Jay Forrester (the initial architect of system dynamics) has often proposed: "don't just do something, stand there!" In other words, seek to carefully understand the dynamics operating in a complex system before trying to change it.

Complexity and Complication

With this brief foray into flocking, feedback and system delay, we are ready to introduce a key feature of complex adaptive systems that helps us understand the unique features of these systems. This feature involves a distinction that Miller and Page (2007, p. 9) draw between systems that are complicated and those that are complex:

> Complexity is a deep property of a system, whereas complication is not. A complex system dies when an element is removed, but complicated one continue to live on, albeit slightly compromised. Removing a seat from a car makes it less complicated; removing the timing belt makes it less complex (and useless). Complicated worlds are reducible, whereas complex ones are not.

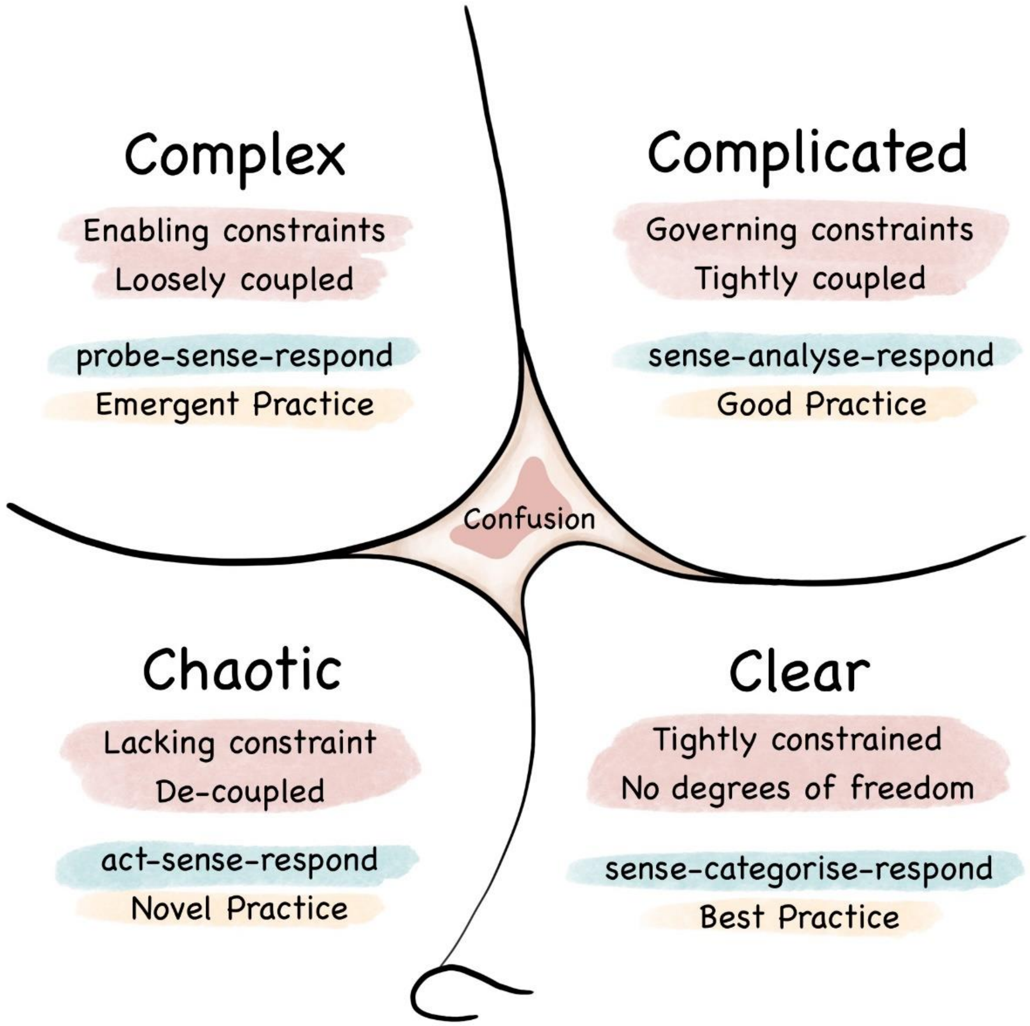
While a complex system would seem to be less robust than a complicated system, Miller and Page (2007, p. 9) that this is not the case – and in making the case for the adaptive capacity of complex systems they point the way to the two factors we are focusing on in this essay: emergence and teamwork:

> While complex systems can be fragile, they can also exhibit an unusual degree of robustness to less radical changes in their component parts The behavior of many complex systems emerges from the activities of lower-level components. Typically, this emergence is the result of a very powerful organizing force that can overcome a variety of changes to the lower level components.

It is in the dramatic and often unanticipated emergence of new forms when separate parts are brought together that complexity gains its adaptive reliance. Furthermore, it is through the dynamic and constructive interaction of people as members of a team, that the separate parts are brought together and effectively integrated in the newly emerging form of this social system.

The Snowden Cynefin Framework

David Snowden (2023) offers a model that provides a further distinction among various kinds of complex adaptive systems. Snowden's Cynefin Framework consists of four fluid and inter-related states. In his framework, an organization is challenged to recognize and adapt whether addressing a clear, tightly constrained organizational environment or when shifting into a highly complex and ultimately chaotic state:



Individually, we prefer comfort, predictability, and safety. As a result, we find ourselves in constant pursuit of the state that Snowden labels Clear.

Clear Systems

In this state, rules are clear, roles are clear, there are severe constraints on degrees of freedom. Feedback is close and immediate—proximal in nature. We often create this organizational environment. Sports & games likely present the clearest example of a Clear system or organizational environment, especially games involving only 2 people, such as chess.

In the realm of chess there are clear rules about each piece's ability to move. The board is static and remains stable throughout the game. Each player may only make 1 move at a time, then must wait for the move of the other. In order to reduce the risk of fatigue on player capacity, moves must be made within a certain timeframe. Proper lighting must be available in order to establish sufficient trust and clarity of the move. The feedback is proximal. Given the imposed timeframe, we can see immediately how our opponent responds to our move – though there are important sources of feedback that are distal (regarding time) as we eventually discover how our overall strategy worked in determining the outcome of the game.

Chess masters are able to recognize move patterns in very advanced fashion based on playing and rehearsing thousands of moves—they shrink the distal timeframe. They bring the future into the present. The advantage held by a chess master in shrinking the timeframe is primarily a matter of pattern recognition. This recognition is, in turn, based on experience and prolific recall of chess move patterns. It seems that the future is brought into the present through engagement of the past (retrieving and incorporating the history of previous games).

It is no surprise, then, that a more capable memory machine that could be provided with clear rules and copies of every chess move ever made in history would be able to compete and eventually surpass all human beings. When that event happened in May of 1997 when IBM's Deep Blue defeated World Chess Champion Gary Kasparov, the world began to question whether computers would surpass humans in all games, all sports, all professions. Certainly, that has proven true in simple, clear, well-defined, stable, static, highly constrained games---in that quadrant humans are being surpassed and replaced by more capable computers and artificial intelligence.

Complicated Systems

When we move into the quadrant of Complicated, we move from very strong rules and little degree of freedom toward more generalized governing constraints and tight coupling. Serial processes must often occur in a certain order if they are to be completed. While multiple pathways are available, there is usually only one that is of optimal value and that is most likely to lead to successful. The feedback might not be proximal—we might not know if we have taken the best pathway for a while. However, the ultimate distal feedback is quite clear. We have been successful or unsuccessful. Serial, interlocking decision-nodes must be sorted through carefully by the players of these games and sports if they are to be successful.

One can imagine a relay race taking place during a track meet. One phase of this race involves tightly coupled interaction in passing the baton. In this case, not only does each runner have to run as fast as possible in the right direction—she must also ready the baton at just the right time and in the exact space designated by the sport to hand over to another runner who must be reaching a similar speed at just the right moment without leaving the baton-passing zone. These tightly coupled transitions must occur 3 times in order for the relay race to be completed and in the right order. Thus, relay races are complicated. We have all seen events in which the most talented, speedy team fails to pass the baton efficiently or even drops the baton and all is lost.

Complicated games do not transition so well as clear games (such as chess) to a virtual reality---although many of the quest-like games often require challenging and tight coupling when introducing a Boss who must be defeated in order to move to the next stage of the game. Thus, single-player, serial, complicated virtual games likely allow for a non-human to complete the game more successfully than a human. However, in real-world complicated games like relay races, computers are faced with the near impossible task of running, which involves highly complicated multi-agent (body parts) that interplay with one another.

Computers struggle mightily with this level of complexity. As a result, we see mixed results in Palmer's Complicated quadrant depending on the context and nature of the game, activity or task in which humans and computers can sometimes battle. The outcomes are less predictable than we have seen with clear, simple games, activities and tasks. The distal feedback is much harder to discern while the game is underway. The baton can be dropped. A new agent can enter the game and "mess" everything up.

Complex Systems

As we move from complicated to complexity, we shift from a highly static, stable and predictable environment or context into a complex one. This environment is filled with dynamic and inter-dependent movements of multiple agents across an often-fluid environment. Feedback is not only delayed (distal) but often confusing or even contradictory. Interactions become more loosely coupled and there are more degrees of freedom with enabling constraints. What are enabling constraints? This sounds paradoxical. Are they enabling more freedom or are they constraining freedom? As often is the case, both can be true.

Here is a definition of enabling constraints that we have found to be helpful (Juarrero 2017):

> Enabling constraints force alignment of the agents which leads to resonance. This, in turn, creates a higher order system. The higher order system provides feedback to the agents which constrains their behavior and stabilizes the higher order system Rather than direct control of a rule, enabling constraints are dynamic and sometimes fluid, yet lead to alignment of agents and bring the possibility of agent-resonance, creating a higher-order system.

One begins to think of a river, with the banks of the river providing the enabling constraint that aligns all the water molecules to move in the same direction. The riverbed and gravity provide further enabling constraints that provide direction-of-flow, thus distinguishing the collection of water from a still and static lake. Three of the enabling constrains are visible and tangible---the two banks and the bed. One is invisible, that being gravity, yet as essential to the form and function of the higher-order river as we know it.

The resonance of the water often creates the sound of a rushing river. The water becomes a higher-order system transforming water into a river. That river then begins to erode and alter the banks depending on rain, soil conditions and other feedback factors and may change the direction of the river—such as historically occurred with the Mississippi river until humans began to outsmart mother nature by creating new and constraining cement banks and dikes to avoid flooding and instability in the river.

A game, action or sport that is complex generally shifts into those that require continuous team-based effort and action. Moving beyond complicated baton-passing, we move into team sports such as soccer and basketball---where the players dance across a field, loosely deciding to send the ball to any other team-mate or the goal at any moment. If soccer were only complicated, then each player would have to stand in line and pass only to the next. They could run in a well-demarcated zone of the field, yet not leave that zone or never pass when out of that zone.

Such a game, we believe, would be tedious, so the full engagement of complexity makes soccer and basketball two of the most watched and revered sports in the world. The thought of an IBM Deep Blue taking on an entire soccer team seems a bit ridiculous, with the computer sitting stationary on the field, blinking and vibrating its powerful memory-discs, requiring a long extension cord and being in a tent if it rains. It might successfully predict the winning team in a soccer match—yet is no match for the soccer team of humans. Thus, in the realm of complexity in the physical realm, computers are no match for humans.

The requirement for human movement, loosely coupled, dynamic interactions of multiple agents far surpass the computer's capacity for intricate movement and interaction. To date, no AI or computer has even attempted to form a soccer team or basketball team and a collection of current-state robots would likely provide humorous entertainment—yet lose badly to a human team. It is true that in a virtual realm, a computer could take on multi-player roles and begin to outwit human teams---yet, to date, we see teams incorporating artificial intelligence to inform and guide their human teams.

There is some evidence that highly skilled experts can be out-performed by a less expert team that is using a computer AI system to assist them, what is now being called crowd-sourcing or collaborative intelligence. For example, at the University of Washington, biologists used crowds of external contributors to map the structure of an AIDS-related virus that had stumped academic and industry experts for more than 15 years.

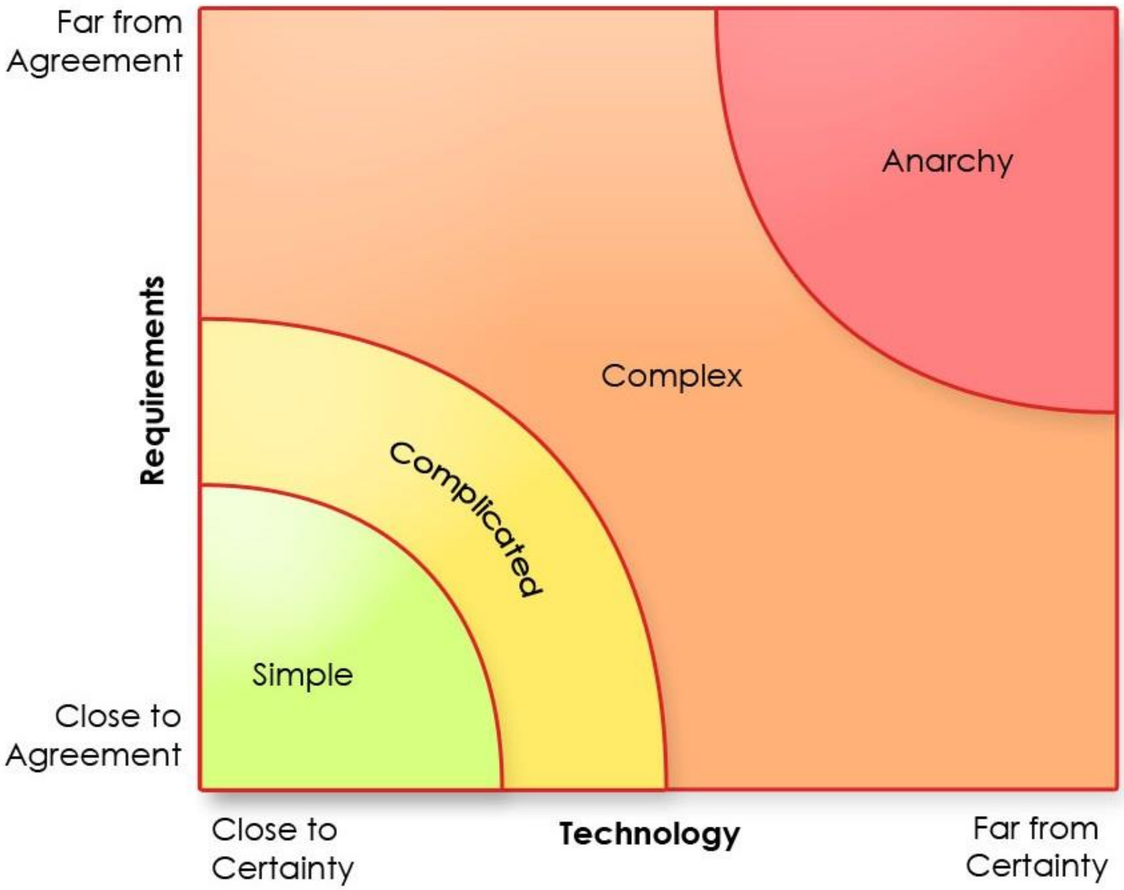
It would appear, then, that in the complex quadrant, collaboration between computer-AI and human actions, games, and performance may present promising future directions, yet we do not face any immediate risk of being surpassed by computer-AI, especially in complex environments that involve complex human interactions, emotions, and social engagement like playing soccer or team-based healthcare.

Snowden also makes clear that there is a cliff between Clear and Chaotic---that can happen suddenly due to external and internal threats or disruptions to the organization. It seems plausible as well that an organization that is acting as if it is in a Clear state, is really in a complex one and may not be appropriately adapting to that reality---and is thus thrust into Chaos which can rapidly spiral into total collapse or, if well led, an inflection point or vital re-orientation that likely will require more complexity-responsive leadership, teamwork, and actions.

The state of chaos goes beyond the scope of this essay, so we will leave further clarifications around chaos to future essays we write as well as to other experts in that field.

The Stacey Matrix

A second model is offered by Ralph Stacey (1996, p. 47)—an equally as insightful observer of the human condition and the operation of complex organizational systems. The Stacey diagram offers guidance for practices related to Complex Adaptive Systems which we will be addressing later in this essay:



In the Stacey model, we find a chart moving from Simple to Complicated and from Complicated to Complex. Movement is along the axis of Certainty and Agreement. High certainty and high agreement, find us in the zone of simplicity---clear rules, clear roles, certain actions and outcomes, proximal feedback. As certainty wains, as feedback becomes more distant (in time and space) and agreement becomes more challenging, we move into the zone of the complicated---requiring the more tightly coupled and serial decisions and actions of that zone. Once uncertainty is dominant, feedback is distant and often contradictory, and disagreement is more likely than agreement---we find ourselves in the zone of complexity.

In a somewhat oversimplified example of healthcare, we may say the actions and decisions within an emergency room are in the simple zone---if we narrow it down to "where does this person need to be? Home, a nursing home, this hospital, another hospital, in critical care here or somewhere else?" When it comes to the patient's disposition, the Emergency Department can focus on simple rules and come to a high degree of certainty and agreement after an initial assessment and evaluation with laboratory and imaging data. Once the decision is made to put the patient in a specific level of care in the hospital, then things likely become more complicated. Several specialists might be called in to share their views on the diagnosis and provision of care.

A clear series of steps will be taken that slowly and sometimes quickly move the patient toward being released from the hospital after the passage of several days. Thus, the hospital engagement aligns well with a complicated realm. We may have some level of disagreement between doctors and administrators or nurses about the best course of action. We have ways to resolve these disagreements through meetings and rules of engagement that allow us to proceed in a serial fashion toward the inevitable discharge from the hospital. The patient's course may wax-and-wane, yet it is inevitable that the patient will leave the hospital at some point---at which time decisions must be made again about where and how the patient will leave.

Once the patient leaves the hospital, ironically, things become more complex as now the primary agent, the patient, is much more engaged in the process and family, social, housing, follow-up and many other factors come into play. In this complex realm of uncertainty, more disagreements can arise---the patient's sister may have strong beliefs that she would not share in the more controlled hospital environment. The patient's car may breakdown, so getting to follow-up visits becomes challenging. The ambulatory setting of clinics and urgent care interface with patients impacted by more complexity, uncertainty, and disagreement which can degenerate into anarchy without the wisdom, guidance, and support from a whole team of people working collaboratively together. Thus, in the realm of complexity, teamwork becomes central to success and computer-AI can be a member of the team, yet not replace the team.

Self-Organization, Feedback, and Emergence

Complex Adaptive Systems are systems with several inter-dependent subunits and dynamics that often defy linear, causal descriptions and predictions. They are more ecological than rational, making them challenging to fully grasp. In the following diagram, we can begin to picture the vast interplay of a small collection of related agents---called simple, self-organized local relationships---with the changing external environment, influenced by negative and positive feedback leading to emergent phenomena that ultimately shift toward adaptive behaviors. Those adaptive behaviors then begin to alter feedback loops (negative and positive) in ways that impact local self-organized relationships and new emergent phenomena appear and the cycle continues.

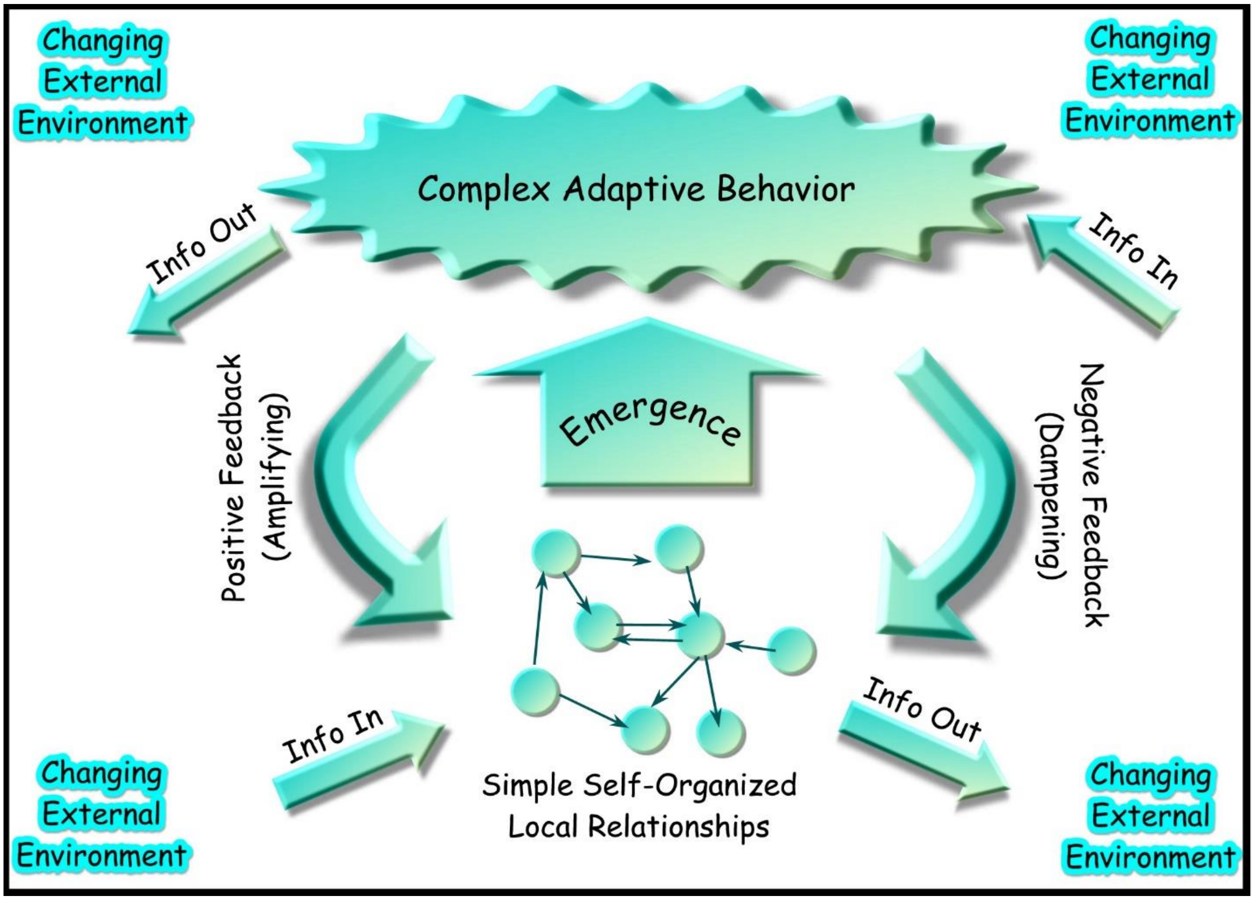


Diagram: ***The Wiki and the Blog: Toward a Complex Adaptive Intelligence Community*** D. Calvin Andrus, Ph.D. Office of Application Services Central Intelligence Agency Washington, DC 20505 calvina@ucia.gov

This living organizational dynamic can't be fully understood using a reductionistic lens---believing one can control the entire process by, for example, writing a new policy to govern the behaviors within the simple self-organized local relationships---often called "frontline workers" in healthcare. In fact, much effort and expense are allocated to one single agent within the self-organizing team---the physician, hoping that leverage will alter the entire dynamic.

This belief is so strong in healthcare that physicians are inundated with efforts to give them negative feedback about "unnecessary care, labs, images, hospitalizations, procedures, medications, etc." in the form of what are called "prior authorizations" which we will discuss in detail later in this article. Attempting to get predictable outcomes from pressures on a single agent within a complex adaptive system is folly—yet it is the primary tool used by most organizational leaders in healthcare to influence behaviors, costs, utilizations, etc.

If one shifts from a reductionistic toward a wholistic lens with the Complex Adaptive System of healthcare, one begins to recognize that guiding and coaching teams of self-organized local relationships will have far more influence and impact on organizational behaviors by allowing more local control over adapting to external environmental influences. For example, using our Flock of Birds metaphor---if the health care "flock" is allowed to respond to feedback with more agility and less delay, then new innovative adaptations can be tested more immediately, without waiting for official approval via the leaders. This provides the leaders more time and ability to study the emergent ideas and adaptations to find those with the most adaptive capacity. It further reduces the delay between feedback and action thereby allowing for the ever-important self-corrective nature of healthy change.

Navigating complexity requires a broader lens that recognizes the dynamic interplay of many agents (together called teams) with their local environment and the cultivation of more adaptive emergent influences on overall organizational behaviors. This living systems wholistic approach encourages emergent adaptations, more team autonomy, and greater adaptive capacity. It is not risk-free, however, as some emergent adaptive behaviors may be contrary to organizational success and would then require self-corrective action. Overdoing either positive or negative feedback can also de-stabilize an organization in ways that can be catastrophic, so this approach must be taken with great humility, patience, wisdom, and courage.

Central to successful navigation and influence on complex adaptive systems is a full understanding of how to develop high-performance self-organizing local relationships---also known as high-performance frontline teams. Let's take a moment to explore the current state of understanding of what the most vital context and components are that create the most effective, high-performance teams.

Teams Operating as Complex Adaptive Systems

Many of us have experienced low-performance teams which tend to bias us against teams. That "team" where no one else did anything and we did 90% of the work, yet others took all the credit. That "team" in which a group of people competed with each other to be the leader and nothing else really got done. That team where a dominant character dragged the others on some wild goose chase only to promote his role in the organization.

Let's face it, most teams are not very effective and don't perform at a high level. Yet, we have all witnessed and cheered on many great high-performance teams---that rag-tag group of middle-talent USA hockey-players who slayed the mighty Russian team in 1980, the dynasty 49er's in the 1990's, 2013 New Zealand Rugby team, the Chicago Bulls in the 90's, etc.

The Magical Ingredient

These teams inspire and excite us at their amazing abilities. Yes, they include lots of talent, yet there is something else magical about these teams---how they flow and work together, like a flock of birds, dazzling with their fluid dance of victory, often against the odds and against many seemingly insurmountable obstacles. That magic is the magic of teams---the excess energy and effort that comes when simple, self-organizing local relationships are well guided by coaches, experience, and strong relationships within the team. Team peak experiences, though rare, manifest experiences that members of those teams will relish for the rest of their lives and the rest of us yearn for in our workplace and homes.

Thankfully, Google undertook one of the largest and most comprehensive explorations of what makes for the highest performing teams. (Vakil, 2012) While most of us would guess "the team with the most talented members (agents)" or "the teams in the most powerful place with the most powerful people on it"---Google's Aristotle Project revealed far more impactful influences on team performance. Here is their top 5 with the first being by far the most influential:

#1. Psychological Safety
#2. Dependability
#3. Structure and Clarity
#4. Meaning
#5. Impact

What does it mean that psychological safety is most important and what role does psychological safety play in the successful leadership of a complex adaptive system?

Psychological Safety

First described by Amy Edmonson (2018), psychological safety indicates that all members of a team feel safe with each other and their leaders to express themselves fully and honestly without risk of embarrassment, punishment, ridicule, or reprimand. Errors surface because it is safe to surface them. Opportunities are evaluated because the actual situation is fully understood. All members of the team are actively engaged in solving the challenges they discover together.

Psychological safety is related to trust—yet differs in important ways. Trust is often we experience toward others. "I trust Jimmy because he makes me feel safe and speaks honestly and reliably with me." My own psychological safety, however, is an internally available state that requires all my local relationships are safe from my perspective. I might trust 3 people on my team fully and not trust one, and so my team is not safe for me.

Psychological safety is a higher threshold that takes more time and effort to achieve because all of us have different thermostats of safety based on our own life experiences. For example, if I experienced a deeply traumatic event with someone from a particular ethnic, gender, or religious background, that may make me feel unsafe with anyone from that particular background---unless and until I make myself vulnerable and am self-aware enough to realize I am stereotyping to protect myself in a dysfunctional way. I must open up and make myself vulnerable, which means others on my team must do the same. Vulnerability-based trust (Lencioni, 2005), then, is essential to achieving full team psychological safety---starting with the leader(s) who must be willing to be vulnerable to help the team achieve full psychological safety.

This can be a very tall order for leaders who have relied on being resilient overachievers who appear invulnerable in their pursuit of promotions and higher levels of leadership in healthcare or any other environment. Leadership focus on cultivating team-safety, then, far outweighs command-and-control mechanisms when engaging with complex adaptive systems. Without psychological safety, it's unlikely the other 4 key characteristics of high-performance teams identified in the Aristotle Project can be manifested.

It would appear, then, that simple, self-organized local relationships must be awash in a sea of psychological safety to begin to produce more adaptive emergent influence on complex adaptive behaviors to improve overall performance. Vertically integrated, hierarchical industries such as healthcare often struggle to increase psychological safety as titles, positions, and professional silos often reduce safety in ways that can resist the introduction of team-safety as a new system cultural priority. It is no surprise, then, that many healthcare organizations have turned to executive and team coaching to begin to shift the culture in direction of team-performance over individual performance goals, metrics, and outcomes.

Complexity of Health Care Systems: An Initial Analysis

Keeping these comments in mind – with their saturation in hope and delight—we can turn in a preliminary manner to the pressing matter regarding how Miller and Page's insights relate to our understanding of and attempt to reform and improve contemporary health care system. We build on the analysis of complex health care systems that we offered in our previous essay (Fish and Bergquist, 2022).

Mind of Their Own

First, the leaders of mid-21st Health Care Systems need to recognize that they are dealing with complex adaptive systems. These systems tend to have "a mind of their own." They are self-correcting and self-organizing. Furthermore, they tend to be strongly influenced by initial conditions (the moment when the parts first came together), as well as emerging decision horizons. As Miller and Page note, profound and rapid disruptive and unexpected change can occur in an adaptive system if a powerful organizing factor suddenly enters the system's "playing field." Earthquakes take place as the system adjusts to the intrusive event or force and as it pulls for greater attention (acting as a "strange attractor"). In contemporary health care systems, this earthquake has been centered on Covid-19-responsive measures and models.

We have already noted in our previous essay (Fish and Bergquist, 2022) that the world of health care is filled with complex, multi-tiered problems and dilemmas that do not yield to simple solutions (as is the case with health care puzzles). Not only are problems and dilemmas quite complex—these challenging issues also require multi-disciplinary perspectives. They often incorporating financial and interpersonal matters as well as matters related to medicine and the specific care of patients.

In the case of dilemmas, there is also the challenge of discovering that several viable solutions exist regarding the issue(s) being addressed. Competing priorities and differing perspectives and practices compete for our attention. They often are distilled into a set of two competing priorities. We swing back and forth in considering the benefits and drawbacks concerning the perspectives and practices to be found in each polarity. We suggest that the world of polarities often accompanies the complex adaptive system in which we are operating as leaders and operatives in contemporary health care.

Multiple Competing Interests

Given the elusive nature of complex adaptive systems and the problems, dilemmas and polarities accompanying these systems, it is readily apparent that the study of and understanding of complex systems is critical. As Miller and Page (2007, p. 7) conclude:

> The science of complex systems and its ability to explore the interest in between is especially relevant for some of the most pressing issues of our modern world. Many of the opportunities and challenges before us- globalization, sustainability, combating terrorism, preventing epidemics, and so on-are complex. Each of these domains consists of a set of diverse actors who dynamically interact with one another awash 1n a sea of feedbacks.

Miller and Page (2007, p. 7) arrive at this conclusion by identifying a set of "interests" that intersect in the study of complex systems. They seem to be hovering on the edge of acknowledging the presence of multi-tiers dilemmas (and even distilled polarities) in many, if not all, complex systems. While they are relating these interests specifically to the computer-based modeling of complex systems, their list seems to be directly relevant to any engagement in the study of these system:

> It is the interest in between various fields, like biology and eco- nomics and physics and computer science. Problems like organization, adaptation, and robustness transcend all of these fields. For example, issues of organization arise when biologists think about how cells form, economists study the origins of firms, physicists look at how atoms align, and computer scientists form networks of machines.
>
> It is the interest in between the usual extremes we use in modeling. We want to study models with a few agents, rather than those with only one or two or infinitely many. We want to understand agents that are neither extremely brilliant nor extremely stupid, but rather live somewhere in the middle.
>
> It is the interest in between stasis and utter chaos. The world tends not to be completely frozen or random, but rather it exists in between these. two states. We want to know when and why productive systems emerge and how they can persist.
>
> It is the interest in between control and anarchy. We find robust patterns of organization and act1v1ty m systems that have no central control or authority. We have corporations---or, for that matter, human bodies and beehives-that maintain a recognizable form and activity over long periods of time, even though their constituent parts exist on time scales that are orders of magnitude less long lived.
>
> It is the interest in between the continuous and the discrete. The behavior of systems as we transition between the continuous and discrete is often surprising. Many systems do not smoothly move between these two realms, but instead exhibit quite different patterns of behavior, even though from the outside they seem so "close." ·
>
> It is the interest in between the usual details of the world. We need to find those features of the world where the details do not matter, where large equivalence classes of structure, action, and so on lead to a deep sameness of being.

We offer this list because we believe that each of these "interests" is directly related to addressing the mid-21st Century challenges of health care—and represent some of the dilemmas (and polarities) that exist in the world of contemporary health care. This list of competing interests might easily be posted on the agenda of a select committee seeking to find ways in which best to address these challenges. The list, itself, can be approached as a series of polarities that are best confronted through the use of polarity management tools such as we Identified in our first essay (Fish and Bergquist, 2022) and that are offered in more elaborate form by Barry Johnson (1996).

Conclusions

We conclude with an historical (and hopeful) comment about complex adaptive systems that Miller and Page (2007, pg. 3) offer early in their book:

> Adaptive social systems are composed of interacting, thoughtful (but perhaps not brilliant) agents. It would be difficult to date the exact moment that such systems first arose on our planet—perhaps it was when early single-celled organisms began to compete with one another for resources or, more likely, much earlier when chemical interactions in the primordial soup began to self-replicate. Once these adaptive social systems emerged, the planet underwent a dramatic change where, as Charles Darwin noted, "from so simple a beginning endless forms most beautiful and most wonderful have been, and are being, evolved." Indeed, we find ourselves at the beginning of a new millennium being not only continually surprised, delighted, and confounded by the unfolding of social systems with which we are well acquainted, but also in the enviable position of creating and crafting novel adaptive social systems such as those arising in computer networks.

We have walked you through several of the vital components and behaviors of Complex Adaptive Systems, highlighting the very adaptive nature of flocks to utilize proximal feedback to rapidly adapt to external threats within the flock. We have provided a series of games and activities that represent the four states of organizations, with a reflection on how simple organizational processes and states may be automated via computers and AI, and how complicated and complex states and processes will likely remain the primary domain of humans, perhaps with AI-assistance.

We have made the case that having the right mind-set to recognize when an organization is itself a complex adaptive system or addressing highly complex challenges can provide healthcare leaders with a variety of ways to assure successful adaptation---using self-organizing teams with robust feedback and psychological safety, probing the system and watching and enabling adaptive emergent behaviors, monitoring mal-adaptive or potentially destructive emergence while asserting constraints to limit negative impact on the organization. Some have called these “strange attractors.” These are processes and behaviors that draw an organization toward a new desirable state (Gilstrap 2005)

In our second essay in this series on complex adaptive systems we will offer some additional insights regarding the dynamics of complex adaptive systems while probing more deeply into the implications of these insights regarding the operations and leadership of contemporary health care systems.

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